ENERGY CONSERVATION RETROFIT

FRANK D. REEVES MUNICIPAL CENTER

2000 14TH STREET, NW, WASHINGTON, DC 20009

GOVERNMENT OF THE DISTRICT OF COLUMBIA

DEPARTMENT OF REAL ESTATE SERVICES

FINAL

MAY 10, 2011

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ABBREVIATIONS

AC.	ACOUSTIC
ADD.	ADDENDUM
ADD'N	ADDITION
ABC.	AGG. BASE CRS.
AGG.	AGGREGATE
A/C	AIR CONDITIONING
AL.	ALUMINUM
ALT.	ALTERNATE
A.B.	ANCHOR BOLT
&	AND
ARCH.	ARCHITECT
ASP.	ASPHALT
@	AT
BSMT.	BASEMENT
BM.	BEAM
B.M.	BENCHMARK
BLKG.	BLOCKING
BD.	BOARD
BTM.	BOTTOM
BLDG.	BUILDING
CAB'T.	CABINET
C.I.P.	CAST IN PLACE
CLG.	CEILING
CEM.	CEMENT
CG.	CENTIGRAM
CM.	CENTIMETER
CL.	CENTER LINE
CER.	CERAMIC
C.T.	CERAMIC TILE
CHAN.	CHANNEL
CLR.	CLEAR
C.O.	CLEAN OUT
CLOS.	CLOSET
COL.	COLUMN
CONC.	CONCRETE
CONN.	CONNECTION
CONST.	CONSTRUCTION
C.J.	CONTROL JOINT
CONT.	CONTINUOUS
CONTR.	CONTRACTOR
COR'G.	CORRUGATED
CTR.	COUNTER
CTSK.	COUNTERSUNK
C.M.U.	CONC. MASONRY UNIT
D.P.	DAMP PROOFING
DB.	DECIBEL
DEMO	DEMOLITION
DIAG.	DIAGONAL
DIAM.	DIAMETER
DIM.	DIMENSION
DISP.	DISPENSER
DWL.	DOWEL
DN.	DOWN
D.S.	DOWNSPOUT
DWG.	DRAWING
EA.	EACH
EL.	ELECTRIC
E.W.C.	WATER COOLER
ELEV.	ELEVATION
EQ.	EQUAL
EQUIP.	EQUIPMENT
EXH.	EXHAUST
EXPAN.	EXPANSION
E.J.	EXPANSION JOINT
EXIST.	EXISTING
EXT.	EXTERIOR
F.T.	FEET
FIN.	FINISH
FIXT.	FIXTURE
FL.	FLASHING
FLR.	FLOOR
F.D.	FLOOR DRAIN
FLUOR.	FLUORESCENT
FTG.	FOOTING
FND.	FOUNDATION
FR.	FRAME
F.H.C.	FIRE HOUSE CAB
GA.	GUAGE
G.I.	GALVANIZED IRON
GL.	GLASS
GD.	GRADE
G.	GRAM
GRL.	GRILLE
GRD.	GRID
G.	GROUND
GYP.	GYPSUM
G.B.	GYPSUM BOARD
H.R.	HANDRAIL
HDN.	HARDENER
HDW.	HARDWARE
HDWD.	HARDWOOD
HTR.	HEATER
HT.	HEIGHT
H.P.	HIGH POINT
H.M.	HOLLOW METAL
HORIZ.	HORIZONTAL
H.B.	HOSE BIBB
H.W.	HOT WATER
IN.	INCH
I.D.	INSIDE DIAMETER
INSUL.	INSULATION
INT.	INTERIOR
INV.	INVERT

JAN.	JANITOR
JT.	JOINT
JST.	JOIST
K.P.	KICK PLATE
LAM.	LAMINATED
LDG.	LANDING
LTH.	LATH
LAV.	LAVORATORY
LG.	LENGHT
LT.	LIGHT
L.W.C.	L.W. CONCRETE
LVR.	LOUVER
M.O.	MASONRY OPENING
MAT'L.	MATERIAL
MFR.	MANUFACTURER
MAX.	MAXIMUM
MECH.	MECHANICAL
MTL.	METAL
M.L.	METAL LATH
M.	METER
MIN.	MINIMUM
MLDG.	MOULDING
MULL.	MULLION
N.G.	NATURAL GRADE
NOM.	NOMINAL
N.I.C.	NOT IN CONTRACT
N.T.S.	NOT TO SCALE
NO.	NUMBER
OBS.	OBSCURE
O.C.	ON CENTER
OPG.	OPENING
O.A.	OVERALL
O.D.	OUTSIDE DIAMETER
OFCI.	OWNER FURNISHED CONTRACTOR INSTALLED
O.F.S.	OVERFLOW SCUPPER
O.F.D.	OVERFLOW DRAIN
OPHD	OPPOSITE HAND
PTD.	PAINTED
P.G.	PAGE
P.R.	PAIR
PNL.	PANEL
PTN.	PARTITION
P.	PENNY
PL.	PLATE
PLBG.	PLUMBING
PLY'WD.	PLYWOOD
PM.	PROJECT MANUAL
PT.	POINT
PRMA	PROTECTIVE ROOF MEMBRANE ASSEMBLY
P.S.I.	POUNDS PER SQ. IN.
P.S.F.	POUNDS PER SQ. FT.
P.C.	PRECAST
P.T.	PRESSURE TREATED
P.I.	PROPERTY LINE
RAD.	RADIUS
REG.	REGISTER
REQ'D.	REQUIRED
REV.	REVISION
R.	RISER, RISERS
R.D.	ROOF DRAIN
RFG.	ROOFING
RM.	ROOM
RGH	ROUGH
RD.	ROUND
SCR.	SCREW
SECT.	SECTION
SEL.	SELECT
SHT.	SHEET
SDG.	SIDING
SIM.	SIMILAR
SLDG.	SLIDING
SM.	SMOOTH
SPEC.	SPECIFICATION
SPL.	SPLASH
SQ.	SQUARE
STD.	STANDARD
STL.	STEEL
S.S.	STAINLESS STEEL
STRUC.	STRUCTURE
SUSP.	SUSPENDED
SW.BD.	SWITCHBOARD
S.V.	SMOKE VENT
T.C.	TOP OF CURB
T.G.	TEMPERED GLASS
T.O.P.	TOPE OF PARAPET
T.S.D.	TOP OF STEEL DECK
T.T.P.	TOP OF TAPERED PLYWD.
TYP.	TYPICAL
V.	VENT
VERT.	VERTICAL
V.G.	VERTICAL GRAIN
VEST.	VESTIBULE
V.C.T.	VINYL COMP. TILE
VIF.	VERIFY IN FIELD
W.W.M.	WELDED WIRE MESH
W.C.	WATER CLOSET
W.H.	WATER HEATER
W.F.	WIDE FLANGE
W/	WITH
W/O	WITHOUT
WD.	WOOD
WDW.	WINDOW

GENERAL NOTES

1. THESE CONTRACT DOCUMENTS INDICATE THE DESIGN INTENT OF THE CONSTRUCTION PROJECT AND ESTABLISH STANDARDS FOR QUALITY AND PERFORMANCE. THE CONTRACTOR SHALL PROVIDE A COMPLETE PROJECT IN ACCORDANCE WITH THE DESIGN INTENT AND THE STANDARDS INDICATED IN THE DOCUMENTS OR REQUIRED BY LOCAL JURISDICTION.

2. LEAD AND OTHER HAZARDOUS MATERIALS ABATEMENT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR IN COMPLIANCE WITH ENVIRONMENTAL REPORTS SUPPLIED AS PART OF SOLICITATION. OWNER IS TO BE NOTIFIED IMMEDIATELY IF ADDITIONAL HAZARDOUS MATERIALS, INCLUDING ASBESTOS, ARE ENCOUNTERED IN THE COURSE OF THE WORK.

3. THE BUILDING IS TO REMAIN IN OPERATION AND OPEN TO STAFF DURING CONSTRUCTION. SEE SPECIFICATION SECTIONS 011000, 011400 AND 015000.

4. NOTIFY THE OWNER AND ARCHITECT FOR CLARIFICATION OF ALL CONFLICTS IN THE CONTRACT DOCUMENTS. CONTRACTOR SHALL BE RESPONSIBLE FOR REPLACING ANY WORK INSTALLED INCORRECTLY DUE TO MISINTERPRETATION OF THE CONTRACT DOCUMENTS.

5. CONSTRUCTION CONDITIONS NOT SPECIFICALLY DETAILED IN THE CONTRACT DOCUMENTS SHALL BE SUBJECT TO CONFORMANCE WITH DETAILS OF SIMILAR CONDITIONS INDICATED. NOTIFY THE OWNER AND ARCHITECT FOR CLARIFICATION. CONTRACTOR SHALL BE RESPONSIBLE FOR REPLACING ANY WORK INSTALLED INCORRECTLY DUE TO MISINTERPRETATION OF THE CONTRACT DOCUMENTS.

6. THE CONTRACTOR SHALL FIELD VERIFY ALL CONDITIONS AND DIMENSIONS INDICATED ON THE CONTRACT DOCUMENTS AND SHALL NOTIFY THE OWNER AND ARCHITECT OF ANY DISCREPANCIES OR REQUIRED DEVIATIONS FROM THE CONTRACT DOCUMENTS PRIOR TO THE PURCHASE OF MATERIALS, FABRICATION OR CONSTRUCTION.

7. SUBMIT TO THE ARCHITECT AND THE OWNER A PROJECT SCHEDULE, A CONSTRUCTION MATERIALS AND EQUIPMENT LIST, AND A DELIVERY SCHEDULE. ORDER MATERIALS IN A TIMELY FASHION, SO AS NOT TO DELAY THE PROJECT SCHEDULE. NOTIFY ARCHITECT AND OWNER WITHIN 5 DAYS OF CONTRACT AWARD, OF ANY MATERIAL OR EQUIPMENT DELIVERY WHICH MAY DELAY PROJECT COMPLETION.

8. THE CONTRACTOR SHALL OBTAIN AND PAY FOR ALL MATERIALS, LABOR, EQUIPMENT, TOOLS, CONSTRUCTION EQUIPMENT, WAREHOUSING, TRANSPORTATION AND DELIVERY COSTS, HOISTING, REMOVAL OF TRASH AND DEBRIS, AND OTHER FACILITIES AND SERVICES NECESSARY FOR EXECUTING AND COMPLETING THE WORK.

9. UNLESS OTHERWISE APPROVED, ALL WORK SHALL BE PERFORMED BY THE CONTRACTOR'S OWN FORCES. OBTAIN OWNER AND ARCHITECT APPROVAL OF ALL PROPOSED SUBCONTRACTORS, PRIOR TO AWARDING SUB-CONTRACTS.

10. THE CONTRACTOR ASSUMES ALL RESPONSIBILITY FOR THE ACTIONS OF THE CONTRACTOR'S EMPLOYEES, SUB-CONTRACTORS AND THEIR AGENTS AND EMPLOYEES, AND ANY OTHER PERSONS PERFORMING ANY OF THE CONTRACTOR'S WORK FOR THIS PROJECT.

11. ISSUE COMPLETE SETS OF CONTRACT DOCUMENTS TO EACH OF THE SUBCONTRACTORS TO ENSURE THE SUBCONTRACTORS' FULL UNDERSTANDING AND COORDINATION OF THE SCOPE OF THEIR WORK.

12. THE CONTRACTOR SHALL COORDINATE AND WORK WITH ALL TRADES ON THE PROJECT SITE, WHETHER OR NOT UNDER CONTRACT TO THE CONTRACTOR (SUCH AS TELEPHONE AND DATA SERVICE, LANDSCAPE, ETC.). ANY CHANGES OR DELAYS ARISING FROM CONFLICTS BETWEEN SUCH TRADES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AT NO ADDITIONAL EXPENSE TO THE OWNER.

13. COORDINATE SCHEDULING, PROVISIONS FOR STORAGE AND INSTALLATION OF ITEMS FURNISHED BY THE OWNER AND BY OTHERS.

14. WORK SHALL BE PERFORMED DURING NORMAL WORKING HOURS UNLESS OTHERWISE SPECIFICALLY APPROVED BY OWNER AND ARCHITECT. CONTRACTOR SHALL SCHEDULE AND PERFORM ALL WORK SO AS NOT TO UNREASONABLY DISTURB NEIGHBORS. ACTIVITIES PRODUCING HIGH NOISE LEVELS SHALL BE RESTRICTED TO APPROVED TIMES AND SHALL BE COORDINATED WITH OWNER AND ARCHITECT.

15. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR, AND HAVE CONTROL OVER, ALL CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES AND PROCEDURES AND FOR COORDINATING ALL PORTIONS OF THE WORK REQUIRED BY THE CONTRACT DOCUMENTS.

16. EXAMINE ALL SURFACES TO DETERMINE THAT THEY ARE SOUND, DRY, CLEAN AND READY TO RECEIVE FINISHES PRIOR TO INSTALLATION. START OF INSTALLATION SHALL IMPLY ACCEPTANCE OF SUBSTRATE AND SHALL NOT BE GROUNDS FOR CLAIMS AGAINST IMPROPER PERFORMANCE OF INSTALLED MATERIAL. ADVISE ARCHITECT OF ANY EXISTING CONSTRUCTION NOT LEVEL, SMOOTH AND PLUMB WITHIN INDUSTRY STANDARDS PRIOR TO START OF CONSTRUCTION.

17. WORK DAMAGED DURING CONSTRUCTION OR NOT CONFORMING TO SPECIFIED STANDARDS TOLERANCES OR MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION SHALL BE REPLACED AT NO ADDITIONAL COST TO THE OWNER.

CODE COMPLIANCE AND PERMITS:

C1. THE ARCHITECT'S AND ENGINEERS' SEALS, AFFIXED TO THESE CONTRACT DOCUMENTS, CERTIFIES TO THE BEST OF THE ARCHITECT'S AND ENGINEERS' KNOWLEDGE THAT THE DOCUMENTS MEET APPLICABLE CODES. NOTIFY THE OWNER AND ARCHITECT OF ANY PORTION OF THESE DOCUMENTS FOUND TO BE IN CONFLICT WITH SUCH CODES, AND OBTAIN RESOLUTION OF THE CONFLICT PRIOR TO PROCEEDING WITH THE AFFECTED WORK.

C2. PERFORM ALL WORK IN ACCORDANCE WITH ALL APPLICABLE CODES, REGULATIONS, LOCAL AUTHORITY REGULATIONS AND LOCAL CODE OFFICIALS' DIRECTIVES.

C3. CONTRACTOR TO OBTAIN AND PAY FOR ALL TRADE PERMITS, INSPECTIONS AND APPROVALS BY LOCAL AUTHORITIES.

C4. PROVIDE ADA COMPLIANT FIXTURES, HARDWARE, AND DIMENSIONS WHERE INDICATED AND WHERE HANDICAPPED ACCESSIBILITY IS REQUIRED.

C5. ALL PENETRATIONS THROUGH FIRE-RATED CONSTRUCTION SHALL BE PROTECTED WITH APPROPRIATE FIRE DAMPERS, FIRE SAFING OR FIRE DOORS AS REQUIRED BY LOCAL CODE OFFICIALS. MAINTAIN INTEGRITY OF ALL EXISTING AND NEW FIRE SEPARATIONS DURING CONSTRUCTION OF ALL WORK OF THIS CONTRACT.

C6. HARDWARE SCHEDULED FOR INSTALLATION ON DOORS AND FRAMES WHICH REQUIRE A FIRE-RATED LABEL SHALL COMPLY WITH ALL CODE REQUIREMENTS GOVERNING HARDWARE TYPE AND INSTALLATION METHODS FOR FIRE RATED ASSEMBLIES.

C7. EXIT DOORS, EGRESS WINDOWS, AND OTHER OPENINGS REQUIRED FOR MEANS OF EGRESS SHALL BE OPERABLE FROM THE INSIDE WITHOUT USE OF A KEY OR SPECIAL KNOWLEDGE OR EFFORT.

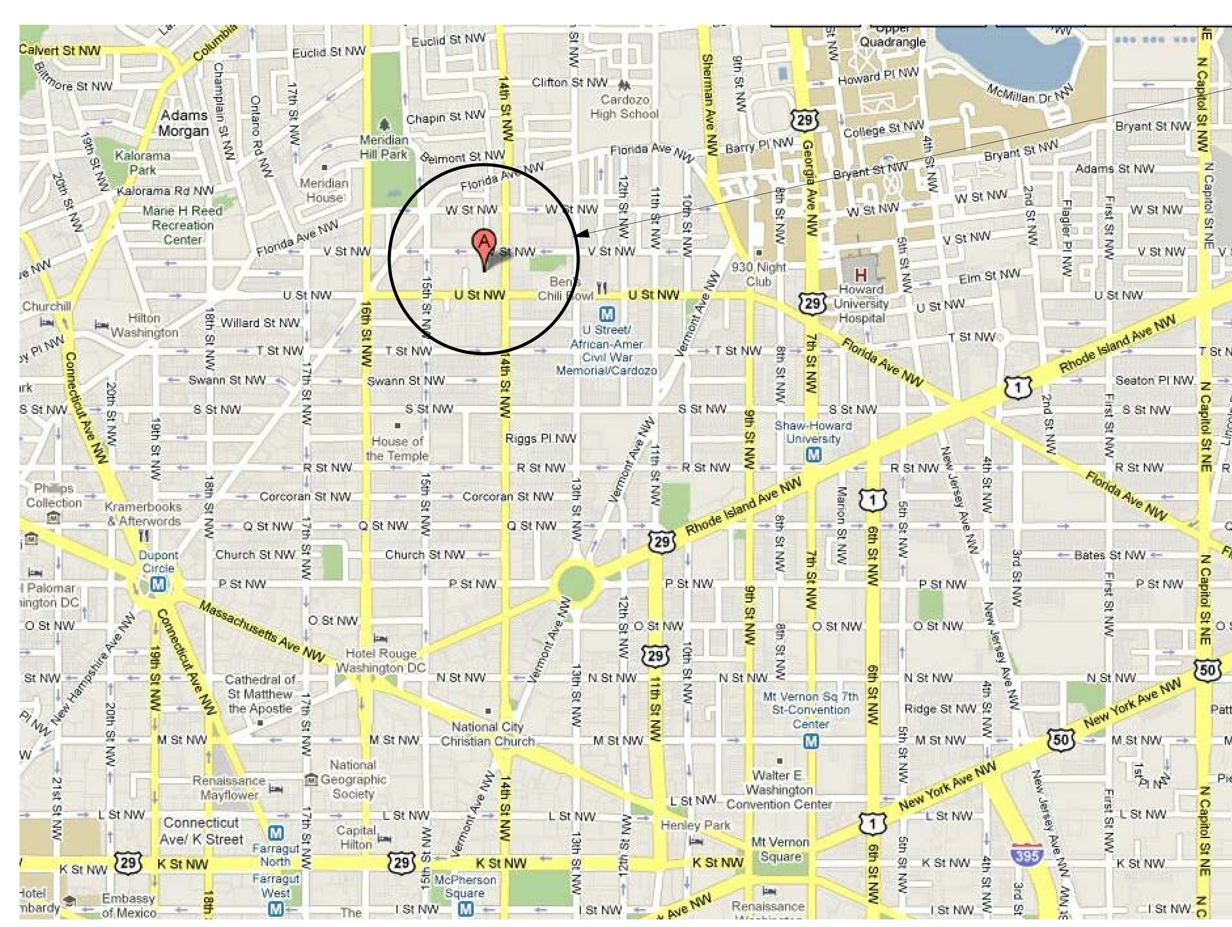
SYMBOLS LEGEND

- SIM / 1 / A108 A102: SECTION NUMBER; DESTINATION SHEET NUMBER; SHEET NUMBER OF ORIGIN
- SIM / 1 / A102 A103: DETAIL NUMBER; DESTINATION SHEET NUMBER; SHEET NUMBER OF ORIGIN
- A101 / 1: DESTINATION SHEET NUMBER; ELEVATION NUMBER
- 1 / A1-102 A1-101 View Name 1/8" = 1'-0": DRAWING VIEW TITLE
- 2: NEW CONSTRUCTION ANNOTATION KEYNOTE NUMBER
- 15: DEMOLITION ANNOTATION KEYNOTE NUMBER
- Name Elevation: LEVEL INDICATOR
- Room name 101: ROOM NAME AND NUMBER
- XX: GLAZED OPENING REFERENCE
- 1i: PARTITION TYPE REFERENCE
- 101: DOOR NUMBER REFERNCE
- A: COLUMN BUBBLE REFERENCE
- A00: EQUIPMENT REFERNCE

MATERIALS LEGEND

CONCRETE	EARTH	STEEL	GLASS
CMU	EXISTING CONSTRUCTION TO REMAIN	BATT INSULATION	RIGID INSULATION
BRICK	GRANULAR FILL	PLYWOOD	SHIMS/ BLOCKING
SAND	STONE	WOOD FRAMING	FINISH WOOD

VICINITY MAP



PROJECT SITE

DESCRIPTION OF WORK

THIS ENERGY CONSERVATION RETROFIT OF THE DC GOVERENMENT OFFICE BUILDING, REEVES CENTER FOR MUNICAPL AFFAIRS CONSISTS OF FOUR COMPONENTS:

SCOPE ITEM 1- ADD AIRLOCK TO EXISTING EXIT DOORS AT LOBBY TO RETAIN CONDITIONED AIR

SCOPE ITEM 2- REPLACE ROOF AND INSULATION AT 7TH AND 9TH LEVELS, WITH PORTIONS OF REPLACEMENT ROOF VEGETATED

SCOPE ITEM 3- CHILLER PLANT REPLACEMENT AND RECONFIGURATION FOR ENERGY USE REDUCTION

SCOPE ITEM 4- FOR ENERGY EFFICIENCY, INSTALL VFD'S ON SECONDARY CHILLED WATER AND INSTALL 2-WAY CONTROL VALVES

BUILDING & ZONING INFO.

PROJECT ADDRESS: 2000 14TH STREET, NW, WASHINGTON DC 20009

ZONING	CR (W/ ART OVERLAY)	
LOT	0844, 0209	
SQUARE	0204	
WARD	1	
BUILDING HEIGHT:	PERMITTED	EXISTING
HEIGHT	90'	109.67'
NUMBER OF STORIES	NO LIMIT	8 STORIES + 2B
LOT COVERAGE	60%	54%
LOT AREA	97, 600 SF	
BUILDING OCCUPANCY	52,882 SF	

APPLICABLE CODES:

BUILDING CODE:
2006 ICC INT'L EXIST. BLDG. CODE (IEBC)
2006 ICC INTERNATIONAL BUILDING CODE (IBC)
2008 DCMR12A BUILDING CODE SUPPLEMENT

MECHANICAL:
2006 ICC INTERNATIONAL MECHANICAL CODE (IMC)
2008 DCMR12E MECHANICAL CODE SUPPLEMENT

PLUMBING:
2006 ICC INTERNATIONAL PLUMBING CODE (IPC)
2008 DCMR12F PLUMBING CODE SUPPLEMENT

ELECTRICAL:
2006 ICC INTERNATIONAL ELECTRICAL CODE NFPA NEC 2005
2008 DCMR12C ELECTRIC CODE SUPPLEMENT

ENERGY:
2006 ICC INTERNATIONAL ENERGY CODE (IECC)
2008 DCMR12I ENERGY CONSERVATION CODE SUPPLEMENT

ACCESSIBILITY
2006 ICC INTERNATIONAL BUILDING CODE (IBC) CHAPTER 11/ANSI A117.1 2003
2008 DCMR12A SUPPLEMENT/CHAPTER 11A

BUILDING CODE ANALYSIS:

PERMITTED USES:	OFFICE, RETAIL, RESIDENTIAL AND MIX-USE DEVELOPMENT
USE GROUPS:	A-2, A-3, B, S-2
CONSTRUCTION TYPE:	1B (FIRE RESISTANT CONSTRUCTION REQ'D -IBC 2006, TABLE 601
SPRINKLER SYSTEM	YES, FULLY SPRINKLERED
FIRE ALARM SYSTEM	YES

BUILDING AREA -	GROSS SQ.FT.
BASEMENT 2	88,445
BASEMENT 1	85,108
1ST FLOOR	49,337
2ND FLOOR	45,060
3RD FLOOR	46,707
4TH FLOOR	46,761
5TH FLOOR	45,151
6TH FLOOR	45,176
7TH FLOOR	28,515
8TH FLOOR	26,367
TOTAL	506,627

DRAWING LIST

SHEET #	SHEET DESCRIPTION
CS-1	COVER SHEET
COMMON SHEETS	
M0-001	MECHANICAL SYMBOLS, ABBREVIATIONS AND NOTES
M0-002	BAS SYMBOLS, LEGENDS AND NOTES
E0-001	ELECTRICAL SYMBOLS, ABBREVIATIONS AND NOTES
E0-201	PARTIAL POWER RISER DIAGRAM
SCOPE ITEM 1 - ADD AIRLOCK TO ATRIUM	
A1-101	MAIN LOBBY AIRLOCK
SCOPE ITEM 2 - NEW ROOF & INSULATION WORK	
A2-101	ROOF PLAN
A2-201	ROOF DETAILS
A2-202	ROOF DETAILS
SCOPE ITEM 3 - CHILLER REPLACEMENT WORK	
M3-201	ENLARGED MECHANICAL P.H. PLANS
M3-301	PIPING FLOW DIAGRAM
M3-401	HVAC SCHEDULES AND CONTROL DIAGRAM
M3-402	CONTROL DIAGRAM
M3-403	CONTROL DIAGRAM
M3-501	DETAILS
M3-502	DETAILS
E3-101	PENTHOUSE LEVEL ELECTRICAL DEMO & NEW WORK PLANS
E3-201	LOAD CALCULATIONS, ELEVATIONS & PANELBOARD SCHEDULES
SCOPE ITEM 4 - CHILLED WATER VFD REPLACEMENT	
M4-101	BASEMENT LEVEL B1 MECHANICAL PLAN
M4-102	BASEMENT LEVEL B2 MECHANICAL PLAN
M4-103	GROUND FLOOR MECHANICAL PLAN
M4-104	SECOND FLOOR MECHANICAL PLAN
M4-105	THIRD FLOOR MECHANICAL PLAN
M4-106	FOURTH FLOOR MECHANICAL PLAN
M4-107	FIFTH FLOOR MECHANICAL PLAN
M4-108	SIXTH FLOOR MECHANICAL PLAN
M4-109	SEVENTH FLOOR MECHANICAL PLAN
M4-110	EIGHTH FLOOR MECHANICAL PLAN
SCOPE ITEM FOR REFERENCE DRAWINGS FROM ORIGINAL CONSTRUCTION (1963)	
M-23	PENTHOUSE MECHANICAL PLAN
M-28	MECHANICAL-AIR HANDLING UNIT AND FAN-COIL UNIT RISER
M-31	MECHANICAL SCHEDULES
M-32	MECHANICAL SCHEDULES

APPROVED	DESIGNED TDB		
	DRAWN TD	5/10/11	FINAL
	CHECKED TDB	REVISION / DATE	DESCRIPTION / BY / APP.

APPROVED

ADMINISTRATOR
CAPITAL CONSTRUCTION SERVICES ADMINISTRATION

DATE:

CHIEF DESIGN & ENGINEERING DIVISION

DATE:

CERTIFICATION

REGISTRATION NO.

DATE:

ARCHITECT

DATE:

COVER SHEET

REEVES CENTER FOR MUNICIPAL AFFAIRS
ENERGY CONSERVATION RETROFIT

2000 14TH STREET NW
WASHINGTON DC 20009

BELL Architects, PC
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GOVERNMENT OF THE DISTRICT OF COLUMBIA
DEPARTMENT OF REAL ESTATE SERVICES

ARCHITECTURAL

DRAWING NO.

CS-1

PROJECT NO. PL901C
BLDG NO. 00762
DATE: 5/10/11
SHEET 1 OF 5

1"=10' 1"=20' 1"=30' 1"=40' 1"=50' 1"=100' 1"=200' 1"=400' 3"=1'-0" 1-1/2" = 1'-0" 1" = 1'-0" 3/4" = 1'-0" 1/2" = 1'-0" 3/8" = 1'-0" 1/4" = 1'-0" 3/16" = 1'-0" 1/8" = 1'-0" 3/32" = 1'-0" 1/16" = 1'-0"

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GENERAL NOTES:

1. NEW DOORS 01 & 02 SHALL MATCH WIDTH OF EXISTING DOORS 03 & 04

2. NEW INTERIOR STOREFRONT AIRLOCK ENCLOSURE TO BE CLEAR ANODIZED ALUMINIUM

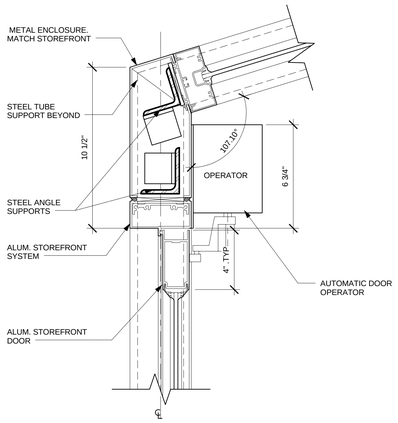
3. EXISTING CURTAINWALL IS STAINLESS STEEL CLAD OVER ALUMINIUM. PROTECT EXISTING CLADDING. REPAIR/REPLACE ANY CLADDING AFFECTED BY NEW AIRLOCK ENCLOSURE. COORDINATE STEEL ANCHOR PLATE WITH STOREFRONT, DOOR SILL AND HINGE TYPE

4. SAWCUT AND REMOVE FLOOR TILE UNDER FOOTPRINT OF STOREFRONT FOR ANCHOR PLATE. PROVIDE TWO BOLTS PER PLATE

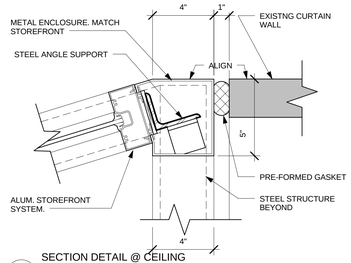
5. PROVIDE POWER TO NEW AND RELOCATED DEVICES CONCEALED IN FRAMING

Door Schedule -AIRLOCK-

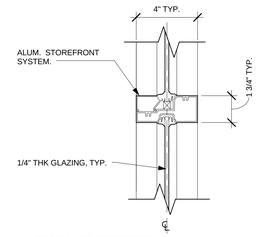
Mark	Existing/New	Height	Width	Material	Remarks
03	Existing	7' - 11"	3' - 2 1/4"	Clear annodized aluminium	Replace quarry tile @ sill
04	Existing	7' - 11"	3' - 2 1/4"	Clear annodized aluminium	Replace quarry tile @ sill
05	Existing	7' - 11"	3' - 1 1/2"	Clear annodized aluminium	Replace quarry tile @ sill and replace closer cover
10		7' - 0"	3' - 0"		



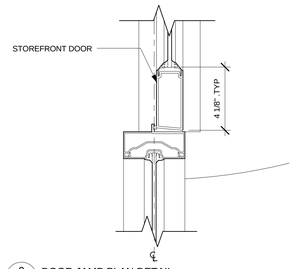
12 SECTION DETAIL @ DOOR HEAD
A0-101 A0-102 3" = 1'-0"



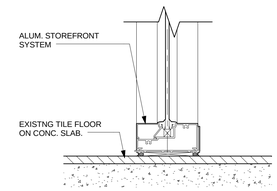
10 SECTION DETAIL @ CEILING GLAZING
A0-101 A0-102 3" = 1'-0"



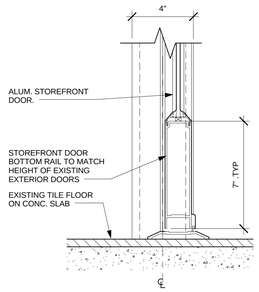
7 TYPICAL STOREFRONT MULLION DETAIL
A0-101 A0-102 3" = 1'-0"



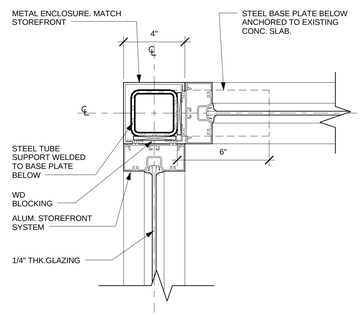
9 DOOR JAMB PLAN DETAIL
A0-101 A0-102 3" = 1'-0"



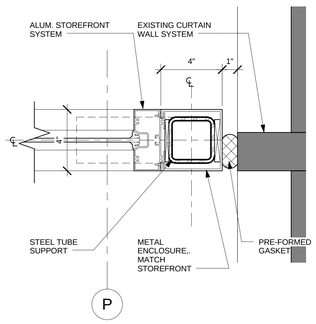
6 SECTION DETAIL @ TYPICAL STOREFRONT SILL
A0-101 A0-102 3" = 1'-0"



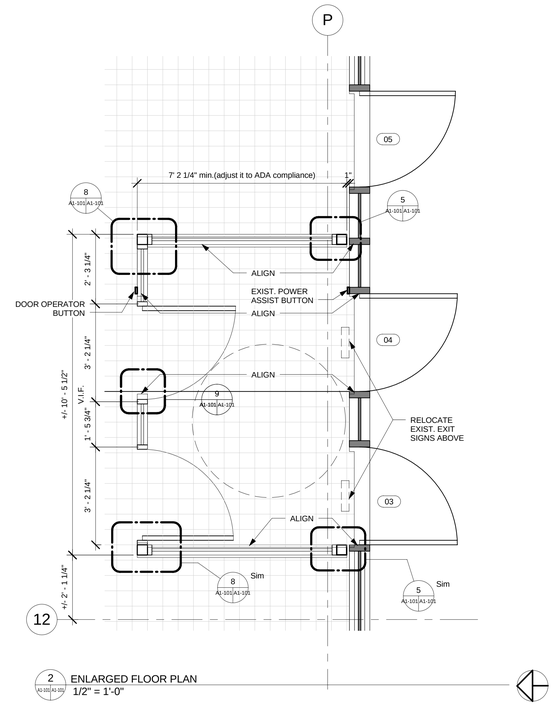
11 SECTION DETAIL @ DOOR SILL
A0-101 A0-102 3" = 1'-0"



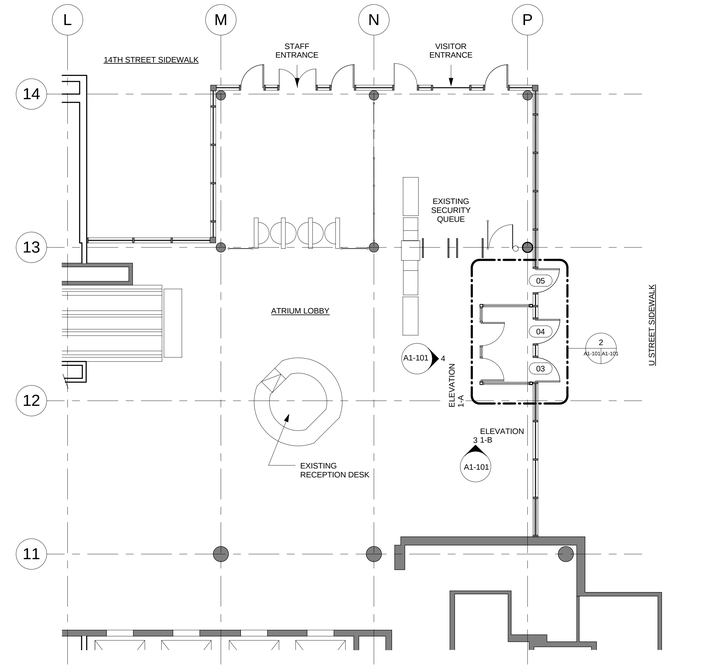
8 AIRLOCK PLAN DETAIL @ CORNER
A0-101 A0-102 3" = 1'-0"



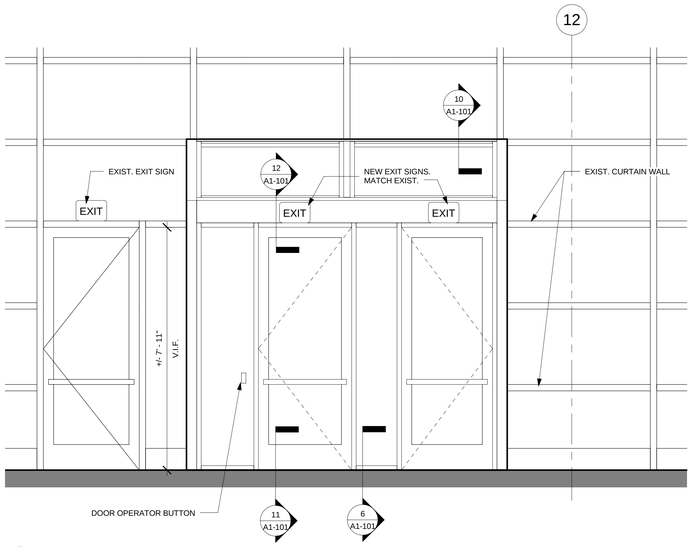
5 AIRLOCK PLAN DETAIL @ EXISITING CURTAINWALL
A0-101 A0-102 3" = 1'-0"



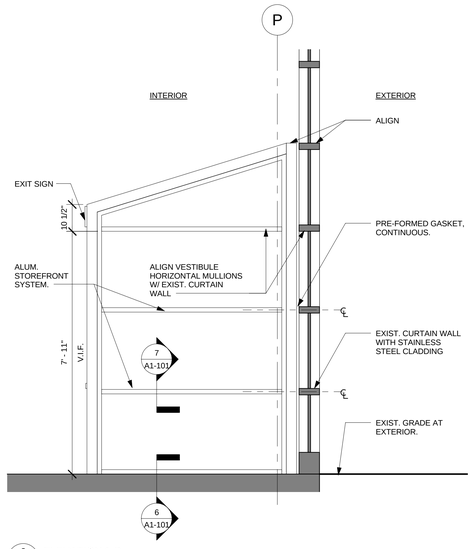
2 ENLARGED FLOOR PLAN
A0-101 A0-102 1/2" = 1'-0"



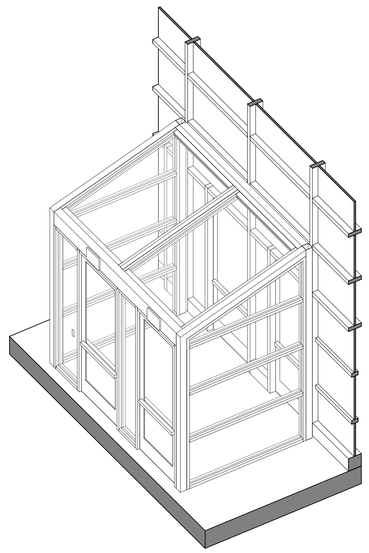
1 GROUND FLOOR LOBBY KEYPLAN
A0-101 A0-102 1/8" = 1'-0"



4 ELEVATION 1-A
A0-101 A0-102 1/2" = 1'-0"



3 ELEVATION 1-B
A0-101 A0-102 1/2" = 1'-0"



13 3D AIRLOCK VIEW
A0-101

DESIGNED	TDB					
DRAWN	TD		5/10/11	FINAL		
CHECKED	TDB	REVISION	DATE	DESCRIPTION	BY	APP.

CERTIFICATION

MAIN LOBBY AIRLOCK

ARCHITECTURAL

REEVES CENTER FOR MUNICIPAL AFFAIRS
ENERGY CONSERVATION RETROFIT

2000 14TH STREET NW
WASHINGTON DC 20009

DRAWING NO.

A1-101

REGISTRATION NO.
DATE:

BELL Architects, PC
1228 9th Street NW
Washington, DC 20001

PROJECT NO. PL901C
BLDG NO. 00762

ARCHITECT
DATE:

GOVERNMENT OF THE DISTRICT OF COLUMBIA
DEPARTMENT OF REAL ESTATE SERVICES

DATE: 5/10/11
SHEET 2 OF 5

1"=10" | 1"=20" | 1"=30" | 1"=40" | 1"=50" | 1"=100" | 1"=200" | 1"=400" | 3"=1'-0" | 1-1/2" = 1'-0" | 1" = 1'-0" | 3/4" = 1'-0" | 1/2" = 1'-0" | 3/8" = 1'-0" | 1/4" = 1'-0" | 3/16" = 1'-0" | 1/8" = 1'-0" | 3/32" = 1'-0" | 1/16" = 1'-0"

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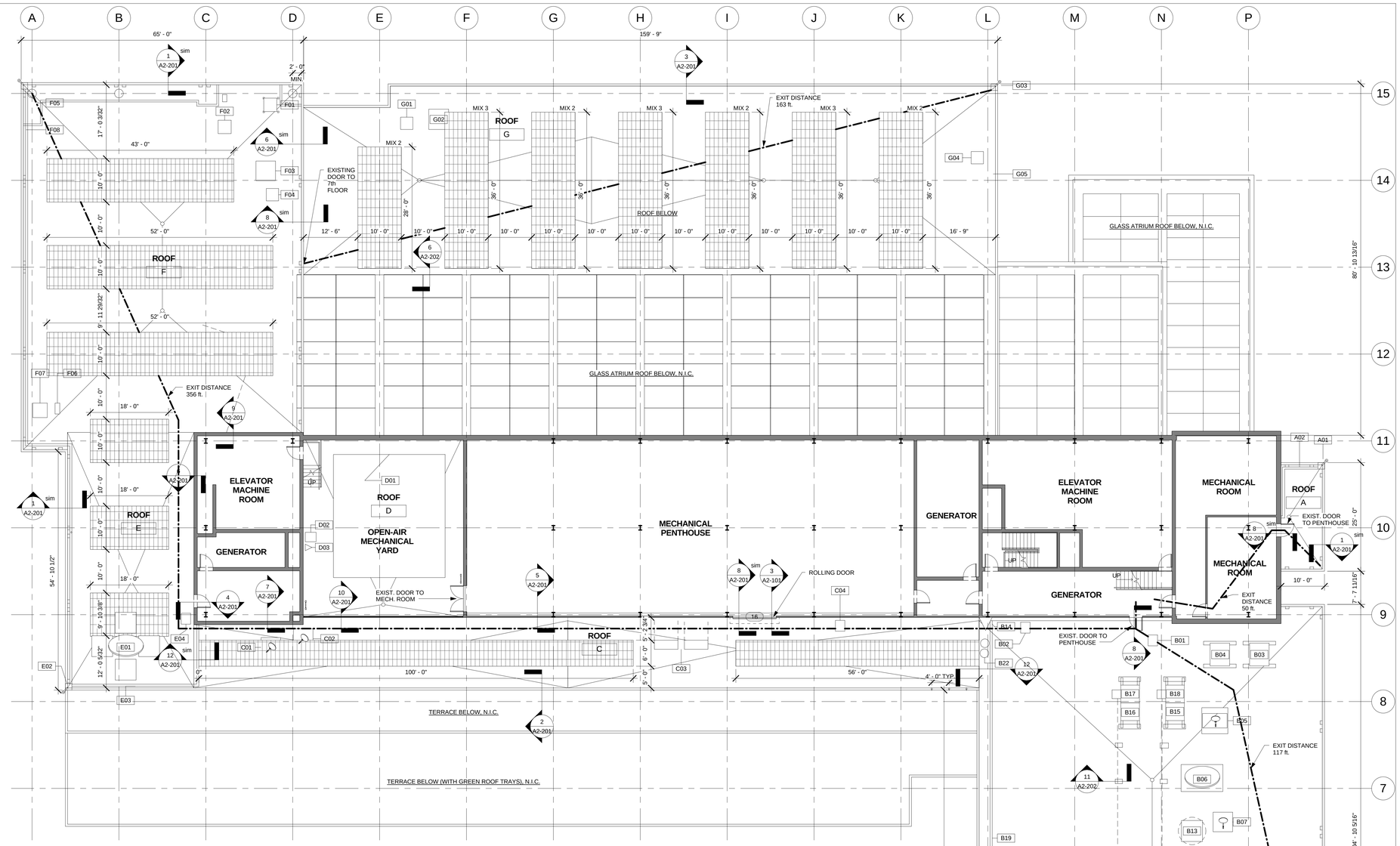
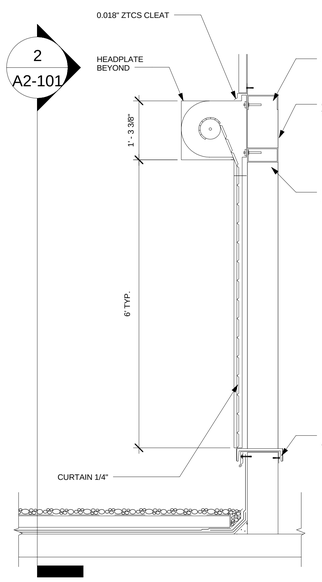
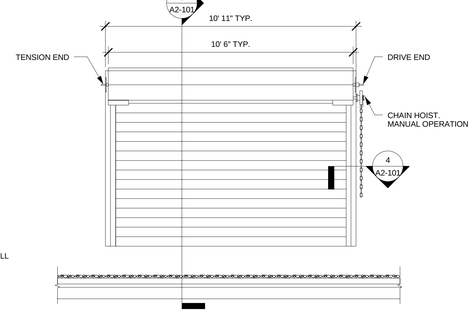
MAIN ROOF EQUIPMENT SCHEDULE						
MARK	DESCRIPTION	EXISTING MOUNTING	PROPOSED MOUNTING	ACTION	DETAIL	COMMENTS
A01	SEC. CAMERA	PARAPET MOUNTED	EXISTING	EXISTING TO REMAIN		
A02	CONDUIT	ROOF MOUNTED	MOUNT TO COPING	EXISTING TO REMAIN		
B01	RTU	LOOSE FOAM EQUIPMENT PAD	EXISTING	EXISTING TO REMAIN		
B02	RTU	LOOSE FOAM EQUIPMENT PAD	EXISTING	EXISTING TO REMAIN		
B03	RTU	CONCRETE PARKING CURB	CONCRETE RAILS	EXISTING TO REMAIN		
B04	RTU	CONCRETE PARKING CURB	CONCRETE RAILS	EXISTING TO REMAIN		SEE ROOF NOTE 3
B05	SATELLITE	UNATTACHED BALLAST	EXISTING	EXISTING TO REMAIN		SEE ROOF NOTE 3
B06	SATELLITE	UNATTACHED BALLAST	NONE	PERMANENT REMOVAL		
B07	SATELLITE	UNATTACHED BALLAST	NONE	PERMANENT REMOVAL		
B08	SATELLITE	UNATTACHED BALLAST	NONE	PERMANENT REMOVAL		
B09	SEC. CAMERA	PARAPET MOUNTED	EXISTING	EXISTING TO REMAIN		
B10	RTU	ROOF PITCH POCKET	CONCRETE RAILS	EXISTING TO REMAIN		SEE ROOF NOTE 5
B11	RTU	ROOF PITCH POCKET	CONCRETE RAILS	EXISTING TO REMAIN		SEE ROOF NOTE 5
B12	RTU	ROOF PITCH POCKET	CONCRETE RAILS	EXISTING TO REMAIN		SEE ROOF NOTE 5
B13	EXHAUST	WOOD ROOF CURB	NEW WOOD CURB	EXISTING TO REMAIN	5/A2-202	
B14	SATELLITE	UNATTACHED BALLAST	EXISTING	EXISTING TO REMAIN		SEE ROOF NOTE 6
B15	RTU	CONCRETE ROOF CURB	EXISTING	EXISTING TO REMAIN	4/A2-202	
B16	RTU	CONCRETE ROOF CURB	EXISTING	EXISTING TO REMAIN	4/A2-202	
B17	RTU	CONCRETE ROOF CURB	EXISTING	EXISTING TO REMAIN	4/A2-202	SEE ROOF NOTE 5
B18	RTU	CONCRETE ROOF CURB	EXISTING	EXISTING TO REMAIN	4/A2-202	SEE ROOF NOTE 5
B19	CONDUIT	ROOF MOUNTED	MOUNT TO COPING	EXISTING TO REMAIN		
B20	SATELLITE	UNATTACHED BALLAST	NONE	EXISTING TO REMAIN		
B21	EXHAUST	WOOD ROOF CURB	NEW WOOD CURB	EXISTING TO REMAIN	3/A2-202	
B22	CANS	NONE	EXISTING	EXISTING TO REMAIN		
C01	SATELLITE	UNATTACHED BALLAST	NONE	PERMANENT REMOVAL		
C02	SATELLITE	UNATTACHED BALLAST	NONE	EXISTING TO REMAIN		
C03	DUCTWORK	NONE	NEW WOOD CURB	EXISTING TO REMAIN		
C04	RTU	LOOSE FOAM EQUIPMENT PAD	EXISTING	EXISTING TO REMAIN		
D01	COOLING TOWER	STEEL SUPPORTS	EXISTING	EXISTING TO REMAIN		N.I.C
D02	RTU	FOAM EQUIPMENT PAD ON METAL SUPPORT	EXISTING	EXISTING TO REMAIN		N.I.C
D03	SATELLITE	TOWER	EXISTING	EXISTING TO REMAIN		N.I.C
E01	SATELLITE	UNATTACHED BALLAST	NONE	PERMANENT REMOVAL		
E02	SEC. CAMERA	PARAPET MOUNTED	EXISTING	EXISTING TO REMAIN		
E03	CONDUIT	ROOF MOUNTED	MOUNT TO COPING	EXISTING TO REMAIN		
E04	RTU	LOOSE FOAM EQUIPMENT PAD	EXISTING	EXISTING TO REMAIN		
F01	RTU	ROOF PITCH POCKET	CONCRETE RAILS	EXISTING TO REMAIN		SEE ROOF NOTE 4
F02	RTU	ROOF PITCH POCKET	CONCRETE RAILS	EXISTING TO REMAIN		SEE ROOF NOTE 4
F03	SATELLITE	UNATTACHED BALLAST	EXISTING	EXISTING TO REMAIN		
F04	EXHAUST	WOOD ROOF CURB	NEW WOOD CURB	EXISTING TO REMAIN	3/A2-202	
F05	SEC. CAMERA	PARAPET MOUNTED	EXISTING	EXISTING TO REMAIN		
F06	RTU	LOOSE FOAM EQUIPMENT PAD	EXISTING	EXISTING TO REMAIN		SEE ROOF NOTE 4
F07	EXHAUST	WOOD ROOF CURB	NEW WOOD CURB	EXISTING TO REMAIN	5/A2-202	
F08	CONDUIT	ROOF MOUNTED	MOUNT TO COPING	EXISTING TO REMAIN		
G01	EXHAUST	WOOD ROOF CURB	NEW WOOD CURB	EXISTING TO REMAIN	5/A2-202	
G02	EXHAUST	WOOD ROOF CURB	NEW WOOD CURB	EXISTING TO REMAIN	5/A2-202	
G03	SEC. CAMERA	PARAPET MOUNTED	EXISTING	EXISTING TO REMAIN		
G04	EXHAUST	WOOD ROOF CURB	NEW WOOD CURB	EXISTING TO REMAIN	3/A2-202	
G05	CONDUIT	ROOF MOUNTED	MOUNT TO COPING	EXISTING TO REMAIN		



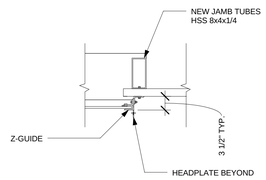


3 A2-101/A2-102 ROLLING DOOR -ELEVATION, SECTION AND JAMB DETAIL- 3/4" = 1'-0"

1 A2-201/A2-101 1 3/32" = 1'-0"



2 A2-101 ROLLING DOOR -ELEVATION, SECTION AND JAMB DETAIL- 3/8" = 1'-0"



4 A2-101 ROLLING DOOR -ELEVATION, SECTION AND JAMB DETAIL- 3/4" = 1'-0"

ROLLING DOOR NOTES:

1. PROVIDE LOCK HASP INSIDE PENTHOUSE TO SECURE IT
2. CURTAIN COLOR SHALL MATCH EXISTING PENTHOUSE WALL PANELS
3. RELOCATE THE FOLLOWING EXISTING CONDUITS OUTSIDE THE DOOR OPENING: (3) HORIZONTAL AT HEAD, (5) HORIZONTAL AT SILL, (3) VERTICAL AT JAMB
4. INSTALL (4) 3/4" x 12" ANCHOR BOLTS THROUGH CHANNEL SILL INTO GROUTED CORES OF EXISTING CMU, (2) AT EACH END
5. CUT EXISTING METAL WALL PANELS AS REQUIRED FOR DOOR. PROVIDE CAP TRIM PIECES

ROOF NOTES

1. REMOVE, PROTECT AND REINSTALL ALL EQUIPMENT ON ROOF AS REQUIRED FOR DEMOLITION AND REPLACEMENT OF ROOFING
2. COORDINATE SHUTDOWN AND REMOVAL/REINSTALLATION OF ROOF TOP UNITS WITH OWNER
3. UNITS B03 AND B04: DISCONNECT UNITS, MOVE, REINSTALL ON EXISTING CURBS, AND RECONNECT AS REQUIRED FOR ROOF ASSEMBLY INSTALLATION
4. UNITS F01, F02 AND F06: REROUTE CONDUITS THROUGH NEW CONDUIT ENCLOSURE. SEE DETAIL 1/A2-202
5. UNITS B10, B11, B12, B17 AND B18: MODIFY EXISTING AUXILIARY SUPPORT POST AS SHOWN IN DETAILS 11/A2-202
6. UNIT B14: REMOVE EXISTING WOOD BASE; RESET ON NEW CONCRETE PAVERS
7. TEMPORARILY REMOVE LIGHTING PROTECTION SYSTEM FOR RE-ROOFING. REINSTALL SYSTEM AND PROVIDE CERTIFICATION OF REINSTALLATION TO OWNER
8. THIS ROOF LEVEL IS EQUAL TO MECHANICAL PENTHOUSE. ROOFS ABOVE MECHANICAL PENTHOUSE ARE NIC, AS ARE ROOFS/TERRACES BELOW AND WEST OF ROOF C. ROOF G IS AT 7TH LEVEL
9. VEGETATED ROOF AREAS WILL REPLACE BALLAST WITH GREEN ROOF TRAYS
10. MECHANICAL EQUIPMENT LOCATIONS ARE DIAGRAMMATIC AND THEY ARE SHOWN IN THEIR GENERAL LOCATION
11. AFTER EXISTING ROOF REMOVAL ENSURE ALL CONCRETE DECK SLOPES TO DRAIN WITHOUT LOW SPOTS. INFILL WITH TOPPING AT ANY DEVIATIONS FROM SLOPE TO DRAIN
12. AS PART OF PERMANENT REMOVALS IN MAIN ROOF EQUIPMENT SCHEDULE, REMOVE ANY POWER, PIPING, COMMUNICATIONS, ETC. CONNECTIONS BACK TO ORIGIN POINT
13. PRIME AND PAINT ALL EXPOSED STEEL MISCELLANEOUS FRAMING AND SUPPORTS

ROOF REPLACEMENT SCHEDULE			
ROOF AREA	BASE ROOF	VEGETATED ROOF	NOTES
ROOF A	PRMA	0 SF	
ROOF B	PRMA	0 SF	
ROOF C	PRMA	1364 SF	PLANT MIX 1
ROOF D	PRMA	0 SF	
ROOF E	PRMA	593 SF	PLANT MIX 1
ROOF F	PRMA	1737 SF	PLANT MIX 1
ROOF G	PRMA	2560 SF	PLANT MIX 2 + 3

DESIGNED	TDB				
DRAWN	RC		5/10/11	FINAL	
CHECKED	TDB	REVISION	DATE	DESCRIPTION	BY / APP.

CERTIFICATION

ROOF PLAN

ARCHITECTURAL

REEVES CENTER FOR MUNICIPAL AFFAIRS
ENERGY CONSERVATION RETROFIT

2000 14TH STREET NW
WASHINGTON DC 20009

DRAWING NO.

A2-101

REGISTRATION NO.
DATE:

ARCHITECT
DATE:

BELL Architects, PC
1228 9th Street NW
Washington, DC 20001

GOVERNMENT OF THE DISTRICT OF COLUMBIA
DEPARTMENT OF REAL ESTATE SERVICES

PROJECT NO. PL901C
BLDG NO. 00762
DATE: 5/10/11
SHEET 3 OF 5

1"=10' | 1"=20' | 1"=30' | 1"=40' | 1"=50' | 1"=100' | 1"=200' | 1"=400' | 3"=1'-0" | 1-1/2" = 1'-0" | 1" = 1'-0" | 3/4" = 1'-0" | 1/2" = 1'-0" | 3/8" = 1'-0" | 1/4" = 1'-0" | 3/16" = 1'-0" | 1/8" = 1'-0" | 3/32" = 1'-0" | 1/16" = 1'-0"

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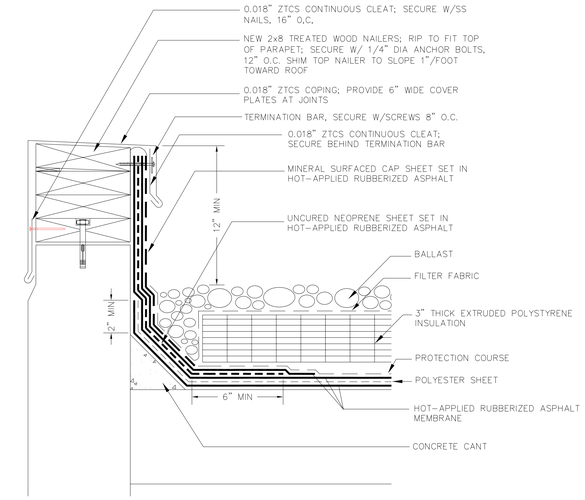
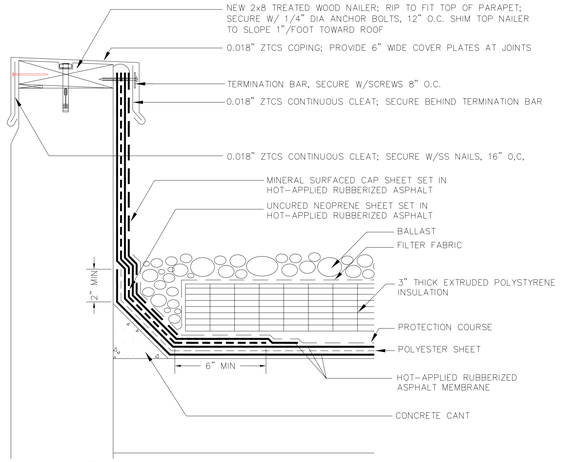


1 A2-201 PARAPET DETAIL
3" = 1'-0"



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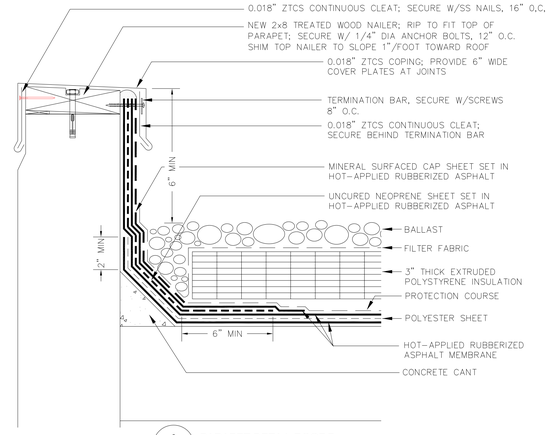
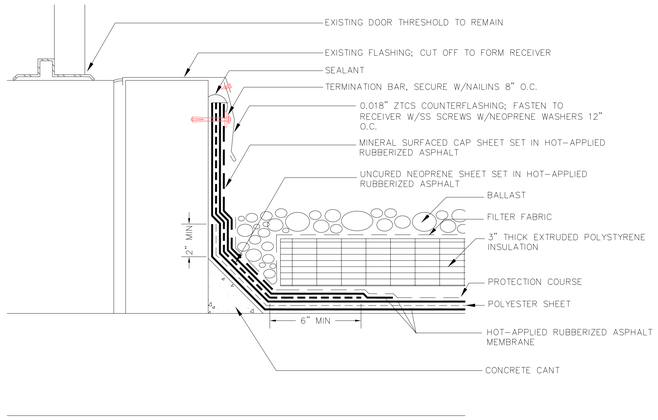
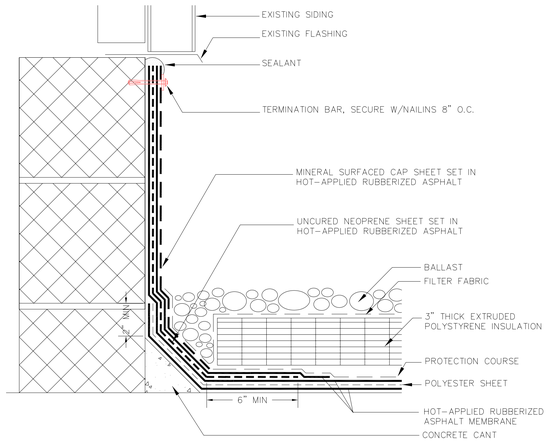


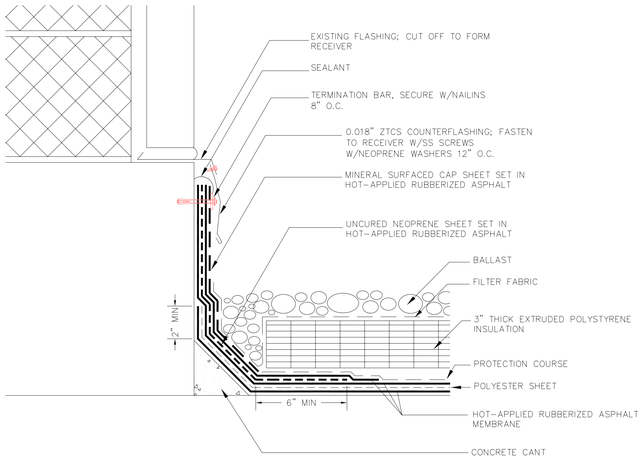
3 A2-201 PARAPET DETAIL ROOF 7
3" = 1'-0"



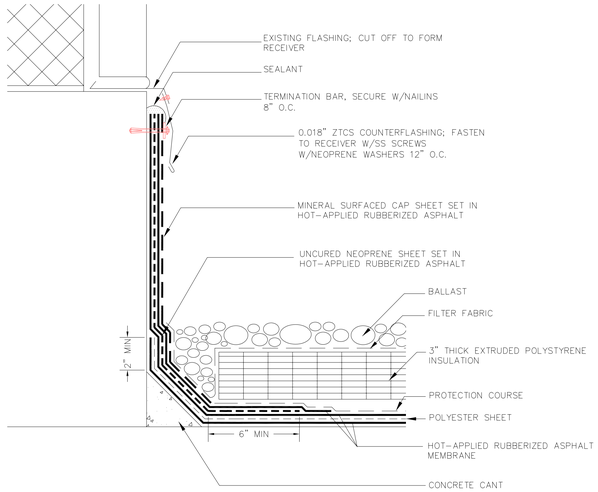
4 A2-201 PENTHOUSE DOOR FLASHING DETAIL
3" = 1'-0"



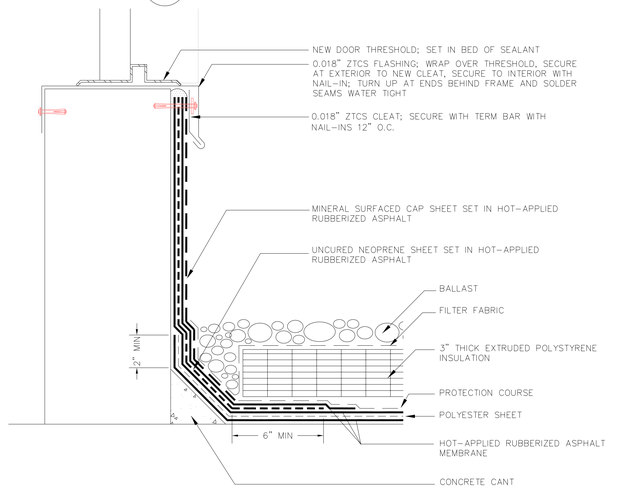
5 A2-201 PENTHOUSE FLASHING AT SIDING
3" = 1'-0"



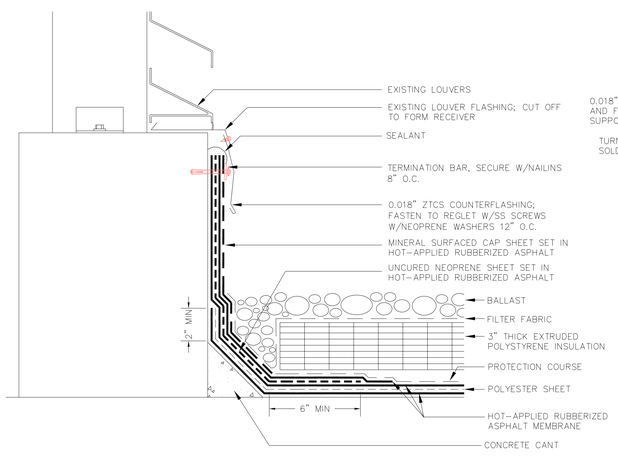
6 A2-201 PENTHOUSE FLASHING DETAIL
3" = 1'-0"



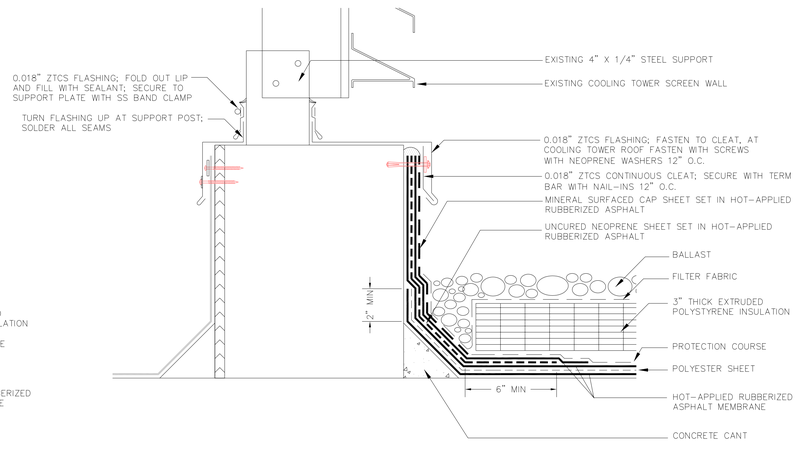
7 A2-201 PENTHOUSE FLASHING DETAIL
3" = 1'-0"



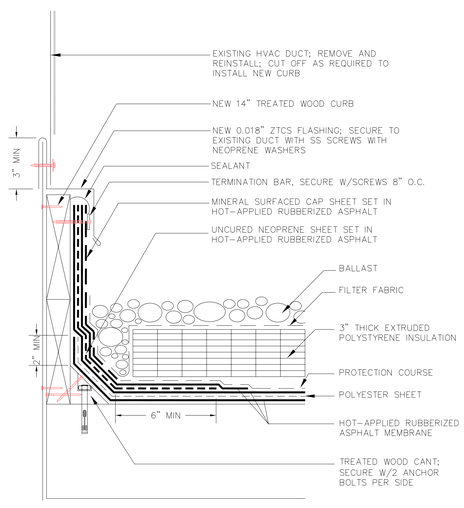
8 A2-201 DOOR THRESHOLD DETAIL
3" = 1'-0"



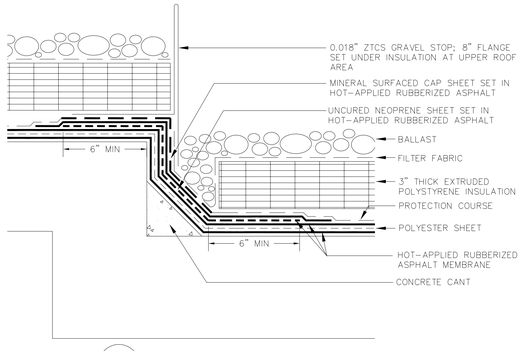
9 A2-201 LOUVER FLASHING DETAIL
3" = 1'-0"



10 A2-201 DIVIDER CURB AT COOLING TOWER
3" = 1'-0"



11 A2-201 HVAC FLASHING DETAIL
3" = 1'-0"



12 A2-201 GRAVEL STOP DETAIL
3" = 1'-0"

DESIGNED RB					
DRAWN		05/10/2011	FINAL		
CHECKED	REVISION	DATE	DESCRIPTION	BY	APP.

CERTIFICATION

ROOF DETAILS

ARCHITECTURAL

REEVES CENTER FOR MUNICIPAL AFFAIRS
ENERGY CONSERVATION RETROFIT

2000 14TH STREET NW
WASHINGTON DC 20009

DRAWING NO.

A2-201

REGISTRATION NO.
DATE:

BELL Architects, PC
1228 9th Street
Washington, DC 20001

SEAL ENGINEERING
3323 Duke Street
Alexandria, VA 22314

ARCHITECT
DATE:

GOVERNMENT OF THE DISTRICT OF COLUMBIA
DEPARTMENT OF REAL ESTATE SERVICES

PROJECT NO. PL901C
BLDG NO. 00762
DATE: 05/10/2011
SHEET 4 OF 5

1"=10' 1"=20' 1"=30' 1"=40' 1"=50' 1"=100' 1"=200' 1"=400' 3"=1'-0" 1-1/2" = 1'-0" 1" = 1'-0" 3/4" = 1'-0" 1/2" = 1'-0" 3/8" = 1'-0" 1/4" = 1'-0" 3/16" = 1'-0" 1/8" = 1'-0" 3/32" = 1'-0" 1/16" = 1'-0"

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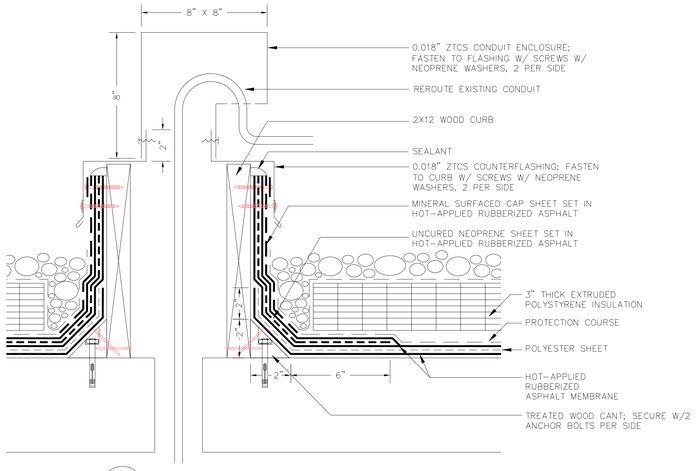
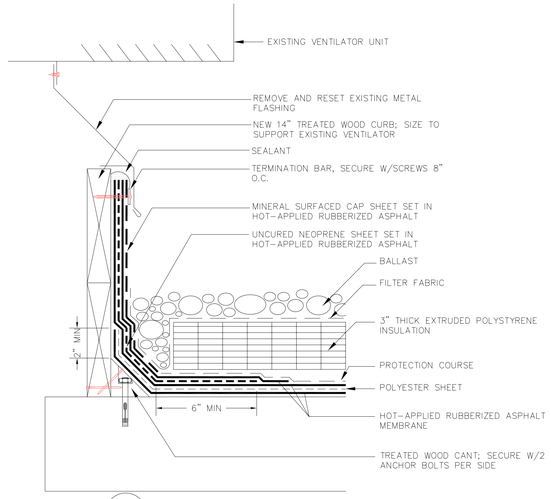
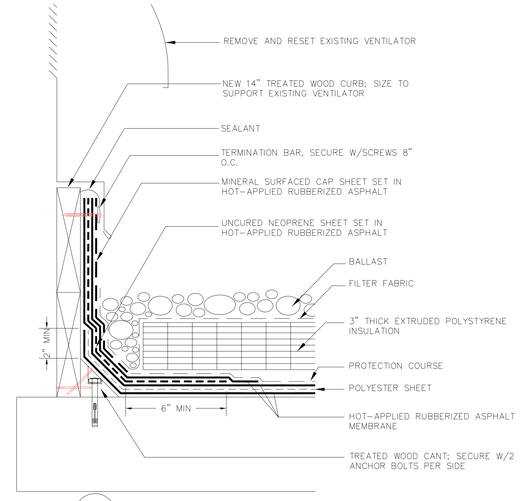


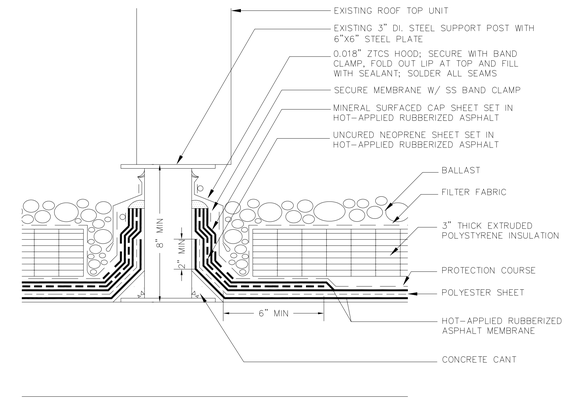
1 CONDUIT ENCLOSURE
A2-202 3" = 1'-0"



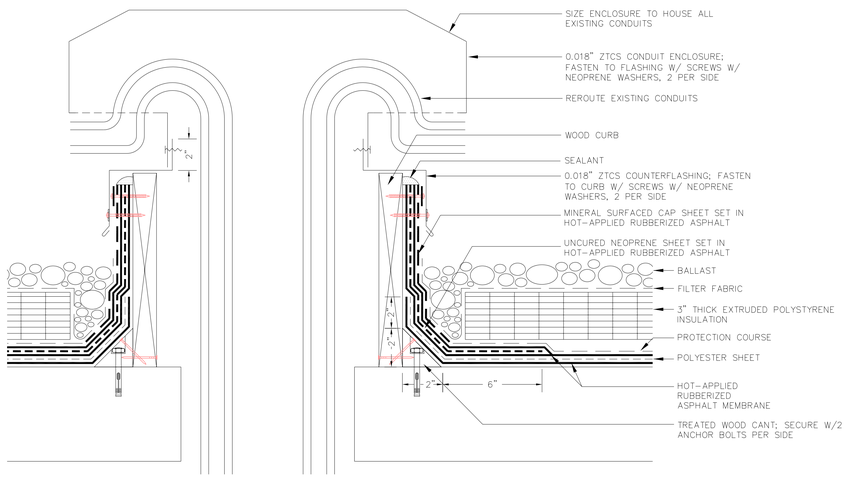
2 VENTILATOR DETAIL
A2-202 3" = 1'-0"



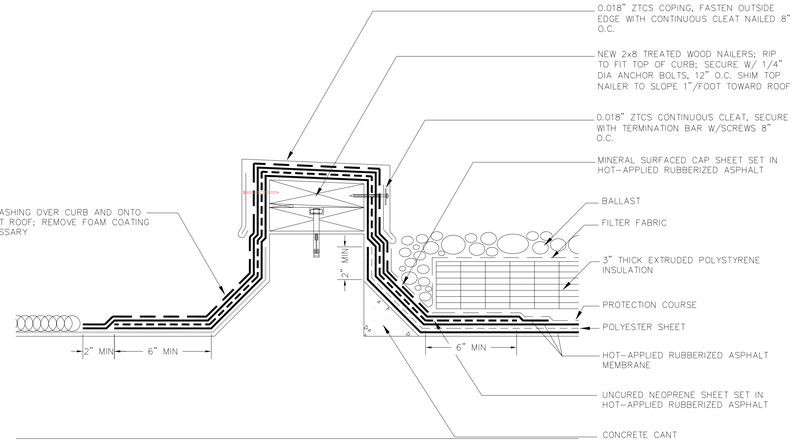
3 VENTILATOR DETAIL
A2-202 3" = 1'-0"



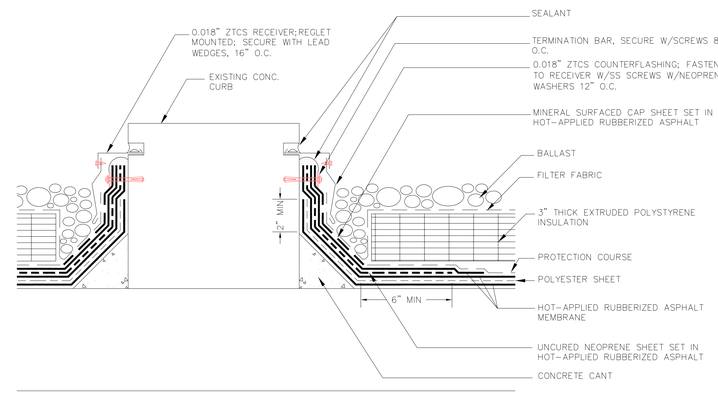
4 POST SUPPORT DETAIL
A2-202 3" = 1'-0"



5 CONDUIT ENCLOSURE
A2-202 3" = 1'-0"



6 ROOF 7 DIVIDER CURB DETAIL
A2-202 3" = 1'-0"



7 CONCRETE EQUIPMENT CURB DETAIL
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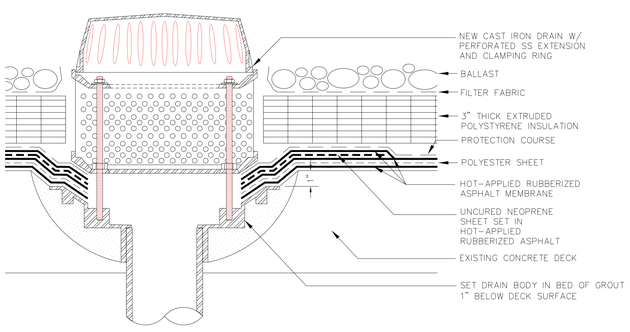

8 DRAIN DETAIL
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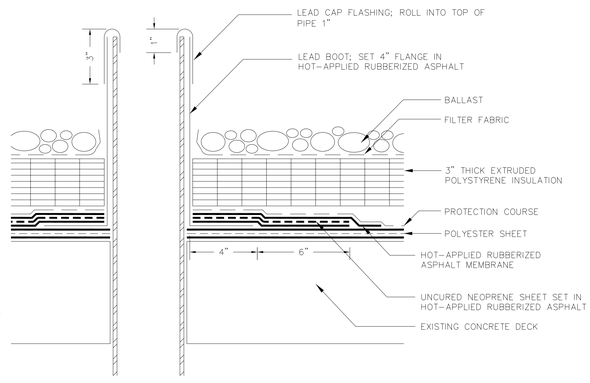
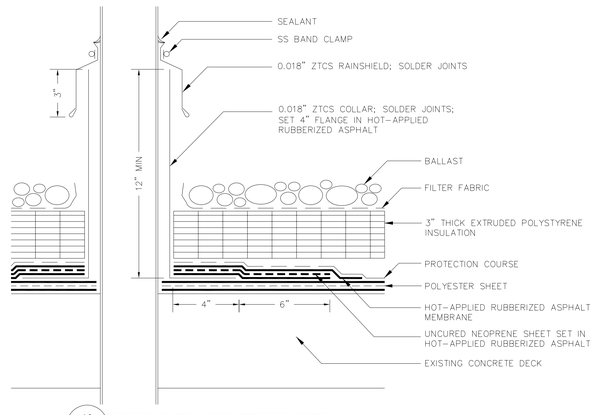


9 VENT PIPE DETAIL
A2-202 3" = 1'-0"



10 PIPE/CONDUIT/FLUE PENETRATION DETAIL
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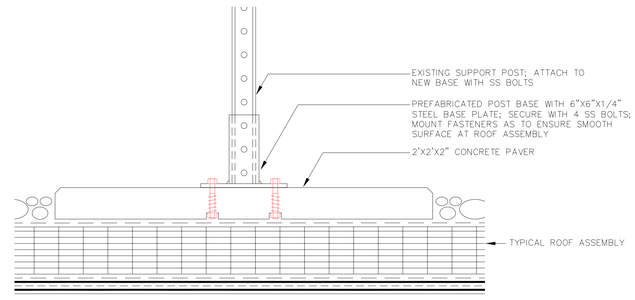

11 PAVER MOUNTED SUPPORT
A2-202 3" = 1'-0"

DESIGNED RB					
DRAWN		05/10/2011	FINAL		
CHECKED	REVISION	DATE	DESCRIPTION	BY	APP.

CERTIFICATION

ROOF DETAILS

ARCHITECTURAL

REEVES CENTER FOR MUNICIPAL AFFAIRS
ENERGY CONSERVATION RETROFIT

2000 14TH STREET NW
WASHINGTON DC 20009

DRAWING NO.

A2-202

REGISTRATION NO.
DATE:

BELL Architects, PC
1228 9th Street
Washington, DC 20001

SEAL ENGINEERING
3323 Duke Street
Alexandria, VA 22314

PROJECT NO. PL901C
BLDG NO. 00762

ARCHITECT
DATE:

GOVERNMENT OF THE DISTRICT OF COLUMBIA
DEPARTMENT OF REAL ESTATE SERVICES

DATE: 05/10/2011

SHEET 5 OF 5

1"=10' | 1"=20' | 1"=30' | 1"=40' | 1"=50' | 1"=100' | 1"=200' | 1"=400' | 3"=1'-0" | 1-1/2" = 1'-0" | 1" = 1'-0" | 3/4" = 1'-0" | 1/2" = 1'-0" | 3/8" = 1'-0" | 1/4" = 1'-0" | 3/16" = 1'-0" | 1/8" = 1'-0" | 3/32" = 1'-0" | 1/16" = 1'-0"

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GOVERNMENT OF THE DISTRICT OF COLUMBIA

DEPARTMENT OF REAL ESTATE SERVICES

CONSTRUCTION DIVISION

SPECIFICATIONS

100% - Construction Document Submission
May 10, 2011

INVITATION NO.
DCAM-2011-B-0156

PROJECT NO: PL901C (DRES) 115-082 (BELL)

PROJECT NAME: Energy Conservation Retrofit at Reeves Center for Municipal Affairs

LOCATION: 2000 14th St NW Washington, DC 20009

BUILDING ID NO.: 00762

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015000	Temporary Facilities and Controls
015001	Construction and Safety Signs
016000	Product Requirements
017329	Cutting and Patching
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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Work covered by the Project.
2. Work under other contracts.
3. Use of premises.
4. Government's occupancy requirements.
5. Specification formats and conventions.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

Project Identification: RCMA - Energy Conservation Retrofit, Reeves Municipal Center, Project Number PL901C.

1. Project Location: 2000 14th Street NW, Washington, DC 20009.

B. Government: DC Government, Department of Real Estate Services (DRES)

1. Contracting Officer (CO): Diane Wooden, DC DRES, 2000 14th Street NW, 5th Floor, Washington, DC 20009.

2. Contracting Officer's Technical Representative (COTR): Hares Sayed, DCDRES, CCSA 2000 14th Street, NW 8th Floor, Washington, DC 20009, (202) 841-6269 hares.sayed@dc.gov.

C. Architect: BELL Architects, PC, 1228 9th Street NW, Washington, DC 20001, tel. (202) 548-7570.

D. MEP Engineer: Vanderweil Engineers, 625 N. Washington Street, Alexandria, VA 22314, tel. (703) 683-9700.

E. The Work consists of the following:

1. The Work includes retrofits throughout the building, including:
   a. Roofing replacement.
   b. Vegetated roof and associated maintenance.
   c. New entry vestibule (Deductive alternative).

F. Solicitation Requirements: The Project shall be bid and work will be performed by the DC Government Department of Real Estate Services. Work of the Project shall comply with all requirements contained in the Solicitation.

G. Project will be constructed under a single prime construction contract.

H. Phased Work: Because the facility will remain occupied and in operation during construction, the Work will be conducted in phases to be coordinated with COTR. The Contractor shall prepare a Phasing Plan to facilitate coordination with COTR. See Section 013300 "Submittal Procedures."

1.3 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.4 HAZARDOUS MATERIALS

A. General: It is not known whether hazardous materials may be present in areas affected by construction. If hazardous materials are encountered during construction, do not disturb. Cease work in the affected area and inform COTR immediately. DC government will arrange remediation of hazardous materials under a separate contract.

1.5 USE OF PREMISES

A. General: The premises are to remain in operation and open to staff and the public during the duration of the Project. Contractor's use of premises for construction operations, including use of Project site, during construction period, shall be governed by provisions of Division 01 Sections "Work Restrictions" and "Temporary Facilities and Controls," and by Contract limits as indicated on drawings.

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. Government Occupancy: Allow for Government occupancy of Project site and use by staff and the public.

2. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Government, Government's employees, occupants 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.

C. Use of Existing Building: Maintain existing building in a weather-tight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.6 GOVERNMENT'S OCCUPANCY REQUIREMENTS

A. Full Government Occupancy: Government will occupy site and existing building during entire construction period. Cooperate with Government during construction operations to minimize conflicts and facilitate Government usage. Perform the Work so as not to interfere with Government'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 COTR and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to COTR of activities that will affect Government's operations.

1.7 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 21-division format and CSI/CSC's "MasterFormat" numbering system (1 through 14, 22, 23, 26, 28, 31, 32 and 33).

1. Division 01: Sections in Division 01 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 011400 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 CONTRACTOR USE OF PREMISES

A. The premises are to remain in operation and open to staff and the public during the entire period of construction. The Contracting Officer, COTR or his designated representative will conduct a pre-construction survey with the Contractor to review and document conditions surrounding the project premises prior to the beginning of construction activity.

B. Cooperate with the Government's representatives during construction operations to minimize conflicts and facilitate Government usage. Perform the Work in a manner that does not interfere with the Government's operations. Contractor is to prepare a Phasing Plan to coordinate phasing with COTR. A Phasing Schedule will be formulated to govern scheduling of phases of the Work.

C. The Contractor shall limit use of the premises to the work in areas indicated, to allow for Government occupancy and public use.

1. Confine operations at the site to areas indicated. Do not disturb portions of the site beyond the areas in which Work is indicated.
2. Keep driveways and entrances serving the premises clear and available at all times to the Government, Government employees, users and visitors. Do not use these areas for parking or storage of materials.
3. Schedule deliveries to minimize space and time requirements for storage of material and equipment on site.
4. Maintain existing building in a safe and weather-tight condition throughout the construction period. Repair damage caused by construction operations. Take precautions to protect the building, its occupants and the public during the construction period.
5. Keep public areas, such as hallways, stairs, lobbies and toilet rooms, free from accumulation of waste material, rubbish, construction debris and construction materials.
6. Limited space on the premises will be made available for the Contractor's storage and related activities, provided that its use will not interfere with operations of the Government. Arrange and gain approval for use of this space through the COTR and Facilities Manager.
7. Existing materials and equipment that are removed as part of the construction operations, and that are not reused or designated to be salvaged as Government or other's property, shall become the property of the Contractor and shall be removed from the site. Storage or sale of excess salvageable materials and equipment is not permitted on site.

8. Pollution producing equipment shall not be located near air intakes where airborne smoke or fumes could be drawn into the building.
9. No parking will be available on site during working hours of the building occupants. The Contractor and Contractor's employees shall make their own arrangements for vehicle parking off site.

D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify COTR not less than 72 hours in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without COTR's written permission.

1.3 WORKING HOURS

A. Government Occupied Hours: The building is occupied by staff during normal working hours. Construction operations shall be limited as determined by and coordinated with the COTR. Contractor is to coordinate with the COTR for access to the building.

B. Option for Weekend Work: Contractor shall have the option of conducting construction during weekend hours when the building is not occupied, subject to advance approval in writing by COTR. Notify COTR in writing a minimum of 72 hours in advance to request approval for weekend work hours, stating proposed hours. Any off hour work shall be performed at no additional expense to the DC Government.

C. Local neighborhood Noise Control Ordinances apply. Contractor shall notify Authorities of operations that may produce noise or other disturbance, and obtain approvals at least 72 hours before commencing with such operations.

D. Construction activity that produces high noise levels, such as core drilling or similar operations, shall, in addition to observance of paragraph B above, be coordinated in advance with the Contracting Officer or his representative. Construction noise must be kept below 90 decibels during regular weekday business hours when building is fully occupied.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 011400

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

1.3 DEFINITIONS

A. Unit price: A price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased. The price includes all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

1.4 PROCEDURES

A. General: Provide unit prices on the Bid Form, or if not included on Bid Form attach the schedule at the end of this section to the Bid Form, with prices per unit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. Schedule of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No.1 – Provide unit price to install pre-planted tray vegetated roofing system complete including associated edging, in lieu of ballast.
   1. Unit of Measure: 50 pre-planted vegetated roof trays

B. Unit Price No.2 – Provide unit price to install ballast, in lieu of pre-planted vegetated roofing system.
   1. Unit of Measure: One Square (100 square feet)

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

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

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate the alternate into the Work. No other adjustments are made to the Contract Sum.

B. Add Alternate: An item which will be an addition to the Scope of Work and added to the Base Bid amount if the Government decides it will be necessary to complete the Work. The cost is the net addition to the Contract sum to incorporate the Alternate into the Work.

C. Deduct Alternate: An item which will be taken out of the Scope of Work and deducted from the Base Bid amount if the Government decides it will not be necessary to complete the Work. The credit is the net deduction from the Contract sum to incorporate the Alternate into the Work.

1.4 PROCEDURES

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

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

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or

deferred for later consideration. Include a complete description of negotiated modifications to alternates.

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Deduct Alternate No. 1: Under this alternate, provide pricing to delete in Section B, “Schedule for Construction, Alterations, Repair, Price” section of the solicitation document. This price should be self standing and will consider all labor, materials, equipment, bond, insurance, profit and overhead of the contractor, so that the Contracting Officer can add or delete this deduct alternate portion without any other adjustment to the bidding price.

END OF SECTION 012300

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination drawings.
2. Requests for Information (RFIs).
3. Project Web site.
4. Project meetings.

B. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 DEFINITIONS

A. RFI: Request from Owner, Construction Manager or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

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

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

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility.

1.6 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect and Construction Manager.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: Software-generated form from Prolog system

D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow 7 working days for Architect's response for each RFI. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:

   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for coordination information already indicated in the Contract Documents.
   d. Requests for adjustments in the Contract Time or the Contract Sum.
   e. Requests for interpretation of Architect's actions on submittals.
   f. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software Prolog that is part of Project Web site. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect and Construction Manager.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's and Construction Manager's response was received.

F. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within 7 days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.7 PROJECT WEB SITE

A. Use Owner's Project Web site, Prolog, for purposes of hosting and managing project communication and documentation until Final Completion. Project Web site shall include the following functions:

1. Project directory.
2. Project correspondence.
3. Meeting minutes.
4. Contract modifications forms and logs.
5. RFI forms and logs.
6. Task and issue management.
7. Photo documentation.
8. Schedule and calendar management.
9. Submittals forms and logs.
10. Payment application forms.
11. Drawing and specification document hosting, viewing, and updating.
12. Online document collaboration.
13. Reminder and tracking functions.
14. Archiving functions.

B. On completion of Project, provide 1 complete archive copy of Project Web site files to Owner and to Architect in a digital storage format acceptable to Architect.

C. Provide the following Project Web site software packages under their current published licensing agreements:
1. Meridian Systems, Prolog

1.8 PROJECT MEETINGS

A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner**,** Construction Manager, and Architect, within 3 days of the meeting.

B. Preconstruction Conference: Owner will Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner, Construction Manager and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference.

Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress, including the following:

   a. Tentative construction schedule.
   b. Phasing.
   c. Critical work sequencing and long-lead items.
   d. Designation of key personnel and their duties.
   e. Procedures for processing field decisions and Change Orders.
   f. Procedures for RFIs.
   g. Procedures for testing and inspecting.
   h. Procedures for processing Applications for Payment.
   i. Distribution of the Contract Documents.
   j. Submittal procedures.
   k. Preparation of record documents.
   l. Use of the premises and existing building.
   m. Work restrictions.
   n. Working hours.
   o. Owner's occupancy requirements.
   p. Responsibility for temporary facilities and controls.
   q. Procedures for moisture and mold control.
   r. Procedures for disruptions and shutdowns.
   s. Construction waste management and recycling.
   t. Parking availability.
   u. Office, work, and storage areas.
   v. Equipment deliveries and priorities.
   w. First aid.
   x. Security.
   y. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

   a. Contract Documents.
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.

f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility problems.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Construction Manager will conduct progress meetings at weekly intervals.

1. Attendees: In addition to representatives of Owner**,** Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of proposal requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Related Sections:
   1. Division 01 Section “Product Requirements” for procedures and submittals required for requesting substitutions of products, equipment or construction contained in the Specifications.

B. This Section includes certain administrative and procedural requirements for shop drawings, coordination drawings, schedules, samples and certain other quality assurance submittals. The requirements of this section are in addition to those specified in SPECIAL STIPULATIONS, SECTION 1.3, Article entitled “Submittals”, and shall not be construed as justification for deviation from the requirements listed therein.

C. This section does not include requirements for the following submittals:
   1. Closeout submittals specified in Division 1 Section "Closeout Procedures."
   2. Record documents specified in SPECIAL STIPULATIONS, SECTION 1.3, Article entitled “Preparation of As-Built Drawings”.
   3. Reports, schedules and other submittals specified in SPECIAL STIPULATIONS, SECTION 1.3, Article entitled “Photographs.”

D. For clarity purposes, shop drawings, coordination drawings and schedules are further categorized as follows:

   1. Shop drawings include drawings and schedules specifically prepared for the project, except for coordination drawings.
   2. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

      a. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

         1) Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
         2) Indicate required installation sequences.

b. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to COTR for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

E. Product data includes manufacturer's standard catalogs, pamphlets and other printed materials, and includes but is not limited to the following:

a. Product specifications.
b. Installation instructions.
c. Color charts.
d. Catalog cuts.
e. Rough-in diagrams and templates.
f. Wiring diagrams.
g. Performance curves.
h. Operational range diagrams.
i. Mill reports.

F. Samples may include samples of such scale to allow delivery for review, as well as field samples or mock-ups of full-size physical examples erected on-site or elsewhere, to establish a true-scale standard by which the corresponding work will be judged or a standard for compliance testing.

G. Other quality assurance submittals include materials specifically prepared for the project, except drawings and schedules, and include but are not limited to the following:

1. Design data and calculations.
2. Certifications of compliance or conformance.
3. Manufacturer's instructions and field reports.
4. Test reports.

H. Paper and Electronic Submittals: Submit shop drawings, product data, schedules and quality assurance submittals in six (6) paper copies and one electronic copy, by Adobe Acrobat PDF or other mutually agreed upon format. Each submittal file shall be organized as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

a. Submittal shall be identified by Specification Section number followed by a hyphen and then a sequential submittal number for that Section (e.g., 061000-1). Resubmittals shall include a second hyphen followed by a sequential number identifying the resubmittal (e.g., 061000-1-2, 061000-1-3, etc.).

3. Provide means to permanently record Contractor’s review and approval markings and certification by Contractor stating that submittal complies with the Contract Documents, or statement of deviations from the requirements of the Contract Documents including

minor variations and limitations. Deviations may be listed on an attached sheet referenced on the transmittal form.

4. Provide means for insertion to permanently record action taken by COTR or COTR's designated reviewer.

5. Transmittal Form for Submittals: Use electronic form acceptable to COTR**,** containing the following information:

   a. Project name.
   b. Date.
   c. Submittal number, including designation if resubmittal and number.
   d. Name and address of Architect.
   e. Name of Construction Manager.
   f. Name of Contractor.
   g. Name of firm or entity that prepared submittal.
   h. Names of subcontractor, manufacturer, and supplier.
   i. Category and type of submittal.
   j. Submittal purpose and description.
   k. Specification Section number and title.
   l. Specification paragraph number or drawing designation and generic name for each of multiple items.
   m. Drawing number and detail references, as appropriate.
   n. Location(s) where product is to be installed, as appropriate.
   o. Related physical samples submitted directly.
   p. Indication of full or partial submittal.
   q. Transmittal number, numbered consecutively.
   r. Submittal and transmittal distribution record.
   s. Other necessary identification.
   t. Remarks.

I. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on A/E's receipt of submittal. Review time for submittals received after 1:00 p.m. shall commence on the following day.

1. Initial Review: Allow 5 work days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. COTR will advise Contractor when submittal being processed must be delayed for coordination.

2. Concurrent Review: Where concurrent review of submittals by COTR's consultants, Contracting Officer, or other parties is required, allow 5 work days for initial review of each submittal.

3. If intermediate submittal is necessary, process in same manner as initial submittal.

   a. Allow 5 work days for processing each resubmittal

1.3 PHASING PLAN

A. Within five days of Notice to Proceed, submit a Phasing Plan to COTR outlining proposed phases of work to allow normal building operations to continue during construction period. Plan will be used as basis for coordination with COTR for a schedule of phases governing progress of the work.

B. When phases are determined, submit a Phasing Schedule to COTR for approval.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial CPM (Critical Path Method) schedule within 7 calendar days after receiving the Notice to Proceed. After review, resubmit required revised data within 3 days. Schedule shall be submitted in five (5) hard copies and CD-ROM's. Schedule shall comply with requirements set forth in Bid Solicitation.

B. Submit revised Progress Schedules with each Application for Payment.

C. Distribute copies of reviewed schedules to COTR, Project site file, subcontractors, suppliers, and other concerned parties.

D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

E. Submit computer generated horizontal bar chart with separate line for each major portion of Work or operation, identifying first work day of each week.

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

G. Indicate estimated percentage of completion for each item of Work at each submission.

H. Revisions To Schedules:
   1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
   2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
   3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including effect of changes on schedules of separate contractors.

1.5 SUBMITTALS SCHEDULE

A. No later than 7 calendar days after Notice to Proceed, submit a Submittals Schedule in six (6) paper copies and CD-ROM's to COTR. Submittal schedule shall be submitted concurrently with CPM construction schedules. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for COTR's final release or approval.

1.6 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit through COTR an RFI in the form specified.

1. COTR will return RFIs submitted by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Contractor shall compensate the Government for the Architect’s, Engineers and/or Construction Manager’s time, materials and expenses to process frivolous RFIs, resulting from the Contractor’s actions such as:

1. Contractor’s lack of studying the Contract Documents;
2. Contractor’s lack of coordinating their own Work and the Work of their subcontractors;
3. Contractor’s repeating previous RFIs.

C. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. RFI number, numbered sequentially.
6. RFI subject.
7. Specification Section number and title and related paragraphs, as appropriate.
8. Drawing number and detail references, as appropriate.
9. Field dimensions and conditions, as appropriate.
10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
11. Contractor's signature.
12. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

D. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to COTR.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. COTR's Action: COTR or his designated representative will review each RFI, determine action required, and respond. Allow seven (7) working days for response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. COTR or designated representative’s action may include a request for additional information, in which case time for response will date from time of receipt of additional information.
3. COTR action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal.

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify COTR in writing within 10 days of receipt of the RFI response and before putting the response into effect.

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log at regular progress meetings. Software log shall include the following:

1. Project name.
2. Name and address of Contractor.
3. RFI number including RFIs that were returned without action or withdrawn.
4. RFI description.
5. Date the RFI was submitted.
6. Date COTR’s response was received.

G. On receipt of COTR’s action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify COTR within seven days if Contractor disagrees with response.

1. Include identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Include identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.7 FRONT-END SUBMITTALS

A. Supervisory Names: Concurrent with submission of Construction Schedule and Submittal Schedules, submit list of key supervisory personnel for Project and major subcontracts. Submittal shall include list of qualifications, including experience in recent projects of similar nature. Submittal shall also designate and certify supervisory personnel that will be present at job site at all times when work is in progress.

1.8 GENERAL SUBMITTAL REQUIREMENTS

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities and with the Submittal Schedule specified above Submittals shall be transmitted to the Contracting Officer's designated representative within 7 calendar days after receipt of notice to proceed, unless the approved Submittal Schedule specifically provides for a later submission. Transmit each submittal sufficiently in advance of the scheduled performance of related construction activities to avoid delaying the Work, allowing for the review times specified for submittals in Division 1 Section "Construction Progress Documentation" and elsewhere in the Contract documents.

1. Coordinate each submittal with other submittals and related activities that require sequential scheduling, to allow for testing, purchase, fabrication and product delivery in a timely manner.
2. Schedule transmittal of different categories of submittals for the same element of Work and for different elements of related parts of the Work at the same time.
3. Allow sufficient time for submittal review, corrections following the initial review and resubmittal review before activities scheduled after the submittal approval.
4. Any resubmission required after Government review shall be made within 3 calendar days after return of the submittal, unless specifically authorized otherwise by the Contracting Officer.
5. Submittals which are determined to be incomplete or otherwise substandard will be returned to the Contractor with no further review. Delays due to incomplete or rejected submittals will not be excused.
6. Construction will not be allowed to proceed if submittals are not received in a timely manner. Failure by the Contractor to provide the required submittals in a timely manner will not result in an extension to the Contractor's Construction Schedule.
7. Failure by the Contractor to provide the required submittals in a timely manner may result in progress payment requests being returned to the Contractor until submittals are up-to-date.

B. Submittal Preparation: Identify and prepare drawings and samples as specified in the Construction Contract Clauses. Minimally include the following on a permanent label for other submittals:

1. Project name and number.
2. Date.
3. Name, address and telephone number of firm or entity that prepared the submittal.
4. Name and address of the Contractor.
5. Name of the manufacturer.
6. Number and title of appropriate specification section.

7. Drawing number and detail references, as appropriate.
8. Space to record Contractor's review and approval markings, and for Contracting Officer's or Contraction Officer's Representative's action; approximately 5 by 5 inches (250 by 250 mm).

C. Submittal Transmittal: Transmit each submittal from the Contractor to the Contracting Officer or Contracting Officer's representative electronically by use of a transmittal form as described in Paragraph 1.2H above.

1.9 SHOP DRAWINGS AND COORDINATION DRAWINGS

A. Submit originally prepared information, drawn accurately to scale. Do not reproduce Contract Documents or copy standard printed materials as the basis for Shop Drawings and Coordination Drawings.

B. Minimally include the following information on Shop Drawings and Coordination Drawings:

1. Dimensions.
2. Identification of products and materials.
3. Compliance with specified standards.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurements, if any.
6. Highlighted or encircled deviations from the Contract Documents, if any.

C. Sheet size: Except for templates, patterns and similar full-size drawings, submit Shop Drawings and Coordination Drawings in format of at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (750 by 1000 mm).

D. Distribution: When submittal is approved, Contractor shall prepare final blue-line or black-line print copies from the approved reproducible print, for the following purposes.

1. One print shall be marked and retained as a "Record Document."
2. Unless otherwise requested, two prints shall be provided to the Contracting Officer.
3. Additional prints shall be provided to the entities involved in the effected construction.

1.10 PRODUCT DATA

A. Collect Product Data into a single submittal for each system or element of construction. Mark copy to show specific product choices and options applicable to the project. Product Data shall include the following information, where applicable:

1. Manufacturer's printed recommendations.
2. Compliance with recognized trade association standards.
3. Compliance with recognized testing standards.
4. Applicability of testing agency labels and seals.
5. Notation of dimensions verified for fit by field measurements.
6. Notation of coordination requirements.

B. Preliminary Submittal: Prior to submittal of complete Product Data, submit a preliminary single copy of that part of Product Data when selection of options is required, such as for color charts. Preliminary submittal will be returned, with selection noted, for the Contractor's use in subsequent submittals.

C. Submittals: Unless otherwise indicated, submit not less than six copies of each Product Data submittal. Two copies will be retained, and the remaining copies will be marked with action taken and returned.

D. Distribution: When submittal is approved, Contractor shall distribute approved copies for the following purposes:

1. One copy shall be marked and retained as a "Record Document."
2. Additional copies shall be provided to the manufacturers, subcontractors, suppliers, installers, governing authorities and others as required for performance of the applicable construction activities.

1.11 SAMPLES

A. Submit full-size, fully fabricated samples, cured and finished in the manner specified. Samples shall be physically identical to the material or product proposed for use.

B. Mount, display, or package samples to facilitate review of kind, color, pattern, texture and other qualities indicated, as a final check of these characteristics with other elements and for comparison of these characteristics with those of the actual component delivered and installed.

C. Where variation in color, pattern, texture or other characteristic is inherent in the material or product, submit at least 3 multiple units that show approximate limits of the variations.

D. Refer to other specification sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operations and similar construction characteristics.

E. Refer to other specification sections for samples to be returned to the Contractor for incorporation in the Work. Such samples must be in undamaged condition at time of use.

F. Preliminary Submittal: Where color, pattern, texture or similar characteristics are specified to be selected from a manufacturer's range of standard choices, submit a preliminary single set sample of available choices prior to submittal of the complete sample. Preliminary submittal will be returned, with selection noted, for the Contractor's use in subsequent submittals.

G. Submittals: Unless otherwise indicated and except for field samples or mock-ups of full-size physical examples erected on-site or elsewhere, submit not less than the number of sets of each sample submittal designated in SPECIAL STIPULATIONS, SECTION 1.3, Article entitled “Submittals”. Comply with requirements in the individual specification section for field samples and mockups.

H. Distribution: Except for field samples or mockups, when submittal is approved, Contractor shall distribute approved copies designated in SPECIAL STIPULATIONS, SECTION 1.3, Article entitled “Submittals”.

1.12 OTHER QUALITY ASSURANCE SUBMITTALS

A. Submit other quality assurance submittals in compliance with requirements in the individual specification sections.

B. Certifications: Submit notarized certifications from the party certifying compliance with specified requirements. Certifications shall be signed by an officer or other individual authorized to sign documents on behalf of the company certifying compliance.

1.13 REVIEW ACTION ON SUBMITTALS

A. Except for submittals for the record or for information or for another purpose where no action and return is required, the Contracting Officer or the Contracting Officer's authorized representative will review submittals and mark returned copies to indicate action taken.

B. Compliance with specified characteristics is the Contractor's responsibility, and is not part of the Contracting Officer's review and indication of action taken. No matter what review action is taken, final acceptance will depend on full compliance with the Contract Documents.

C. Submittals that do not contain an appropriate marking of approval by the Contracting Officer or Contracting Officer's representative shall not be used for construction.

D. Action Stamp: Each submittal will be stamped with a uniform action stamp. The stamp shall be marked to indicate one of the following actions taken:

1. Final Unrestricted Release: Where marked "No Exception", the work covered by the submittal may proceed, provided it complies with the requirements of the Contract Documents.
2. Final But Restricted Release: Where marked "Exceptions As Noted", the work covered by the submittal may proceed, provided it complies with the notations or corrections on the submittal and with the requirements of the Contract Documents.
3. Return for Resubmittal: Where marked "Revise and Resubmit", do not proceed with the work covered by the submittal, including purchasing, fabrication, delivery or any other activity. Revise or prepare a new submittal according to the notations on the submittal or on the return transmittal. Resubmit without delay, repeating as necessary to obtain a final release action mark.
4. No Action: Where a submittal is for the record or for information or for another purpose not requiring review action, the submittal may not be returned or may be returned and marked "Action Not Required."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 013300

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:

1. Division 01 Sections “Summary” and "Work Restrictions" for government occupancy during construction, limitations on utility interruptions and other work restrictions.
2. Division 01 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
3. Division 01 Section “Construction and Safety Signs” for construction and safety signs.
4. Divisions 03 through 32 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 PROJECT CONDITIONS

A. Security: Insertion of temporary barriers at openings, and/or possible use of scaffolds, can result in increased danger of unauthorized access to portions of the building. The Contractor shall be responsible for ensuring security of the site at all times, by means of temporary enclosures or other security methods, to prevent break-ins and other unauthorized access to work areas or other portions of the building.

1. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide COTR with one set of keys for any temporary locks not part of existing building or not provided by Government.

B. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances where needed to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

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

D. Covered Walkway: The public will have access to the building during construction. Erect structurally adequate, protective, covered walkway for passage of individuals to and from the

building entrances on an as-needed basis during periods when construction operations could create hazards in these areas. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.

1. Construct covered walkways using scaffold or shoring framing.
2. Provide wood-plank overhead decking, warning signs, safe and well-drained walkways, and similar provisions for protection and safe passage.

E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weather-tight enclosure for building exterior as needed.

F. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Government and public from fumes and noise.

1. Protect air-handling equipment.

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

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities, if required, shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Government's construction forces**,** Architect, occupants of Project**,** testing agencies, and authorities having jurisdiction.

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

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

1.5 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, and staging and storage areas.

1.6 QUALITY ASSURANCE

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

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber and Plywood: Contractor to provide necessary materials to erect temporary facilities and controls.

2.2 TEMPORARY FACILITIES

A. Field Office: The Government will provide space in the building for a temporary field office for the Contractor. Contractor is to provide all necessary communications facilities as detailed in Section 3.2. Contractor is to post in temporary office a list of all key supervisory personnel for project that shall include contact information during working and non-working hours.

B. Storage and Fabrication Enclosures: Where needed, provide enclosures sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Storage of combustible materials not permitted inside building.

2.3 EQUIPMENT

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

3.2 TEMPORARY UTILITY INSTALLATION

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

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

B. Water Service: Use of Government's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to COTR. At Substantial Completion, restore these facilities to condition existing before initial use.

1. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.

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

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

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

E. Electric Power Service: Use of Government's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to COTR.

F. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Provide a dedicated telephone line for each facsimile machine and computer in field office.

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

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to COTR.

2. Provide dust-control treatment that is nonpolluting and non-tracking. Reapply treatment as required to minimize dust.

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

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

C. Project Identification and Temporary Signs: Provide Project identification and other signs as required. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.

1. Provide temporary, directional signs for construction personnel and visitors.
2. Maintain and touchup signs so they are legible at all times.

D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

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

1. Devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

F. Existing Stair and Elevator Usage: Use of existing stairs and elevators will be permitted, as long as cleaned and maintained in a condition acceptable to COTR. Coordinate usage with COTR and building Facilities Manager. At Substantial Completion, restore stairs and elevators to condition existing before initial use.

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

3.4 PROTECTION FACILITIES INSTALLATION

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

B. Temporary Erosion and Sedimentation Control: If required, comply with requirements of authorities having jurisdiction.

1. Ensure soil, nutrients, debris, sediment and other foreign materials from roof are controlled and do not go into roof drains or storm water system.

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

3.5 OPERATION, TERMINATION, AND REMOVAL

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

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

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

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

1. Materials and facilities that constitute temporary facilities are property of Contractor.
2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 1 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 015001 – CONSTRUCTION AND SAFETY SIGNS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Documents referred to in Paragraph 1, SCOPE of SPECIAL CONDITIONS, are part hereof, the same as if repeated herein.

B. The Contractor shall furnish and erect a construction sign and a safety sign on the site of the Project, as soon as practicable after commencement of the Work, where directed by the Contracting Officer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber shall conform to Fed. Spec. MM-L-751 H, sized and shaped as shown.

B. Plywood shall conform to U.S. Product Standard PS I-74 Exterior Type, AA or overlay surface.

C. Paint shall conform to the following Federal Specification:
   1. For priming, TT-P-25a.
   2. For finishing and lettering, TT-E-489.

PART 3 - EXECUTION

3.1 CONSTRUCTION SIGN

A. Provide minimum 3 foot high and 6 foot wide exterior site sign at main building entry.

B. Sign shall also display title of project, list agencies conducting or sponsoring the project, the A/E firms and Prime Contractor(s).

C. Agency conducting project: DC Department of Real Estate Services. Agencies sponsoring project: DC Department of Environment, US Department of Energy

D. Design/layout and installation shall be by contractor. Design shall be submitted for approval within two weeks of notice to proceed.

   1. All woodwork shall receive one (1) priming and one (1) finishing coat of paint.

   2. Paint supporting framework white; all other colors as noted on drawings in this section.

E. The Contractor shall maintain the sign in good condition for the duration of the Project.

END OF SECTION 015001

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project, including manufacturers' standard warranties on products and special warranties; and procedural and submittal requirements for substitution requests for products, materials, equipment or construction contained in the Specifications.

B. The following definitions are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms that are self-explanatory and have well-recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and other terms of similar intent.
2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
3. "Equipment" are products with operational parts, whether motorized or manually operated, and products that require service connections, such as wiring or piping.

1.3 SUBSTITUTIONS

A. Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:

1. Substitutions requested during the bidding period and accepted by Addendum prior to award of the Contract.
2. Revisions to the Contract Documents requested by the Contracting Officer.
3. Specified options for products and construction methods included in the Contract Documents.
4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

B. General: Substitutions are not normally allowed after award of Contract. Requests for substitutions will be considered after Contract award only when:

1. Specified product or method of construction cannot be provided within Contract Time by causes such as strikes, lockouts, or bankruptcy. COTR will not consider request if product or method cannot be provided as result of failure to pursue Work promptly or coordinate activities properly.

2. Subsequent information or changes indicate specified product will not perform as intended.

3. Specified product or method of construction cannot receive necessary approval by governing authority, and requested substitution can be approved.

4. Specified product or method of construction cannot be provided in manner that is compatible with other materials and where Contractor certifies that substitution will overcome incompatibility.

5. Specified product or method of construction cannot be coordinated with other materials and where Contractor certifies that proposed substitution can be coordinated.

6. Specified product or method of construction cannot provide warranty required by Contract Documents and where Contractor certifies that proposed substitution provides required warranty.

7. Unless one of above conditions applies, Government is not obligated to consider or approve any Contractor proposed substitution. COTR will determine whether Contractor's basis for proposing substitution is valid. If COTR finds Contractor's basis invalid, provide Work as specified in Contract Documents. COTRs decision will be treated as final.

C. Warranties: Standard and special warranties required by the individual sections of the Specifications shall provide guarantees in terms of time limits or rights of the Government in addition to those contained in the Construction Contract Clauses.

1. Standard product warranties shall be preprinted written warranties published by individual manufacturers for particular products, and shall be specifically endorsed to the Government by the manufacturer.
2. Special warranties shall be specifically written to incorporate particular requirements of the Contract Documents, and shall be endorsed to the Government by the entities responsible for the work, as stated in the individual section.

1.4 SUBMITTALS

A. Submittals shall comply with the requirements of the Construction Contract Clauses, Division 1 section "Submittal Procedures" and the individual sections specifying the work.

B. Substitution requests:

1. Submit six copies of each request for substitution. An electronically transmitted Adobe Acrobat PDF submission of the request and all supporting documents may be substituted for paper copies.

2. Identify the product or the fabrication or installation method to be replaced in each request. Include related specification section and Drawing numbers.

3. State the reason why a substitution is being requested.

4. Provide complete documentation including but not limited to the following information, as appropriate:
   a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by others that will be necessary to accommodate the proposed substitution.
   b. A detailed comparison of the significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include performance, weight, size, durability and visual effect.
   c. Test reports and manufacturer's certifications substantiating performance of the proposed substitution.
   d. Product data and drawings, including descriptions of products and fabrication and installation procedures.
   e. Samples, where applicable or requested.
   f. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
   g. Cost information, including a proposal of the net change, if any, in the Contract price.
   h. The Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.

5. Contracting Officer’s Action: If necessary, COTR will request additional information or documentation for evaluation within one week of receipt of request for substitution. COTR will notify Contractor of acceptance or rejection of substitution within two weeks of receipt of request, or one week of receipt of additional information or documentation, whichever is later. Acceptance will be in form of Change Order.
   a. COTR will not make exhaustive attempt to determine products proposed for substitution are equivalent to, or can be modified in order to be equivalent to specified products.
   b. Use product specified if COTR cannot make decision on use of proposed substitute within time allocated.
   c. If accepted by COTR, products proposed for substitution are accepted subject to modifications by manufacturer, if necessary, to meet detailed requirements of Drawings, and Specifications.

6. For Accepted Products: Submit shop drawings, product data, and samples in accordance with Section 013300.

7. Contractor’s submittal, and COTR’s acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with Contract Documents do not constitute acceptable or valid request for substitution, nor do they constitute approval

C. Submit written warranties to the Contracting Officer prior to the date for Project Completion, unless an earlier time of submission is specified elsewhere in the Contract Documents or requested by the Contracting Officer. When a designated portion of the Work is completed and occupied or used by the Government, by a separate agreement with the Contractor during the construction period, submit properly executed warranties within 15 days after completion of that designated portion of the Work.

1. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, provide a written document that contains the appropriate terms and identification, executed by the required parties.

2. Refer to Division 2 through 31 sections for specific content requirements and particular requirements for submitting special warranties.

1.5 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source. Equipment of the same function shall be manufactured by the same entity, unless otherwise indicated.

B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

C. Labels and nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on surfaces of products that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate nameplate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information:
   a. Name of product manufacturer.
   b. Model and serial numbers.
   c. Operating data such as capacity, speed and ratings.

3. Protection: Labels and nameplates shall be protected from defacement and other damage during the remainder of the Work.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

1. Schedule product delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to provide minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

3. Deliver products to the site in an undamaged condition, in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.

4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.

6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

7. Store products subject to damage by the elements above ground, under cover in a weather-tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT COMPLIANCE AND REQUIREMENTS

A. Provide products complete with accessories, trim, finish, safety guards, devices and other items needed for a complete installation and the intended use and effect. Where specified and available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: The Contract Documents, including the Construction Contract Clauses, govern product selection. Requirements for product selection include the following:

1. Where the Specifications lists manufacturers' names or product designations, the Contractor may provide any product that complies with the requirements, subject to the following conditions:
   a. Available Manufacturers: Where a Specification paragraph or subparagraph titled "Available Manufacturers" lists manufacturers' names, provide a compliant product by one of the manufacturers named or by another manufacturer.
   b. Products: Where a Specification paragraph or subparagraph titled "Products" lists product designations, provide one of the products designated, or request a Substitution of another compliant product.
   c. Available Products: Where a Specification paragraph or subparagraph titled "Available Products" lists product designations, provide one of the products designated or another compliant product.
   d. Basis of Design: Where a Specification paragraph or subparagraph titled "Basis of Design" includes a product designation, provide the product designated, or request a Substitution of another compliant product by one of the other manufacturers named, if any, or by another manufacturer.

2. Descriptive Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

3. Performance Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.

4. Prescriptive Requirements: Where Specifications require products that are produced using specified ingredients and components, including specific requirements for mixing, fabricating, curing, finishing, testing and similar operations in the manufacturing process, provide products produced in accordance with the prescriptive requirements that otherwise comply with Contract requirements.

5. Codes, Standards and Regulations: Where Specifications require compliance with an imposed code, standard or regulation; select a product that complies with the codes, standards or regulations specified.

6. Visual Matching: Where Specifications require matching an established Sample, the Contracting Officer's Representative's decision will be final on whether a proposed product matches satisfactorily. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions concerning "substitutions" for selections of a matching product in another product category.

7. Visual Selection: Where specified product requirements include the phrase "as selected from manufacturer's standard colors, patterns, textures .." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Contracting Officer's Representative will select the color, pattern and texture from the manufacturer's product line.

2.2 SUBSTITUTIONS

A. Conditions: The Contracting Officer will receive and consider the Contractor's request for substitution when one or more of the following conditions are satisfied. If the following conditions are not satisfied, the Contracting Officer will return the requests without action except to record noncompliance with these requirements.

1. Extensive revisions to the Contract Documents are not required.

2. Proposed changes are in keeping with the general intent of the Contract Documents.

3. The request is timely, fully documented, and properly submitted.

4. The specified product or method of construction cannot be provided within the Contract Time. The Contracting Officer will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

5. The requested substitution offers the Government a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Government must assume as a result of the substitution.

6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

7. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies that the substitution will overcome the incompatibility.

8. The specified product or method of construction cannot be coordinated with other materials and where the Contractor certifies that the proposed substitution can be coordinated.

9. Proposed equipment and materials are equal and equivalent with the equipment and materials of the contract document. The decision on "equal and equivalent" is the responsibility of COTR and COTR's decision is final.

10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.

B. The Contractor's submittal and the Contracting Officer's Representative's acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with Contract Documents do not constitute an acceptable or valid request for substitution, nor do they constitute approval.

C. Contractor shall compensate the Government for the Architect's, Engineers and/or Construction Manager's time, materials and expenses to review, evaluate and execute changes, resulting from the proposed Substitution, such as:

1. Evaluation of incomplete, inaccurate and poorly documented submittals;
2. Evaluation of any substitution, proposed after the Bidding Period, regardless of merit;
3. Required revisions to Contract Documents for substitutions accepted by COTR;
4. Resubmission of previously approved building permits and other regulatory approvals.

2.3 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work.

D. Rejection of Warranties: The Contracting Officer reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment for the Work or part of the Work, the Contracting Officer reserves the right to refuse to accept the Work in behalf of the Government until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 016000

SECTION 017239 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Definition: Cutting and patching includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and repair required to restore surfaces to their original condition.

C. Refer to other sections for other requirements and limitations applicable to cutting and patching individual parts of the Work.

D. Coordinate cutting and patching with demolition requirements specified in Division 02 Section "Selective Structure Demolition".

1.3 SUBMITTALS

A. Cutting and Patching Plan: Submit a proposal to the Contracting Officer's representative, describing procedures at least 7 calendar days in advance of the time cutting and patching will initially be performed.

1. Include the following information, as applicable:

a. Description of the extent of cutting and patching required. Show how it will be performed and indicate why it cannot be avoided.
b. Description of the anticipated results in terms of changes to existing construction. Include changes to structural elements and operating components as well as changes in appearance and other significant visual elements.
c. List of products to be used and entities that will perform work.
d. Dates and hours of operation when cutting and patching will be performed.
e. Compatibility and cohesion characteristics of patching compounds with adjacent materials.
f. Details and engineering calculations showing integration of reinforcement with the original structure, where cutting and patching involve adding reinforcement to structural elements.

2. Approval by the Contracting Officer or COTR to proceed with cutting and patching does not waive the right to later require complete removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

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

1. The cutting and patching plan shall include but not be necessarily limited to work required at the following structural elements:

a. Wall partitions.
b. Flooring.
c. Miscellaneous structural metals.
d. Structural decking.
e. Window framing.

B. Operational Limitations: Do not cut and patch operating elements, safety related systems, or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements, safety related systems or related components in a manner that would result in increased maintenance or decreased operational life or safety.

1. The cutting and patching plan shall include but not be necessarily limited to work required at the following operating elements or safety related systems:

a. Primary operational systems and equipment.
b. Water, moisture, or vapor barriers.
c. Membranes and flashings.
d. Heating, Ventilating and Air Conditioning systems.
e. Electrical wiring systems.
f. Communication systems.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the COTR’s opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction that is cut and patched in a visually unsatisfactorily manner.

1. Engage a Specialist who is specifically experienced in the work.

1.5 EXISTING WARRANTIES

A. Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to avoid any existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use materials identical to existing materials to the maximum extent available.

B. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

C. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

B. Before proceeding with cutting and patching involving two or more trades, meet at the Project site with the entities providing or affected by the cutting and patching. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

A. Provide temporary support of work to be cut.

B. Protect existing conditions during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

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

D. Bypass in-service existing pipe or conduit scheduled to be removed or relocated before cutting.

3.3 PERFORMANCE

A. Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

B. Cutting: Cut existing construction using methods least likely to damage elements retained and adjoining construction. Where possible, review proposed procedures with the original installer and comply with the original installer's recommendations.

1. In general, use hand or small power tools designed for sawing or grinding, not for hammering and chopping.
2. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
3. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
4. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
5. After utility services are bypassed, cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface that contains the patch after the area has received primer and other undercoats.

3.4 CLEANING

A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items.

B. Thoroughly clean piping, conduit, and similar features before applying paint, restored pipe coverings, or other finishing materials.

END OF SECTION 017239

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:
1. Section 024119 "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Facilitate recycling and salvage of materials

1.4 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.

1.5 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons (tonnes).
4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. LEED Submittal: LEED letter template for Credit MR 2 signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.

H. Qualification Data: For waste management coordinator.

1.6 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: LEED-Accredited Professional, certified by USGBC.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within seven days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Government's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Government.
4. Transport items to Government's storage area designated by COTR.
5. Protect items from damage during transport and storage.

3.3 RECYCLING, DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Government and Contractor.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Government's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum **4-inch (100-mm)** size.

B. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

C. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

E. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

F. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

G. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

H. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Government's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Inspection procedures.
2. Warranties.
3. Final cleaning.

B. Related Sections include the following:

1. SPECIAL STIPULATIONS, SECTION 1.3, Article entitled “Preparation of As-Built Drawings” for submitting Record Drawings, Record Specifications, and Record Product Data.
2. SPECIAL STIPULATIONS, SECTION 1.3, Article entitled “Photographs” for submitting Final Completion construction photographs and negatives.
3. Divisions 2 through 31 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

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

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Government of pending insurance changeover requirements, if any.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Government unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs and photographic negatives, if any, damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by COTR. Label with manufacturer's name and model number where applicable.
7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
8. Submit changeover information related to Government's occupancy, use, operation, and maintenance.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

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

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

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to solicitation.
2. Submit certified copy of COTR's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by COTR. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. If needed, submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Government's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

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

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

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

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

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

1.6 WARRANTIES

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

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

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces. All cleaning agents shall comply with D.C. Government environmental regulations.

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

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

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

a. Clean Project site, yard, and grounds, in areas affected by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, trenches, equipment vaults, manholes, and similar spaces.
h. Clean transparent materials, including glass in doors and windows affected by this Work. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other transparent materials damaged as a result of this Work.
i. Remove labels that are not permanent.
j. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

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

k. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
l. Clean light fixtures, lamps, globes, and reflectors affected by this Work, to function with full efficiency.
m. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Government's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Emergency manual.
   2. Operation manuals for systems, subsystems, and equipment.
   3. Product, systems and equipment maintenance manuals.

B. Related Requirements:

   1. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

C. At Contractor's option, Emergency Manual and Operation and Maintenance manuals may be combined into a single manual. If the single manual option is exercised, the section covering Emergency Procedures shall be the first section of the combined manual.

1.2 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

   1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit emergency, operations and maintenance manuals in the following format:

   1. PDF electronic file. Assemble manuals into a composite electronically indexed file. Submit on digital media acceptable to Architect for review.

      a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
      b. Enable inserted reviewer comments on submittals.

   2. After approval of manuals, submit four paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Three copies will be returned through COTR.

C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion.

1. Correct or revise each manual to comply with review comments.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Directory: Prepare a comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Directory may serve as manual table of contents.

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

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

C. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Government.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager, if any.
7. Name and contact information for Architect.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.

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

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

F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

   a. Identify each binder on front and spine, with printed title of manual and Project title or name.

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

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

2.2 EMERGENCY MANUALS

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

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

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

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.

6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

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

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

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

2.3 OPERATION MANUALS

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

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

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

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

1. Startup procedures.

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

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

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

2.4 PRODUCT MAINTENANCE MANUALS

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

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

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

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

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

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

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

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

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

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

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

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

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

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

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

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

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

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

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

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

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

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

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

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

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.

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

END OF SECTION 017823

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

B. Related Requirements:

1. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.4 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, experienced in operation and maintenance procedures and training.

B. Pre-instruction Conference: Conduct conference at Project site. Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.

4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:

a. Emergency manuals.
b. Operations manuals.
c. Maintenance manuals.
d. Project record documents.
e. Identification systems.
f. Warranties and bonds.

g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Provide qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of season.

   1. Schedule training with at least seven days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, written or a demonstration performance-based test.

E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Government ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Predemolition Photographs or Video: Submit before Work begins.

C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.7 FIELD CONDITIONS

A. Government will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Government's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Government as far as practical.

C. Notify COTR of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. If suspected hazardous materials are encountered, do not disturb; immediately notify COTR. Hazardous materials will be removed by Government under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

   1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to COTR.

D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs and templates.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Building manager will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Government.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.

4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly.

B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without COTR's approval.

1. Building Structure and Shell: 100 percent.
2. Nonshell Elements: 50 percent.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Government.
4. Transport items to Government's storage area designated by Government
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by COTR, items may be removed to a suitable, protected storage location during selective demolition, cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled**,** reused, salvaged, reinstalled, or otherwise indicated to remain Government's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Government's property and legally dispose of them.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 055000 - METAL FABRICATIONS

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. Steel framing and supports for mechanical and electrical equipment.
   2. Loose lintels and support angles.

B. Related Sections include the following:

   1. Division 08 Section “Overhead Coiling Doors”

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design structural framing and supports for mechanical equipment and framing for overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

   1. Wind Loads for exterior framing:

      a. Basic Wind Speed: 90 mph (40 m/s).
      b. Importance Factor: 1.

B. Exposure Category: B.

C. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Paint products.
   2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
   2. Provide templates for anchors and bolts specified for installation under other Sections.
   3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

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

B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).

D. Anchor Bolts: ASTM F 1554, Grade 36.

1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

E. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

G. Wood Screws: Flat head, ASME B18.6.1.

H. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

I. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

J. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

K. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Anchors in Exterior Locations: Alloy Group 1 (A1) stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

L. Adhesive Anchors: To be used in masonry in accordance with structural drawings.

1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Anchors in Exterior Locations: Alloy Group 1 (A1) stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 LOOSE STEEL LINTELS AND SUPPORT ANGLES

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 6 inches (152 mm), unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.8 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication.

C. Prime plates with zinc-rich primer.

2.9 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.10 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Support steel beams and girders on solid grouted masonry or concrete. Secure girders with anchor bolts embedded in grouted masonry or concrete.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

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

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 057500 - DECORATIVE FORMED METAL

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. Beam wraps at storefront entry.
2. Mullion, head and corner cladding at storefront entry.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design exterior decorative formed metal items, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 45 deg F (25 deg C), ambient; 90 deg F (50 deg C), material surfaces.

C. 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 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative formed metal.

1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

C. Samples for Initial Selection: For products involving selection of color, texture, or design.

D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances.

B. Qualification Data: For qualified Installer, fabricator.

C. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

D. Welding certificates.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirror like stainless-steel finish to include in maintenance manuals.

1.7 QUALITY ASSURANCE

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

B. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and that employs competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

C. Installer Qualifications: Fabricator of products.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 COORDINATION

A. Coordinate installation of anchorages for decorative formed metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate installation of decorative formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes.

PART 2 - PRODUCTS

2.1 SHEET METAL

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Stainless-Steel Sheet:
1. ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.

C. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher, and with not less than strength and durability properties of Alloy 5005-H32.

2.2 MISCELLANEOUS MATERIALS

A. Gaskets: As required to seal joints in decorative formed metal and remain airtight; as recommended in writing by decorative formed metal manufacturer.

1. ASTM D 1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
2. Closed-cell polyurethane foam, adhesive on two sides, release paper protected.

B. Sealants, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in decorative formed metal; and as recommended in writing by decorative formed metal manufacturer.

1. Sealants shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.

1. Use filler metals that will match the color of metal being joined and will not cause discoloration.

D. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting decorative formed metal items and for attaching them to other work unless otherwise indicated.
2. Provide flat-head machine screws for exposed fasteners to match existing unless otherwise indicated.

E. Nonstructural Anchors: For applications not indicated to comply with design loads, provide metal expansion sleeve anchors or metal-impact expansion **anchors** of type, size, and material necessary for type of load and installation indicated, as recommended by manufacturer, unless otherwise indicated.

F. Backing Materials: Provided or recommended by decorative formed metal manufacturer.

G. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal and that will prevent telegraphing and oil canning and is compatible with substrate and noncombustible after curing.

1. Contact Adhesive: VOC content of not more than 80 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Metal-to-Metal Adhesive: VOC content of not more than 30 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Multipurpose Construction Adhesive: VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble decorative formed metal items in 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.

B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (1 mm) and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce decorative formed metal items as needed to attach and support other construction.

F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.

G. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

2.4 BEAM WRAPS

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. Hi-Tech Metals, Inc.
2. H & H Enterprises- Architectural Metals.
3. Southwest Metalsmiths.

B. Form beam wraps from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.

1. Stainless-Steel Sheet: Thickness required to comply with performance requirements.

a. Finish: No. 8

C. Fabricate with calk stop angle to retain backer rod and sealant.

2.5 CLOSURES AND TRIM

A. Form closures and trim from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.

B. 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. Fry Reglet Corporation.
2. Pittcon Industries.

C. Form closures and trim from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.

1. Aluminum Sheet: Thickness required to comply with performance requirements

a. Finish: Clear anodic.

2. Stainless Steel Sheet: Thickness required to comply with performance requirements

a. Finish: #8 mirror polish

3. Closures and trim may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view and not exposed to weather.

D. Conceal fasteners where possible; otherwise, locate where they are as inconspicuous as possible. Size fasteners to support closures and trim, with fasteners spaced to prevent buckling or waviness in finished surfaces.

E. Drill and tap holes needed for securing closures and trim to other surfaces.

F. Incorporate gaskets where indicated or needed for concealed, continuous seal at abutting surfaces.

G. Miter or cope trim members at corners and reinforce with bent metal splice plates to form tight joints.

2.6 MULLION CLADDING

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. Hi-Tech Metals, Inc.
2. International Metal Works.
3. KPK Stainless.
4. Metal Sales & Service, Inc.; Metalwerks Division.
5. Southwest Metalsmiths.

B. Form mullion cladding from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.

1. Stainless-Steel Sheet: 0.050 inch (1.27 mm).

a. Finish: #8 mirror polish

2. Aluminum Sheet: Thickness required to comply with performance requirements

a. Finish: Clear anodic.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Apply anodic finishes to formed metal after fabrication unless otherwise indicated.

E. Finish items indicated on Drawings after assembly.

F. 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.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

C. Mirrorlike Reflective, Nondirectional Polish: No. 8 finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Install concealed gaskets, joint fillers, insulation, sealants, and flashings, as the Work progresses, to make exterior decorative formed metal items weatherproof.

E. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior decorative formed metal items soundproof or lightproof as applicable to type of fabrication indicated.

F. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

G. Apply joint treatment at joints of spackled-seam-type metal column covers. Comply with requirements in Section 092900 "Gypsum Board."

3.3 ADJUSTING AND CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. 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.

3.4 PROTECTION

A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 057500

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rooftop equipment bases and support curbs.
   2. Wood blocking**,** cants**,** and nailers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

   1. Preservative-treated wood.
   2. Fire-retardant-treated wood.
   3. Power-driven fasteners.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, blocking, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
2. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

C. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

D. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.

3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Eastern softwoods, No. 2Common grade; NELMA.
3. Northern species, No. 2 Common grade; NLGA.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with of Type 304 stainless steel.

B. Power-Driven Fasteners: NES NER-272.

C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

2.7 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Self-adhesive butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Do not splice structural members between supports unless otherwise indicated.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

G. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 075563 - GREEN ROOF ASSEMBLY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Tray-type vegetated roof assemblies.
      a. Provide equipment, materials, tools, and labor to install vegetated roofing modules. Modules to include growth media and plants. This work shall also include edge treatments, custom shaping of modules, and installing paver stones or ballast, slip sheet/root barrier and irrigation system, if specified.

B. Related Sections include the following:
   1. Division 7 Section "Hot Fluid Applied Roofing" for thermal and moisture protection.
   2. Division 7 Section "Sheet Metal Flashing and Trims" for moisture protection.

1.3 DEFINITIONS

A. Extensive Green Roof Assembly-- An area of planting/landscaping up to 6 inches of soil/growing media, built up on a waterproofed substrate of a man-made structure at any level that is separated from the natural ground.

B. Captured Water: Water that is retained in the drainage layer of a vegetated roof assembly after new water additions have ceased and that cannot escape the roof except through evaporation or plant transpiration.

1.4 SUBMITTALS

A. Product Data for vegetated roofing systems.

B. Provide reference sheet listing 6 references of owners and caretakers of green roof system.

C. Provide two (2) sample vegetated modules, showing same or similar visual reference, priced

D. Planting mix design indicating species.

E. Shop Drawings: Indicating layout of modules, pavers, irrigation, and square footage. Indicate locations for planting mix designs. Indicate extent of root barrier and edging.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Maintenance instructions for inclusion into owner's manuals.

H. To ensure proper installation, provide written documentation of installation procedures. If required for warranty and maintenance purposes, provide documentation showing installer as being certified to install system.

I. To ensure Installer has been trained to efficiently and correctly install green roof system, provide certificate of completion of training issued by green roof system manufacturer.

J. To facilitate planning and create installation efficiency, indicate length of time required to install the green roof.

K. To provide evidence of wind and fire safety, demonstrate video evidence of fire-spread testing and high speed wind resistance testing (minimum of 110 mph).

L. To ensure proper plant selection and efficient delivery, provide address and contact information of professional horticulturist who will oversee planting and cultivation of modules, within 300 miles of project location.

M. To ensure efficient and correct use of materials, submit shop drawings indicating layout of modules, irrigation, and square footage.

1.5 QUALITY ASSURANCE

A. No deviation should be made from this specification. Installer assumes liability for any deviations from specification

B. Only manufacturer-approved Installers may perform the green roof installation.

C. Water/Flood Test: Conduct a flood test prior to installing the Green Roof on roof areas or portions thereof as indicated on drawings. Test shall be conducted either by means of electronic testing or by ponding water at a minimum of 2 inches for a period of 48 hours to check the integrity of the membrane installation. If leaks are detected, waterproofing shall be made watertight/repaired before proceeding with Green Roof installation. Repeat flood test to ensure that waterproofing is watertight and leak proof. Verify that structure can support the dead load weight of the water necessary to conduct the flood test.

D. Field Sample: Apply Green Roofing field sample to an area of at least 100 sq. ft. on the roof deck level to demonstrate surface preparation, correct order of green roof layers, thickness of green roof growing media, planting density, integration with roof deck, and standard of workmanship.

1. Notify COTR and Architect seven days in advance of the dates and times when field sample will be applied.
2. Approved Field Sample may become part of Finished Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Before installing Green Roof, conduct conference at Project site. Notify participants at least five workdays before conference.

1. Participants shall include COTR; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; and installers whose work interfaces with or affects green roof application, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures for green roof installation, including roofing manufacturer's written instructions to protect integrity of waterproofing.
3. Examine existing waterproofing.
4. Review loading limitations of roof during and after green roof installation.
5. Review flashings, special green roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect green roof installation.
6. Review governing regulations and requirements for insurance, certifications, and inspection and testing, if applicable.
7. Review temporary protection requirements for green roof during and after installation.
8. Review green roof observation and repair procedures after green roof installation.
9. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.6 PROJECT CONDITIONS

A. Demolition of the existing roof shall not commence nor proceed during inclement weather or high winds.

B. Contractor shall take necessary action to restrict dust or other materials from entering the building before, during and after installation.

C. Contractor shall take necessary action so that trades do not damage existing waterproofing.

D. Environmental Limitations: Install green roof during temperate weather conditions. Soil and plants shall be installed simultaneously.
1. Install soil and plants between late February and May or October and November.
2. Do not install green roof prior to severe weather, including heavy rain and high wind.
3. Avoid planting during frost conditions or between June and August.
4. Provide supplemental irrigation if natural precipitation does not suffice for roots and plants to establish.

1.7 WARRANTY

A. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Green Roof Warranty: Submit a written warranty, agreeing to the overburden removal and 100 percent plant material as necessary to establish dense green roof plant cover.

1. Warranty period: Two years from date of Substantial Completion.
2. Warranty to include consistency of growing media depth.
3. Warranty includes weed control and plant care.
4. Warranty does not include damage to the Green Roof plant cover due to maintenance of equipment located on the roof or other unrelated activities.

1.8 DELIVERY, STORAGE AND HANDLING

A. Green roof modules are to be delivered in good condition free from shipping damage.

B. Modules are to be kept out of the sun if plastic wrapped to prevent overheating.

C. Modules are to be installed on the roof top within 4 hours of delivery.

D. On the job site, modules are to be handled to prevent damage to the modules themselves and all roofing components.

E. To ensure optimum plant condition and safety, modules must be conveyed to the roof using a rack designed specifically for this use and constructed according to engineer approved and stamped plans. DO NOT stack modules during conveyance to rooftop or installation.

F. Modules are to be conveyed to roof surface with equipment designed to carry the collective load of the green roof modules and transport vehicle. Account for decreasing load limits when boom (of crane or fork lift) is extended. Use crane stabilizers and take all necessary precautions to protect building and personnel.

G. NEVER exceed the load capacity of the roof deck when placing green roof modules on the roof.

H. When suspending modules and conveyance vehicle above deck, take precautions to stabilize and prevent twisting of conveyance vehicle. Four tires or two four inch thick sheets of Styrofoam is recommended.

I. During installation, protect the roof deck, insulation and membranes with appropriate material such as plywood sheeting. NEVER scrape or puncture the slip sheet or membranes. Keep roof surfaces free of soil, grit, or debris at all times with broom. Never set modules on top of soil, dirt or grit.

J. Transport conveyors to be run parallel to the line of installation.

K. Transport carts to have pneumatic tires, to be wheeled about only upon protective plywood sheeting, and to be loaded so as not to exceed weight capacity of roof deck.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Provide maintenance by skilled employees of vegetated roof assembly Installer approved by membrane roofing manufacturer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings

are acceptably healthy and well established but for not less than the following maintenance period:

1. Maintenance Period: 24 months from date of Substantial Completion

B.

PART 2 - PRODUCTS

2.1 GENERAL

A. For ease of handling during installation, future maintenance activities, storage, and reduction in special sizes, the module system to be used comprising of 1’ x 2’ x 1 ½" tray; soil height raised to approximately 2 ½" elevation with removable soil elevator.

B. To meet sustainability objectives, modules to be 100% post-industrial recycled polypropylene with 100 mil thick walls.

C. To meet plant growth, plant health, and maximum storm water absorption, module system to have a minimum of 337 cu ft of soil per 1000 square feet of coverage.

D. To resist photo-degradation, module color to be black.

E. For optimal root health and drainage, module to have positive drain holes placed at lowest point in the module.

F. For proper roof drainage and root health, module bottom to have water dispersal via its drain channels of approximately 7.0 gallons per minute per lineal foot.

G. To optimize plant health and maximize storm water absorption, soil height approximately 2 ½".

H. To shield the module from photo-degradation and to promote plant health via sharing of water and nutrients between the modules, the soil continuum is to be monolithic; approximately 1" (one inch taller than modules, and shall obscure modules during all 12 months of the year for optimal year-round aesthetic presentation.

I. For plant health by sharing of water and nutrients between modules, soil to be joined via subterranean moisture portals uniting soil from module to module.

J. To ensure minimal maintenance, plant material to cover minimum of 95% of surface area of soil within modules at time of delivery.

K. To ensure proper plant selection, efficient delivery and sustainable objectives, module planting and cultivation to occur under supervision of professional horticulturist located within 300 miles of project location.

L. To ensure adherence to proper installation procedures, green roof system manufacturer to provide the Installer with in-person training of Standardized Installation Procedures.

M. To facilitate design, provide photos and descriptions of plant mixture or individually specified plant species to be used.

N. To optimize logistical efficiency, during the growing season, April to Sept. 30, growing time and method to be coordinated so as to mature on or before installation date. Time to mature depends upon plant selection, climate, and time or year. Ask grower for specific timeframes for individual project.

2.2 ROOT BARRIER

A. Root Barrier: Manufacturer's standard black plastic sheet manufactured from recycled polyethylene or polypropylene plastic; formulated to resist root growth and bacteria.
   1. Recycled Content: Provide root barrier material with recycled content so postconsumer recycled content plus one-half of preconsumer recycled content not less than 50% percent by weight.
   2. Root barrier is required at entire roof area where vegetated roof assemblies are installed. Install below ballast and preplanted modules as well as any loose-laid walkway pavers.

2.3 VEGETATED ROOF ASSEMBLY COMPONENTS

A. GROWING MEDIUM
   1. To ensure sustainability, plant health and longevity, and minimal shrinkage, soil to be enhanced German FLL 93 +% (by dry weight) inorganic content.
   2. To ensure proper soil environment and allow for predictable maximum roof load during rain storm, module saturated weight (with soil and fully vegetated) to range between 15 and 17 pounds per square foot.

B. PLANTS
   1. Homogeneous mix of cutting grown highly drought resistant ground covers. Include accent plants for enhanced height, texture, or early/late season bloom times. Local horticulturists should be consulted for specific recommendations.
   2. In order to protect the environment during production and to reduce or prevent the need for ongoing insect control, the cuttings used in the planting are to have been field harvested from within 60 feet of established plantings of Native “Banker Plants”. Banker plants to consist of a 20 species assortment of native plants known to attract beneficial predators such as lady beetles, praying mantis, lacewing, predatory mites, predatory wasps, and others. Production practices to utilize no pre-emergent herbicides, and to include compost, mulch, and other earth friendly and organic growing methods.
   3. When pre-vegetated at a Nursery, the Nursery is to execute the following:
      a. Module is to be filled with soil and appropriately settled either by mechanical vibration or flooding with water. Any settled soil is to be replaced so that soil extends to top of module at time of planting.

      b. Modules are to be filled with plants, selected by purchaser. Plants are to be grown to maturity (approx. 95%+soil coverage).

      c. Refer to the end of the section for planting mix percentages as scheduled on the drawings.

2.4 ACCESSORIES

A. Edging: L-shaped extruded aluminum edging with perforations for drainage. Edging is 3" x 3" with a minimum gauge of 210 mil. Edging, regardless of type, must allow for adequate drainage via sufficient drain perforations at the bottom of the edging, with sidewalls tall enough to cover the modules and contain the soil.

1. Edging required between modules and stone ballast or pavers.

2. If edging is attached to modules, use 10-24 x 1" wafer head self-tapping screws in gray finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The roofing contractor shall examine all surfaces to receive the Green Roof assembly to verify they are suitable for the assembly.

B. Testing: Use either electronic testing or flood testing by ponding water at minimum depth of 2 inches for period of at least 48 hours to check the integrity and water tightness of the existing membrane installation.

1. Verify that the structure can support the dead load weight of a water test before testing.
2. If leaks occur, water must be drained completely and the membrane installation repaired.
3. Retest after repair. Repeat process until all leaks are identified and repaired.

3.2 PREPARATION

A. Throughout installation, keep all work surfaces clean and free of grit, dirt, or debris. Use broom not blower, do not sweep soil under modules or slip sheet. Do not place modules upon soil, dirt, stones or grit. Following installation, remove all excess materials and tools from job site. Ensure that any damage that occurs as a result of installation is appropriately and immediately repaired.

B. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to COTR.

3.3 INSTALLATION

A. Module installation to be conducted when plants are:
1. Properly adapted and acclimatized to local weather conditions
2. When weather is above 35 degrees Fahrenheit and there is no ice on the roof and soil is unfrozen.

3.4 LAYING MODULES

A. Module installation to follow behind installation of slip sheet/root barrier, irrigation system, pavers, ballast, and edging.

B. Module installation to be conducted in strict accordance with manufacturer installation guidelines. Surface to be clean and swept free of soil, dirt, stones or grit before placing each module. Rows to be straight, modules to be tight against each other with edges overlapping and arranged in proper directional orientation. As soon as one row of modules is surrounded completely by the parapet, edging, or other modules, pull all of the plastic soil elevator inserts out of the modules. Pull the soil elevators while standing on the slip sheet and avoid walking on the plants.

C. Module installation to be conducted in accordance with green roof design.

D. Modules to be placed directly on top of appropriate slip sheet/root barrier.

E. It is recommended that any custom cutting/fitting be oriented on the high side (top), or sides of the roof. It is recommended that the cut side of the module be set tight against the edging or toward the side of an intact module so as to prevent soil spillage. If custom cutting must be done on the low, draining, side of the roof, it is imperative that no filter cloth be inserted as it could impede drainage. It is best to orient the cut side against another module, facing upstream.

F. After installing modules, they should be immediately watered so as to thoroughly moisten the media from top to bottom. Water shall be of suitable quality for plant growth and irrigation system or hoses and sprinklers may be used for such purpose. Note: it takes approximately 1 inch of water, or 1¼ gallons per module to moisten each module thoroughly.

3.5 FIELD QUALITY CONTROL

A. Conduct post installation inspection to determine acceptance of modules. Inspection to be made by General Contractor’s Representative or by Owner’s Representative upon General Contractor’s request; five working days notice required.

B. Installer is responsible to ensure proper module/plant maintenance until work has been accepted by representative of Owner or General Contractor.

C. Upon acceptance, Owner assumes responsibility for module/plant maintenance.

3.6 GREEN ROOF CARE AND MAINTENANCE

A. Provide continuing maintenance agreement for care of Green Roof, to include initial green roof maintenance until approximately 90 percent ground cover is achieved, temporary irrigation as needed, and two inspections a year after 90 percent ground cover is reached.

1. Duration of maintenance agreement: Two years.

3.7 PLANTING MIXES:

Plant Mix 1- green

a. Sedum spurium 'John Creech'
b. Sedum sexangulare ‘Utah’
c. Sedum ellecombian
d. Sedum hybridum 'Immergrunchen'
e. Sedum album 'Green Ice'
f. Sedum stefco

Plant Mix 2- gold shades

g. Sedum Angelina
h. Sedum floriferum 'Weihenstephaner Gold'
i. Sedum kamtschaticum 'Variegatum'
j. Sedum sexangulare ‘Utah’
e. Sedum hybridum 'Czar's Gold'

Plant Mix 3- red shades

a. Sedum spurium ‘Dragon’s Blood’
b. Sedum spurium ‘Fuldaglut’
c. Sedum spurium ‘VooDoo’
d. Sedum album 'Coral Carpet'
e. Sedum album 'Red Ice'

END OF SECTION 075563

SECTION 075610 - HOT FLUID-APPLIED ROOFING

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. Protected, hot fluid-applied roofing membrane, reinforced.
2. Insulation.
3. Ballast.
4. Roof drain replacement.

B. Related Sections include the following:

1. Division 7 Section "Green Roof Assembly" for vegetative roof coverings over protected, hot fluid applied roofing.
2. Division 7 Section "Sheet Metal Flashing and Trim" for flashing, counterflashing, and metal roof penetration flashing.

1.3 PERFORMANCE REQUIREMENTS

A. Install hot fluid-applied roofing and flashing system with compatible components that will not permit passage of liquid and will withstand wind loads, flotation loads, thermally induced movement, and exposure to weather without failure.

1.4 SUBMITTALS

A. Product Data: For each type of roofing material indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Samples for Verification: For each of the following products:

1. 12-by-12 inch square of flashing sheet.
2. 12-by-12 inch square of membrane-reinforcing fabric.
3. 12-by-12-inch square of board insulation.
4. Ballast sample
5. Roof drain assembly with perforated extension and clamping ring

C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for current formulation of hot fluid-applied roofing.

F. Maintenance Data: For roofing system to include in maintenance manuals.

G. Warranties: Draft of special warranty specified in this Section.

H. Inspection Report for Information: Copy of roofing system manufacturer's inspection report of completed roofing membrane.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain roofing membrane materials through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide hot fluid-applied roofing with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; complying with ASTM E 108, for application and slopes indicated.

D. Mockups: Install roofing membrane to 100 square feet of deck to demonstrate surface preparation, joint and crack treatment, thickness of roofing membrane, and execution quality. Install insulation, filter fabric and aggregate ballast over half of mock-up roofing membrane.

1. If Construction Engineer determines mockups do not comply with requirements, reapply roofing and overlying construction until mockups are approved.
2. Mockups maintained in an undisturbed condition may be incorporated into the completed Work.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:

1. Review flashing, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
2. Review regulations and requirements of authorities having jurisdiction for insurance, certifications, and inspection and testing, if applicable.

3. Review temporary protection requirements for roofing system during and after installation.
4. Review roof observation and repair procedures after roofing installation.

F. Ballast Design Standard: Comply with ANSI/SPRI RP-4-2002, "Wind Design Standard for Ballasted Single-ply Roofing Systems":

1. Importance Factor: Category I.
2. Exposure: Exposure C.
3. Wind Speed: 90 mph for 3-second gust.

1.6 DEFINITIONS

A. Corner Areas: The corner area is defined as the roof section with sides equal to 40% of the building height. The minimum length of a side is 8.5 feet – See ANSI/SPRI RP-4-2002, Section 2.8.2 and Figure 1.

B. Perimeter: The perimeter area is defined as the rectangular roof section parallel to the roof edge and connecting the corner areas with a width measurement equal to 40% of the building height, but no less than 8.5 feet – See ANSI/SPRI RP-4-2002, Section 2.8.3 and Figure 1.

C. Field: The field of the roof is defined as that portion of the roof surface which is not included in the corner or the perimeter areas as defined above – See ANSI/SPRI RP-4-2002, Section 2.8.4 and Figure 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

1. Handle and store roofing materials and place equipment in a manner to avoid significant or permanent damage to deck or structural supporting members.

B. Protect roofing insulation materials from damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Apply roofing within the range of ambient and substrate temperatures recommended by roofing system manufacturer. Do not apply roofing to a damp or wet substrate or when temperature is below 0 deg F.

1. Do not apply roofing in snow, rain, fog, or mist.

B. Provide positive retaining barricades on ground below work areas to prevent injury to pedestrians and damage to property.

C. Comply with the District of Columbia Fire Marshals' requirements for locating double-jacketed melters on the concrete roof decks.

D. Protect adjacent building surfaces from spilling and splattering of roofing materials. Clean all spilled and splattered materials at once.

1.9 WARRANTY

A. Special Roofing Membrane Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace roofing that does not remain watertight and base flashing that does not remain watertight or that splits, tears, or separates at seams or from substrate within specified warranty period.

1. Warranty also includes insulation.
2. Warranty Period: 20 years from date of Substantial Completion.
3. See Division 2 section for additional warranty information related to roofing and vegetative roof coverings.

B. Special Roofing Installer's Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including roofing membrane, base flashing, board insulation, and mortar-faced insulation board, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. American Hydrotech, Inc.; Monolithic Membrane 6125.
2. Barrett Company; Ram-Tough 250.
3. Henry Company, Monsey Div.; Elasto-Seal 790-11.

2.2 ROOFING MEMBRANE

A. Single-component, 100 percent solids, hot fluid-applied, rubberized asphalt, complying with the general requirements and the following physical requirements in CGSB-37.50, "Hot Applied, Rubberized Asphalt for Roofing and Waterproofing," as demonstrated by testing performed by a qualified independent testing agency of manufacturer's current roofing formulations:

1. Flash Point: Not less than 260 deg C or not less than 25 deg C above manufacturer's maximum recommended application temperature.
2. Cone Penetration: 110 maximum at 25 deg C and 200 maximum at 50 deg C.
3. Flow: 3 mm maximum at 60 deg C.

4. Toughness: Not less than 5.5 J.
5. Ratio of Toughness to Peak Load: Not less than 0.040.
6. Adhesion Rating: Pass.
7. Water-Vapor Permeance: 1.7 ng/Pa x s x sq. m.
8. Water Absorption: 0.35-g maximum mass gain or 0.18-g maximum mass loss.
9. Pinholing: Not more than one pinhole.
10. Low-Temperature Flexibility: No cracking.
11. Crack Bridging Capability: No cracking, splitting, or loss of adhesion.
12. Heat Stability: Comply with requirements for penetration, flow, low-temperature flexibility, and viscosity when heated for five hours at manufacturer's recommended application temperature.
13. Viscosity Test: 2 to 15 seconds.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdiction.

B. Primer: ASTM D 41, asphaltic primer.

C. Elastomeric Flashing Sheet: 60 mil thick, minimum, nonstaining, uncured sheet neoprene with manufacturer's recommended contact adhesives. Comply with the following:

1. Tensile Strength: 9.6 MPa minimum; ASTM D 412, Die C.
2. Elongation: 300 percent minimum; ASTM D 412.
3. Tear Resistance: 40 psf minimum; ASTM D 624, Die C.
4. Brittleness: Does not break at 3 deg F; ASTM D 2137.

D. Filter Fabric: Spunbond polyester or polypropylene, 3.0 ounces per square yard (Confil 689H by International Paper Fabric; Rufon P3B by Phillips Fiber Corp.; Fabrene VIE by DuPont).

E. Modified Bitumen Cap Sheet: SBS-modified asphalt sheet, 160 mil thick, mineral-granule surfaced, woven or nonwoven polyester or glass-fiber reinforced; suitable for application in hot-applied rubberized asphalt; and white or gray granule color.

F. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel termination bars, approximately 1/8 by 1 inch thick; with nailin-type anchors.

G. Nailins: Stainless steel nail with mushroom head in zinc body, 1/4-inch diameter, length to bed in substrate a minimum 1 1/2-inch.

H. Reinforcing Fabric: Manufacturer's recommended spun-bonded polyester fabric.

I. Protection Sheet: Manufacturers standard SBS modified bituminous sheet, polyester or fiberglass reinforced, 80 mils minimum thickness, intended for use as a protective layer

embedded directly into surface of hot-fluid applied membrane (Hydroflex 30 by American Hydrotech; ram 200 by Barrett; or equal).

J. Accessories: Manufacturer's recommended protection course, backer rods, sealants, and other accessories.

K. Screws: ASTM A 304, stainless steel, pan head screws, #10 x length required to penetrate substrate 1 1/2 inches, 1/2 inch for fastening sheet metal. With neoprene washers where heads are exposed.

L. Root Barrier: Manufacturers recommended root barrier system, high-density polyethylene sheeting. (Rootstop-HD by Hydrotech; Root Barrier RAM-40 by Barrett; or equal).

M. Concrete (for underlayment, grouting, patching and cants): ASTM C 476, 1 part portland cement, 1/10 part hydrated lime, sand 2 1/4 to 3 times the sum of the volumes of the cementitious materials with sufficient water to make a smooth paste. For applications associated with roofing or waterproofing, use latex additive to reduce set time to a maximum of 2 hours. Prepackaged materials will be considered for substitution if Contractor provides Engineer with data sheets and mix design.

N. Wood Members, Units: Nailers, and other wood members indicated as roofing system work. Provide wood pressure treated with waterborne preservatives for above-ground use (AWPB LP-2).

O. Nails (wood): Hot-dip galvanized steel common nails.

P. Anchor Bolt: Federal Specification FF-S-325, Group II, Type 4, Class 1 or Type 3, Class 3; ½ inch (12 mm) minimum diameter galvanized steel anchor bolt stud with expansion collar. Length to penetrate substrate a minimum of 2- inches (50 mm) minimum.

Q. Backer Rod: Closed cell polyethylene foam rod or rope, 25 percent greater in diameter than joint width to be sealed.

R. Sealant: ASTM C 920, Grade NS, Class 25, one (Type S) or two (Type M) part polyurethane, non-sag, sealant. Color: Standard to blend with primary material at sealant line.

S. Screws (ss): ASTM A 304, stainless steel, pan head screws, #10 x length required to penetrate substrate 38 mm, 12 mm for fastening sheet metal. With neoprene washers where heads are exposed.

T. Mortar: ASTM C 270 proportion specification, Type N, 1 part portland cement, 1/2 to 1 1/4 parts hydrated lime, 3 3/8 to 6 3/4 parts clean washed sand (not less than 2 1/4 and not more than 3 times the sum of the separate volumes of cementitious materials) and the maximum amount of water which produces a workable consistency. Color: Match existing.

U. Post support base: Prefabricated galvanized steel strut support, with galvanized steel base plate to mount to concrete paver. (Telestrut by Unistrut; or equal)

2.4 BOARD INSULATION

A. Board Insulation: ASTM C 578, extruded polystyrene with two or four edges rabbeted; of type, minimum density, and minimum compressive strength indicated below:

1. Type VI, 1.8 lb/cu. ft. (29 kg/cu. m) and 40 psi (276 kPa).
2. Thickness: 3 inch (75 mm), minimum R-value of 15.

2.5 ROOF DRAINS AND DRAIN LINES

A. Roof Drains: Cast iron roof drain body, flange, flashing ring, top support pan or underdeck clamp (as required) with perforated stainless steel extension, cast iron secondary clamping ring and cast iron and mushroom dome. Provide all required plumbing accessories.

1. Size: to match existing for replacement drain bodies, as indicated on drawing for new drains.
2. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

a. Wade Division Tyler Pipe; W-3000-DFS.
b. Josam Manufacturing Company; 21500 Series.

B. Pipe (cast iron): ASTM A 74, Service Grade (SV), cast iron pipe and fittings; with ASTM C 564 rubber gaskets for pipe and fitting. EPDM (rubber) no-hub (plain end flexible) pipe couplings, with stainless steel clamp, may also be used. Provide all plumbing accessories required to tie new drains into existing storm drain lines.

C. Pipe Insulation: ASTM C 547, heavy density fiberglass, 1 inch thick with ASJ (all service jacket) vapor barrier; size to fit pipe.

2.6 AGGREGATE BALLAST

A. Aggregate Ballast: Washed, crushed stone or smooth stone that will withstand weather exposure without significant deterioration and will not contribute to membrane degradation; of the following size:

1. Size: ASTM D 448, Size 2, ranging in size from 1-1/2 to 2-1/2 inches (38 to 63 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which roofing will be applied, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROOF DEMOLITION AND SUBSTRATE PREPARATION

A. Remove existing gravel surfaced built-up roofing membrane, multiple layers of insulation and vapor barrier/mopping of asphalt down to existing concrete roof deck. Remove existing coping, counterflashing and other roof related accessories not indicated to be reused.

B. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for roofing application. Use scarifiers, scrabblers, grinders or other mechanical methods to remove bitumen from deck surface. The finished surface shall be free of felts and bitumen build-up; only a semi-transparent bitumen/ primer haze should remain.

C. Mask off adjoining surfaces not receiving roofing to prevent spillage from affecting other construction.

D. Protect roof drains and other deck penetrations to prevent spillage and migration of roofing fluids.

E. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

F. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

G. Scrape or grind surface of existing concrete deck after removal of existing roofing to remove asphalt residue from previous roofing membranes/vapor barriers to provide substrate acceptable to fluid-applied roofing membrane manufacturer.

H. Cants: Install 45-degree concrete cants at junctures of roofing system with vertical surfaces or angle changes greater than 45 degrees. Note: this is a mandatory requirement whether or not required by manufacturer.

3.3 ROOF DRAIN REPLACEMENT

A. Prior to starting roof demolition, ensure replacement drain bodies are on site. Install replacement roof drains prior to, or during removal and replacement of sections of roofing.

B. Remove existing drains and install new roof drains at locations of existing drains.

C. Cut out and set drain bodies into concrete deck so that drain clamping ring is 1 inch below surface of concrete deck. Grout drain body in place and secure drain body in place with underdeck clamp or top support pan as required. Provide all plumbing accessories required to tie new drain bodies into existing cast iron storm drain lines.

D. Flash roof drains as shown on Drawing and in accordance with manufacturer's standard details. Install drain clamping rings immediately after installation of drain body and roofing membrane/flashing.

E. Insulate underside of roof drain bodies and tie-ins to existing drain lines. Tape all joints.

F. Immediately after installation of drains, plug drain line 2 feet below drain and water test installation with hose flowing full to be sure that all connections are watertight.

G. Protect roof drains and drain lines from debris entering them throughout construction period. Remove drain plugs if rain is expected.

3.4 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive roofing membrane, including joints and cracks, roof drains, and penetrations, according to CGSB-37.51, "Application of Rubberized Asphalt, Hot-Applied, for Roofing and Waterproofing," and roofing system manufacturer's written instructions.

1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
2. Adhere strip of elastomeric flashing sheet to substrate in a layer of hot fluid-applied, rubberized asphalt. Extend flashing sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8-inch thick, and beyond roof drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric flashing sheet.
3. Embed strip of reinforcing fabric into a layer of hot fluid-applied, rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8-inch thick, and beyond roof drains and penetrations.

    a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.

B. At discontinuous deck-to-deck joints, bridge joints with elastomeric flashing sheet extended a minimum of 6 inches on each side of joints and adhere to substrates in a layer of hot fluid-applied, rubberized asphalt. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric reinforcing sheet.

3.5 WOOD BLOCKING AND NAILER INSTALLATION

A. Construct treated wood curbs and install new treated wood nailers and blocking where indicated.

3.6 ROOFING MEMBRANE APPLICATION

A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow to dry.

B. Start application with manufacturer's technical representative present.

C. Heat and apply rubberized asphalt according to CGSB-37.51, "Application of Rubberized Asphalt, Hot-Applied, for Roofing and Waterproofing," and manufacturer's written instructions.

1. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.

D. Reinforced Membrane: Apply hot fluid-applied, rubberized asphalt to area to receive roofing. Spread a 125-mil thick layer of hot fluid-applied, rubberized asphalt; embed reinforcing fabric, overlapping sheets 2 inches; and spread another 125-mil thick layer of hot fluid-applied, rubberized asphalt to form a uniform, reinforced, seamless membrane, 250-mil thick.

1. Fully embed reinforcing fabric in hot-applied rubberized asphalt at lap joints. Do not allow felt to touch felt.

E. Apply hot fluid-applied, rubberized asphalt over prepared joints and up wall terminations and vertical surfaces to heights indicated on Drawing. Carry full reinforced membrane 2 inches minimum up all vertical surfaces above top of cants.

F. Cover roofing membrane with protection course with overlapped joints while rubberized asphalt is still hot and before roofing membrane is subject to traffic.

G. In areas that will subject to construction traffic, install temporary protection course with overlapped joints over completed membrane.

3.7 BASE FLASHING INSTALLATION

A. Install base flashing at terminations of roofing membrane according to CGSB-37.51, "Application of Rubberized Asphalt, Hot-Applied, for Roofing and Waterproofing," roofing system manufacturer's written instructions, and as shown on Drawing.

B. Prime substrate with asphalt primer.

C. Adhere elastomeric flashing sheet in a layer of hot fluid-applied, rubberized asphalt.

D. Bond mineral surfaced cap sheet in a layer of hot fluid-applied, rubberized asphalt.

E. Extend elastomeric flashing and cap sheets up walls to underside of counterflashing receivers. Extend elastomeric flashing a minimum of 6 inches onto roof deck; extend cap sheets to base of cants.

F. Extend elastomeric flashing and cap sheets up parapets and roof curbs. Extend elastomeric flashing a minimum of 6 inches onto roof deck; extend cap sheets to base of cants. Extend elastomeric flashing across tops of parapets and curbs.

G. Install termination bars and mechanically fasten to top of flashing and cap sheets at terminations and perimeter of roofing. Anchor termination bars with nailins (masonry or concrete substrates) or stainless steel screws (wood or metal substrates) spaced 8 inches on center, maximum.

H. At locations indicated, extend flashing up and terminate on top of curbs.

I. At locations indicated, extend flashing up and over curbs.

J. At locations indicated, extend uncured neoprene flashing down outside face of curbs and lap onto lower wall substrate to encapsulate curb. Adhere neoprene with bonding adhesive, including lapped seams. Seal seams with sealant at edge of top membrane ply.

3.8 INSULATION INSTALLATION

A. Loosely lay board insulation units over roofing membrane, with long joints of insulation in continuous straight lines and with end joints staggered between rows. Abut edges and ends between units.

B. Install single layer of insulation to achieve required thickness over roofing membrane. Cut and fit to within 3/4-inch of projections and penetrations.

3.9 BALLAST INSTALLATION

A. To roofed area, apply aggregate ballast uniformly over filter fabric at rate required by insulation manufacturer, but not less than the following, carefully spreading aggregate to not damage roofing membrane and base flashings.

1. Ballast: Comply with ANSI / SPRI RP-4-2002, "Wind Design Standard for Ballasted Single-Ply Roofing Systems", System 2 requirements, and as indicated below.

a. 13 lb/sq. ft. (65 kg/sq. m) minimum, Size 2 aggregate ballast at roof perimeter, corners and field of roof.

2. Concrete pavers: Install 4 x 4 foot platform of precast concrete pavers outside all penthouse doors. Provide concrete paver platform under equipment supports and roof top equipment where indicated.

3.10 FIELD QUALITY CONTROL

A. Engage a qualified testing agency to observe flood tests and to determine and report leaks.

B. Flood Testing: Flood test each roof deck area for leaks, according to recommendations in ASTM D 5957, after completing roofing membrane and flashing installation, but before insulation is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to a minimum depth of 2 inches and not exceeding a depth of 6 inches. Maintain 2 inches of clearance from top of base flashing.
2. Flood each area for 24 hours.
3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installation is watertight.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion of roofing membrane and flashing.

1. Notify Construction Engineer 48 hours in advance of date and time of inspection.

D. Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, reapply roofing, and repair flashing.

1. After flood tests, repair leaks and make further repairs until roofing installation is watertight.

E. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with requirements.

3.11 PROTECTING AND CLEANING

A. Protect roofing according to manufacturer's written recommendations to prevent damage and wear during application and remainder of construction period.

B. Protect installed insulation from damage due to UV-light exposure, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.12 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <Insert name of Owner>
2. Address: <Insert address>
3. Building Name/Type: <Insert information>
4. Address: <Insert address>
5. Area of Work: <Insert information>
6. Acceptance Date: <Insert date>
7. Warranty Period: <Insert time>
8. Expiration Date: <Insert date>

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

   a. lightning;
   b. peak gust wind speed exceeding 35 m/s;
   c. fire;
   d. failure of roofing system substrate, including settlement, excessive deflection, deterioration, decomposition, and cracking wider than 3 mm;

e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
f. vapor condensation on bottom of roofing; and
g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void, unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.

1. Authorized Signature: <Insert signature>
2. Name: <Insert name>
3. Title: <Insert title>

END OF SECTION 075610

SECTION 076200 - 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. This Section includes the following sheet metal flashing and trim:

1. Counterflashing and receivers.
2. Vent pipe flashings.
3. Support post flashings.
4. Conduit enclosures.
5. Coping.

B. Related Sections include the following:

1. Division 7 Section "Hot Fluid-Applied Roofing" for installing sheet metal flashing and trim integral with roofing membrane.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 150 deg F, ambient; 200 deg F, material surfaces.

C. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

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.

B. Samples: For each type of exposed finish required, prepared one sample of size indicated below:

1. Counterflashings: One 12 inch long sample of each profile, with specified joint. Include fasteners, cleats, end closures, and other attachments.
2. Penetration Flashing: One full-size Sample each of boot/ rain shield and curb cover.
3. Coping: One 12 inch long sample with specified joint. Include fasteners, cleats, end closures, and other attachments.
4. Accessories and Miscellaneous Materials: Full-size Sample.
5. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.

1.5 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Meet with Contracting Officer’s Technical Representative, Construction Engineer, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. Zinc-Tin Alloy-Coated Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead-soft, fully annealed stainless-steel sheet of minimum uncoated thickness indicated; coated on both sides with a zinc-tin alloy (50 percent zinc, 50 percent tin), with factory-applied gray preweathering.

B. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

2.2 UNDERLAYMENT MATERIALS

A. Polyethylene Sheet: 6-mil thick polyethylene sheet complying with ASTM D 4397.

B. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Rosin paper (Slip Sheet): Rosin-sized paper, minimum 0.16 kg/sq. m.

D. Rubberized Asphalt Sheet Membrane (Self-Adhering, High-Temperature Sheet): 0.76 to 1.0 mm thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 116 deg C; ASTM D 1970.
2. Low Temperature Flexibility: Passes after testing at minus 29 deg C; ASTM D 1970.
3. Available Products:

a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "HR" High Performance Roofing Underlayment.
b. Grace, W. R. & Co.; Vycor Ultra.
c. TC MiraDRI; WIP 300HT.

2.3 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.

B. Fasteners: Provide stainless steel wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Nails for Zinc-Tin Alloy-Coated Stainless Steel (Concealed): Stainless steel common nails, 1/8-inch diameter minimum and not less than 1 1/2 inch long.
2. Exposed Fasteners: ASTM A 478, Type 304 stainless steel, pan or truss head, with neoprene washers, 4.2 mm diameter x 13 mm for fastening sheet metal to sheet metal, 4.8 mm diameter x 38 mm for fastening sheet metal to wood.
3. Nailins: Fed Spec FF-S-325, Group V, Type 2, Class 3; zinc alloy body, 1/4 inch diameter; steel pin. Length sufficient to penetrate substrate 1 1/2 inches (Zamac Nailins by Rawl or equal).
4. Blind Fasteners: Stainless-steel rivets.

C. Solder for Zinc-Tin Alloy-Coated Stainless Steel: ASTM B 32, 100 percent tin.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 0.4-mm dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

G. Band Clamps: 1/2 inch wide band with slotted worm drive mechanism. All components stainless steel.

H. Hardware Cloth (ss): Stainless steel; 1/2 x 1/2 inch, min. wire diameter: 0.030 inches.

I. Pourable Sealer: Two component polyurethane (Vulkem 227 by Mameco; Sure-Seal Pourable Sealer by Carlisle, or equal).

J. Wood Members, Units: Nailers, and other wood members indicated as roofing system work. Provide wood pressure treated with waterborne preservatives for above-ground use (AWPB LP-2).

K. Nails (wood): Hot-dip galvanized steel common nails.

L. Anchor Bolt: Federal Specification FF-S-325, Group II, Type 4, Class 1 or Type 3, Class 3; ½ inch (12 mm) minimum diameter galvanized steel anchor bolt stud with expansion collar. Length to penetrate substrate a minimum of 2- inches (50 mm) minimum.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with Drawings and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. 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.

C. Fabricate 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.

1. Seams: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1” deep, filled with butyl sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As identified on Drawing.

2.5 ROOF SHEET METAL FABRICATIONS

A. Counterflashing and Receivers: Fabricate from 0.018 inch thick Zinc-Tin Alloy-Coated Stainless-Steel at locations indicated on Drawing. Fabricate with length sufficient to lap base flashing fasteners 4 inches, minimum. Fabricated with hemmed drip edge at base and with horizontal crimps in face so when installed “spring action” causes counterflashing base to hug base flashing.

B. Vent Pipes: Flash with 4 pound lead. Fabricate boots to be 1 inch maximum larger in diameter than pipe to be flashed. Fabricate separate caps to lap boots 2 inches and to lap down into vent pipes 1 inch.

C. Conduit Enclosure: Fabricated from 0.018 inch Zinc-Tin Alloy-Coated Stainless-Steel. Size as indicated on drawing or of sufficient size to accommodate conduits. Lap, rivet and solder joints except where shown on Drawing.

D. Coping: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners and solder watertight. Fabricate corner sections to extend 24 inches from corner to main coping.

1. Joint Style: Butt, with 12-inch- wide, concealed backup plate and 6-inch- wide, exposed cover plates. Layout seaming to be symmetrical at each elevation.

E. Screen Wall Support: Fabricate from 0.018 inch Zinc-Tin Alloy-Coated Stainless-Steel.

F. Gravel Stop: Fabricate from 0.018 inch Zinc-Tin Alloy-Coated Stainless-Steel to dimensions and profile indicated.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. 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 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. 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, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Coat side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of rubberized asphalt sheet membrane.
3. Bed flanges in layer of hot-applied rubberized asphalt where flashing item will be set on PRMA roofing membrane surface.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder and sealant.

E. 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.

F. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1 ½ inches for nails and not less than ¾ inch for wood screws.

1. Use only stainless-steel fasteners.

G. Seal non-soldered joints with butyl sealant 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 90 deg F, set joint members for 50 percent movement either 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 sealant manufacturer’s requirements.

H. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1 ½ inches.

1. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with Drawing and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Coordinate installation of coping and counterflashing with installation of base flashing. Extend coping fascias and counterflashings 2” over base flashing/ cleat fasteners.

C. Counterflashing Extensions: Fasten counterflashing to through-wall flashing, receivers and integral curb cover counterflashings with stainless steel screws with neoprene washers, spaced as indicated on the Drawings. Lap joints 4 inches and seal with concealed bead of sealant.

D. Vent Pipe Flashing: Following roofing membrane installation, install lead flashing boots in full bed of hot-applied rubberized asphalt. Set flanges in bed of hot-applied rubberized asphalt membrane. Prime flanges and strip in with neoprene sheet flashing set in hot-applied rubberized asphalt membrane. Install separate lead cap, lapping boot a minimum of 2 inches

and turning down into vent pipe a minimum 1 inch. Boot diameter shall not be more than 1 inch greater than the pipe diameter.

E. Screen Wall Supports: Clean supports to bare metal at flashing line. Fabricate flashing with one piece of metal and fit tight to support. Secure with stainless steel band clamp and seal with sealant as shown on drawing. Miter all seams and solder watertight.

F. Gravel Stop: Fabricate gravel stop to dimensions shown on drawings. Set flange under insulation and ballast. Do not mechanically fasten.

G. Door Thresholds: Remove existing door threshold as required to install flashing cap as shown on drawings. Turn ends up behind frame at jamb and solder water tight. Install new door threshold/stop in bed of sealant as shown.

3.4 MISCELLANEOUS FLASHING INSTALLATION

A. Pipe/ Conduit Enclosures: Install wood curbs constructed to provide 8 inches of vertical clearance above the roof insulation surface. Reroute existing or install new pipes/ conduits to configuration shown on the Drawing so conduits slope away from curb. Field verify dimensions and fabricate counterflashing and enclosure as shown on Drawing. Solder all joints, except as noted. Reconnect mechanical equipment, and verify units function properly. Fill enclosure with fiberglass batt insulation.

3.5 COPING

A. Install additional treated wood nailers stacked on top of parapet walls as indicated. Secure in accordance with FM 1-49 'Perimeter Fastening' and the following:

1. Secure first nailer to concrete parapet with expansion anchor bolts as indicated.
2. Secure subsequent nailers with two rows of nails spaced 12 inches on center, staggered.
3. Provide treated wood shim to slope top nailer as indicated.

B. Place back-up plate at coping seam locations, place two beads of sealant along edges of plate, then hook outside edge of coping to installed continuous cleat and lay down coping on prepared substrate. Set cover plate over joint. Back seal cover plate with two beads of sealant.

C. Special Ends: Fabricate end sections of coping where coping abuts higher with 4 inch wide side flanges at roof side and a 4 inch wide upturned flange on top of curb. Solder sheet metal patch to fill area between flanges. Secure end section to wall with two nailins per flange. Cover top edge of upturned coping end section with upper coping section, or with base flashing depending on location.

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 and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. 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

SECTION 078413 - THROUGH-PENETRATION FIRESTOP 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 through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. Related Sections include the following:
1. Division 23 Sections specifying duct and piping penetrations.
2. Division 26 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls, including fire partitions, fire barriers and smoke barriers.
2. Fire-resistance-rated horizontal assemblies, including floor/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

a. Penetrations located outside wall cavities.
b. Penetrations located outside fire-resistance-rated shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

E. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.

F. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.

B. Installation Responsibility: Assign installation of through-penetration firestop systems in Project to a single qualified installer.

C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, OPL ITS, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:

a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

1) UL in its "Fire Resistance Directory."

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 that are produced by one of the following manufacturers:

1. A/D Fire Protection Systems Inc.
2. Grace, W. R. & Co. - Conn.
3. Hilti, Inc.
4. Johns Manville.
5. Nelson Firestop Products.
6. NUCO Inc.
7. RectorSeal Corporation (The).
8. Specified Technologies Inc.
9. 3M; Fire Protection Products Division.
10. Tremco; Sealant/Weatherproofing Division.
11. USG Corporation.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

a. Slag-/rock-wool-fiber insulation.
b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. 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, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to

remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required achieving fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after firestop installations comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.6 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Firestop Systems with No Penetrating Items:

1. UL-Classified Systems: C-AJ- 0001-0999, W-L-000-1-0999.
2. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Silicone sealant.
c. Intumescent putty.
d. Mortar.

C. Firestop Systems for Metallic Pipes, Conduit, or Tubing:

1. UL-Classified Systems: C-AJ-1001-1999, W-L-1001-1999.
2. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Silicone sealant.
c. Intumescent putty.
d. Mortar.

D. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. UL-Classified Systems: C-AJ-2001-2999, W-L-2001-2999.
2. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Silicone sealant.
c. Intumescent putty.
d. Intumescent wrap strips.
e. Firestop device.

E. Firestop Systems for Electrical Cables:

1. UL-Classified Systems: C-AJ-3001-3999, W-L-3001-3999.
2. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Silicone sealant.
c. Intumescent putty.
d. Silicone foam.
e. Pillows/bags.

F. Firestop Systems for Insulated Pipes:

1. UL-Classified Systems: C-AJ-5001-5999, W-L-5001-5999.

2. Type of Fill Materials: One or more of the following:

   a. Latex sealant.
   b. Intumescent putty.
   c. Silicone foam.
   d. Intumescent wrap strips.

G. Firestop Systems for Miscellaneous Electrical Penetrants:

1. UL-Classified Systems: C-AJ-6001-6999, W-L-6001-6999.
2. Type of Fill Materials: One or more of the following:

   a. Latex sealant.
   b. Intumescent putty.
   c. Mortar.

H. Firestop Systems for Miscellaneous Mechanical Penetrants:

1. UL-Classified Systems: C-AJ-7001-7999, W-L-7001-7999.
2. Type of Fill Materials: One or both of the following:

   a. Latex sealant.
   b. Mortar.

I. Firestop Systems for Groupings of Penetrants:

1. UL-Classified Systems: C-AJ-8001-8999, W-L-8001-8999.
2. Type of Fill Materials: One or more of the following:

   a. Latex sealant.
   b. Mortar.
   c. Intumescent wrap strips.
   d. Firestop device.
   e. Intumescent composite sheet.

END OF SECTION 078413

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Service doors.

B. Related Section:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

2. Section 075610 – “Hot Fluid-Applied Roofing” for wind loads and environmental conditions.

1.2 PERFORMANCE REQUIREMENTS

A. General: Install service door assemblies to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to [SEI/ASCE 7]

1. Wind Loads: Design door assembly to withstand wind/suction loads without damage to door or assembly components.
   a. Environmental Conditions and Wind Loads as indicated in Division 7 specification section(s).

2. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.

C. Windborne-Debris-Impact-Resistance Performance: Provide impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and ASTM E 1996.
   1. Small Missile Test: For overhead coiling doors located more than 30 feet (9.144 m) above grade.

D. Thermal Movements: Provide door assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide anchors and fasteners that resist rotation and avoid shear stress as a result of thermal movements. Base engineering

calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 150 deg F, ambient; 200 deg F, material surfaces.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. 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.

C. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

B. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from metal to match curtain slats and finish.

C. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.2 HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
   1. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.3 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from inside side.

B. Chain Lock Keeper: Suitable for padlock.

C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.4 CURTAIN ACCESSORIES

A. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.

B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door. Provide pull-down straps or pole hooks for doors more than 84 inches (2130 mm) high.

2.5 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.6 MANUAL DOOR OPERATORS

A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.

B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25 lbf (111 N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.7 DOOR ASSEMBLY

A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings by Overhead Door Corporation or comparable product by one of the following:
   b. C.H.I. Overhead Doors.
   c. Cornell Iron Works, Inc.
   d. Dynamic Closures Corp.
   e. Lawrence Roll-Up Doors, Inc.
   f. McKeon Rolling Steel Door Company, Inc.
   g. Metro Door.
   h. Wayne-Dalton Corp.

B. Operation Cycles: Not less than 20,000

C. Door Curtain Material: Galvanized steel

D. Door Curtain Slats: Curved or Flat profile slats of 1-1/4-inch (32-mm), 1-1/2-inch (38-mm),1-7/8-inch (48-mm), 2-5/8-inch (67-mm), or 3-1/4-inch (83-mm) center-to-center height.

E. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

F. Hood: Match curtain material and finish

1. Shape: As shown on Drawings
2. Mounting: As shown on Drawings.

G. Locking Devices: Equip door with slide bolt for padlock and chain lock keeper.

H. Manual Door Operator: Chain-hoist operator

1. Provide operator with through-wall shaft operation.
2. Provide operator with manufacturer's standard removable operating arm.

I. Finishes:
1. Door and Hood Finish: Baked-Enamel or Powder-Coated Finish: Color matching existing exterior walls.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer. Adjust seals to provide weathertight fit around entire perimeter.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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. Storefront system, complete with reinforcing, fasteners, anchors, and attachment devices.

2. Accessories necessary to complete work.

B. Related Sections:
1. Division 26 Sections for electrical requirements of automatic door operators and exit signs.
2. Division 7 for sealants and gaskets at entrances and storefronts.
3. Division 8 Section “Glazing” for glazing gaskets and sealants.

C. Products Furnished But Not Installed Under This Section:

1. Anchoring devices which are built into masonry.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
d. Glazing-to-glazing contact.
e. Noise or vibration created by wind and by thermal and structural movements.
f. Loosening or weakening of fasteners, attachments, and other components.
g. Sealant failure.
h. Failure of operating units.

4. Design Wind Loads: Determine design wind loads applicable to the Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
   a. Basic Wind Speed (MPH): 90 mph
   b. Importance Factor (I, II, III): I
   c. Exposure Category (A, B, C, D): C

B. Storefront System Performance Requirements:

1. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft2 (0.3 l/s · m2) at a static air pressure differential of 6.24 psf (300 Pa).
2. Uniform Load: A static air design load of 20 psf (958 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

C. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Glazing.
4. Brake metal.

E. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

F. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of aluminum-framed systems.
2. Include design calculations.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and testing agency.

B. Welding certificates.

C. Preconstruction Test Reports: For sealant.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

E. Source quality-control reports.

F. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.

G. Field quality-control reports.

H. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.

E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

F. Accessible Entrances: Comply with applicable provisions in-ICC/ANSI A117.1.

G. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

H. Structural-Sealant Glazing: Comply with ASTM C 1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.

I. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

J. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

K. Preinstallation Conference: Conduct conference at Project site.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Adhesive or cohesive sealant failures.
e. Failure of operating components.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six (6) months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Trifab-400 Storefront System or comparable product by one of the following:
1. Arch Aluminum & Glass Co., Inc.
2. EFCO Corporation.
3. United States Aluminum.
4. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
5. YKK AP America Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Nonthermal
2. Glazing System: Retained by structural sealant at vertical edges and mechanically with gaskets at horizontal edges
3. Glazing Plane: As indicated.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:

1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.

a. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Color: As selected by Architect from manufacturer's full range of colors.

2.5 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: As indicated on drawings to match existing dimensions of stiles and rails.

a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

C. Pivot Hinges: BHMA A156.1, Grade 1.

1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

D. Panic Exit Devices: To match existing.

1. Must meet BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
2. Exit only function, no pull or operating trim on exterior side of doors.

E. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing. Match keying of existing adjacent doors, or as directed by owner.

F. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to meet field conditions and requirements for opening force.

G. Power Assist and Low Energy Power Door Operators: BHMA A156.19

1. Signage mounted on glass indicating power operated door.
2. Operator to be mounted on pull side of door.
3. Opens and closes door.

H. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

I. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

2.7 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 "Joint Sealants."

1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

F. Storefront Framing: Fabricate components for assembly using manufacturer's standard installation instructions.

G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. Provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. Provide weather sweeps applied to door bottoms.

I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate structural-sealant-glazed systems.

B. Structural-Sealant-Glazed Systems: Perform quality-control procedures complying with ASTM C 1401 recommendations, including, but not limited to, system material-qualification procedures, sealant testing, and system fabrication reviews and checks.

C. Structural-sealant-glazed system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure non-movement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

D. Install glazing as specified in Section 088000 "Glazing."

1. Structural-Sealant Glazing:

a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
b. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

E. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

F. Install perimeter joint sealants as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
2. Alignment:

a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Structural-Sealant Glazing Inspection: After installation of aluminum-framed systems is complete, structural-sealant glazing shall be inspected and evaluated according to recommendations in ASTM C 1401.
2. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. (0.03 L/s per sq. m), of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers and door operators to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

3.6 ENTRANCE DOOR HARDWARE SETS

Door Hardware Set No.001
Door No. 001; has the following:

Qty.	Item	Description	Manufacturer	Finish
4	Off-set Pivot Hinges	To match existing	To match existing	Polished stainless Steel
1	Exit Device	To match existing	To match existing	Polished stainless Steel
1	Door Operator	To match existing	To match existing	Polished stainless Steel
1	Activation Switch	To match existing	To match existing	Polished stainless Steel
1 set	Sweep	To match existing	To match existing	Polished stainless Steel
1 set	Weatherstripping	To match existing	To match existing	Black
1	Heavy Duty Threshold	To match existing	To match existing	Mill finish Aluminum

Door Hardware Set No.002
Door No. 002; has the following:

Qty.	Item	Description	Manufacturer	Finish
4	Off-set Pivot Hinges	To match existing	To match existing	Polished stainless Steel
1	Exit Device	To match existing	To match existing	Polished stainless Steel
1	Closing Device	To match existing	To match existing	Polished stainless Steel
1 set	Sweep	To match existing	To match existing	Polished stainless Steel
1 set	Weatherstripping	To match existing	To match existing	Black
1	Heavy Duty Threshold	To match existing	To match existing	Mill finish Aluminum

END OF SECTION 084113

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Storefront framing.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:

   1. Design Wind Pressures:
      a. Design Wind Speed: 90 mph for 3 second gusts
      b. Importance Factor: 1.0 (Use Category I)
      c. Exposure: Exposure C

   2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

   3. Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads:
      a. Outward design wind pressure plus the weight of the glass. Base design on glass type factors for short-duration load.
      b. Inward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

   1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.4 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

C. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Preconstruction adhesion and compatibility test report.

1.5 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: **GANA's "Laminated Glazing Reference Manual" and** GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."

B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

1.6 WARRANTY

A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Ten (**10)** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent.

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. AFG Industries, Inc.; Krystal Klear.
b. Guardian Industries Corp.; Ultrawhite.
c. Pilkington North America; Optiwhite.
d. PPG Industries, Inc.; Starphire.

C. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
1. EPDM complying with ASTM C 864.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.4 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
4. Colors of Exposed Glazing Sealants: To match existing, as selected and verified by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

2.5 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.6 MONOLITHIC-GLASS TYPES

A. Glass Type **GL-**1: Clear fully tempered float glass.
1. Provide safety glazing labeling.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

SECTION 099113 - EXTERIOR PAINTING

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 surface preparation and the application of paint systems on the following exterior substrates:

1. Brick.
2. Steel.
3. Galvanized metal.

B. Related Sections include the following:
1. Division 05 Sections for shop priming of metal substrates.
2. Division 08 Sections for factory priming doors.
3. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 SUBMITTALS

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

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. COTR will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m), or as appropriate for application.
b. Other Items: COTR will designate items or areas required.

2. Final approval of color selections will be based on benchmark samples.

a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by COTR at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Benjamin Moore & Co.
2. ICI Paints.
3. Kelly-Moore Paints.
4. PPG Architectural Finishes, Inc.
5. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

C. Colors: As selected by COTR from manufacturer's full range.

2.3 PRIMERS/SEALERS

A. Alkali-Resistant Primer: MPI #3.

1. Sherwin-Williams; Loxon Concrete and Masonry Primer A24W8300.
2. VOC Content: E Range of E3

B. Bonding Primer (Water Based): MPI #17.

1. Benjamin Moore; Fresh Start All-Purpose Acrylic Primer 023.

2. VOC Content: E Range of E3.

2.4 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

B. Alkyd Anticorrosive Metal Primer: MPI #79.
1. Kelly-Moore; Kel-Gard Alkyd Rust Inhibitive Primer.
2. VOC Content: E Range of E2.

2.5 EXTERIOR LATEX PAINTS

A. Exterior Latex (Flat): MPI #10 (Gloss Level 1).
1. Benjamin Moore; Moorcraft Super Spec 100% Acrylic Exterior Flat 183-01.

2. VOC Content: E Range of E3.

B. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).
1. Benjamin Moore; Aura Waterborne Exterior Paint, Semi-Gloss Finish 632.

2. VOC Content: E Range of E3.

2.6 QUICK-DRYING ENAMELS

A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
1. Sherwin-Williams; Industrial Enamel B54 Series.

2. VOC Content: E Range of E2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Clay Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content of surfaces or alkalinity of mortar joints to be painted exceed that permitted in manufacturer's written instructions.

F. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

G. Steel and Iron Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 099113

SECTION 230000 – COMMON MECHANICAL AND ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes.

1. This Section includes the basic requirements peculiar to Division 23 and forms an integral part of each mechanical section included in those Divisions. This Section supplements the General Requirements in Division 01.
2. Perform work and provide material and equipment as shown on the drawings, as specified and in accordance with this Section. Completely coordinate work of this Division with work of others and provide a complete and fully functional installation.
3. Drawings and Specifications form complimentary requirements. Provide work specified and not shown, work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation
4. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from authorities that have jurisdiction. Perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.
5. Examine Drawings and other Sections of Specifications for requirements that affect work of this Section.
6. Attention is directed to the following specialized requirements of this Section:
   a. Paragraph GUARANTEE AND 24-HOUR SERVICE. The requirement to provide a 24 hour phone number for service during the guarantee period is incorporated; also, an extended warrantee to cover the full one year contractor's guarantee period starting on the date of beneficial occupancy, even if equipment has been previously used for temporary heat or other purpose.
   b. Paragraph RECORD DRAWINGS. A requirement to incorporate photographs, taken during construction, of buried and concealed components is incorporated.
   c. Paragraph SUBMITTALS. A special cover sheet for each shop drawing, to be filled out by the contractor, is required. A description of "Acceptable Manufacturers" is included. No other manufacturers will be considered for this project. The turn-around time Vanderweil requires to process shop drawings is described.

B. Related Sections

1. Concrete bases
   a. Concrete pads and bases are required for all floor-mounted mechanical equipment. These pads and bases are provided under Division 03-CONCRETE.
   b. Furnish the proper size and shape and any other pertinent information regarding these pads and bases from equipment supplier Shop Drawings, along with any requirements for inserts or anchor bolts, and supervise their installation prior to the pouring of the pads and bases.

1.2 DEFINITIONS

A. As used in Division 23 Sections, "provide" means "furnish and install." "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project. "Architect" means the "Prime Design Consultant." If R.G. Vanderweil Engineers, LLP is not the prime design consultant, the Architect may authorize R.G. Vanderweil Engineers, LLP to act on the Architect's behalf in matters concerning the Division 23 Sections of specifications.

B. "RFI" means "Contractor's Request for Information."

1.3 CONTRACT DOCUMENTS

A. Listing of Drawings does not limit responsibility of determining full extent of work required by these Contract Documents. Refer to Architectural, HVAC, Electrical, and all other Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of this Section must be coordinated

B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of an item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, provide all other components and materials necessary to make the systems fully complete and operational.

E. Information and components shown on riser diagrams, but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.

F. Data that may be furnished electronically (on compact disk (CD), electronic mail, or otherwise) is diagrammatic. Electronically furnished information is subject to the same limitation of precision described above. If furnished, electronic data is for convenience and generalized reference, and shall not substitute for sealed or stamped construction documents.

1.4 ELECTRONIC CAD FILES

A. Electronic CAD files for HVAC drawings will be furnished by Engineer at contractor’s request. These files will be provided on CD in the AutoCAD Release used by the Engineer. If any other media or AutoCAD version is requested, Engineer will require advance reimbursement of processing costs.

B. Requests should be made by filling out the following form and providing an authorized signature. The requested information will not be released prior to receipt of the completed Release of Liability Form for the appropriate documents.

1.5 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are unclear, submit clarification request in writing before Award of Contract. Otherwise, Architect's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or unclarities thus resolved.

B. Where Drawings or Specifications do not coincide with manufacturers' recommendations or with applicable codes and standards, submit clarification request in writing before installation. Otherwise, make changes in installed work required for compliance with manufacturer instructions or codes and standards within Contract Price.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specs, provide material, installation or work that is of the higher standard.

D. It is the requirement of these contract documents to require provision of systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In these cases, where notification required by Paragraph (A) above has not been submitted, provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed in accordance with the design intent.

E. In cases covered by Paragraph (D) above, where the contractor believes engineering guidance is needed, submit a sketch identifying proposed solution. Architect shall review, note if necessary, and approve the sketch.

F. Where discrepancies exist between the mechanical and electrical drawings in regards to what trade owns equipment such as disconnects, starters, etc., the discrepancy shall be brought to the Architect’s attention in accordance with paragraph (A) above. If the scope is not resolved prior to the Award of Contract, the Electrical Contractor shall provide such items.

1.6 CODES, STANDARDS, AUTHORITIES AND PERMITS

A. Perform work in accordance with rules, regulations, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities that have legal jurisdiction over the site.

B. Prior to work commencement of work, notify State and applicable authorities and submit all of the applicable notifications for construction, operation and/or demolition.

C. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

1. Local and state building, plumbing, mechanical, electrical, fire and health department codes.
2. American Gas Association (AGA).
3. National Fire Protection Association (NFPA).
4. American Insurance Association (AIA) (formerly National Board of Fire Underwriters).
5. Occupational Safety and Health Act (OSHA).
6. Underwriters Laboratories (UL)
7. Factory Mutual Association (FM)
8. Owner’s Insurance Underwriter.

D. Material and equipment shall be listed by Underwriters' Laboratories (UL), and approved by ASME, ANSI, ASTM, and AGA for intended service.

E. When requirements cited in this Specification conflict with each other or with Contract Documents, most stringent shall govern work. Architect may relax this requirement when relaxation does not violate ruling of authorities that have jurisdiction. Approval for relaxation shall be obtained in writing.

F. Unless indicated otherwise, the most recent editions of applicable specifications and publications of the following organizations form part of these Contract Documents.

1. American National Standards Institute (ANSI).
2. American Society of Mechanical Engineers (ASME).
3. National Electric Manufacturers Association (NEMA).
4. American Society for Testing and Materials (ASTM).
5. American Water Works Association (AWWA).
6. American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
7. Air Moving and Conditioning Association (AMCA).
8. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
9. Air Conditioning and Refrigeration Institute (ARI).
10. Thermal Insulation Manufacturers Association (TIMA).
11. Institute of Electrical and Electronics Engineers (IEEE).
12. Insulated Cable Engineers Association (ICEA).
13. Manufacturer's Standardization Society of the Valve & Fittings Industry (MSS)

G. Specific reference is made to the following NFPA standards which contain an exceptionally high quantity of mechanical, electrical, and fire protection requirements. These standards as referenced by the State Building Code shall apply in full.

1. No. 13 - Installation of Sprinkler Systems
2. No. 14 - Installation of Standpipe and Hose Systems
3. No. 20 - Installation of Centrifugal Fire Pumps
4. No. 30 - Combustible Liquids
5. No. 37 - Installation of Use of Stationary Combustion Engines and Gas Turbines
6. No. 45 - Fire Protection for Laboratories Using Chemicals
7. No. 70 - National Electric Code
8. No. 72 - National Fire Alarm Code
9. No. 101 - Life Safety Code

H. Secure and pay for all permits and inspections required by the Authorities having Jurisdiction. Secure trade permits prior to beginning work.

1.7 GUARANTEE AND 24 HOUR SERVICE

A. Guarantee the Work of this Section in writing for one year following the date of Substantial Completion. If the equipment is used for ventilation, temporary heat, or other use prior to initial beneficial occupancy by the Owner, the bid price shall include an extended period of warranty covering the one-year of beneficial occupancy by the Owner. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Architect's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

B. In addition to guarantee requirements of Division 1 and of Paragraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

C. Replace material and equipment that require excessive service during guarantee period. Excessive service shall be defined as more than 3 service calls for the same material or equipment within a 12 month period.

D. Provide 24-hour service beginning on the date of Substantial Completion and lasting until the termination of the guarantee period. Service may be provided by a separate service organization subject to Owner approval. Submit name and a phone number that will be answered on a 24-hour basis each day of the week, for the duration of the service.

E. Submit copies of equipment and material warranties before final payment.

F. At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to Owner.

G. This Paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

H. Part 2 paragraphs of Division 23 specification Sections may specify warranty requirements that exceed those of this Paragraph.

I. Use of systems provided under this Section for temporary services and facilities shall NOT constitute Final Acceptance of work nor beneficial use by Owner, and shall not institute guarantee period.

J. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will suggest course of action.

1.8 RECORD DRAWINGS

A. Refer to requirements under Division -1 - GENERAL REQUIREMENTS and requirements below.

B. Each trade shall submit the record set for approval by the Authority Having Jurisdiction in a form acceptable to the Authority, when required by the jurisdiction. Such drawing format size changes, and supplemental information required for the submittal are the requirement of the contractor.

1.9 BULLETINS, MANUALS, AND OPERATING INSTRUCTIONS - ELECTRONIC FORMAT

A. Obtain at time of purchase of equipment, electronic versions of operation, lubrication and maintenance manuals for all items. Assemble this literature along with other information in coordinated electronic manuals with additional information describing combined operation of field assembled units, including as-built wiring diagrams. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. Divide manuals into three sections or books as follows:

1. Engineering flow diagrams and controls sequences from project mechanical drawings, approved automatic temperature controls submittal, equipment startup procedures and operational instructions. Startup and operational instructions shall list valves, switches, and other devices used to start, stop and control systems. Describe procedure to be followed in case of malfunctions. Include approved valve directory showing each valve number, location of each valve, and equipment or fixture controlled by valve.

2. Detailed maintenance and troubleshooting manuals containing data furnished by manufacturer for complete maintenance. Include copy of balancing report.

3. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment. Include additional instructions necessary for implementation of first class lubrication program. Include approved summary of lubrication instructions in chart form, where appropriate.

B. Submit electronic version of manual(s) to Architect for approval. After approval, submit electronic version and one hard copy for Architect's distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.

C. Operating instructions: Upon completion of installation, prior to Owner accepting portions of building and equipment for operational use, instruct Owner's operating personnel in operation of systems and equipment. Instruction shall be performed by equipment and controls vendors' factory-trained personnel. Owner shall determine which systems require additional instruction. Duration of instructions for controls shall take equipment through complete cycle of operation (at least five working days). Make adjustments under operating conditions.

1.10 GENERAL REFERENCES

A. Air Moving and Control Association (AMCA)

1. 204 – Balance Quality and Vibration Level for Fans

B. American National Standards Institute, Inc. (ANSI)

1. HI 1.1 - 1.5 - Centrifugal Pumps - Nomenclature, Definitions, Application and Operation.

C. American Society of Mechanical Engineers (ASME)

1. B15.1 - Safety Standards for Mechanical Power Transmission Apparatus.
2. B31.1 - Power Piping.
3. Boiler and Pressure Vessel Code.
   a. Section IX - Welding and Brazing Qualifications.

D. American Society for Non-Destructive Testing, Inc. (ASNT)

1. SNT-TC-1A - Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing.

E. American Welding Society (AWS)

1. D1.1 - Structural Welding Code - Steel.
2. QC1 - Specifications for Qualification and Certification of Welding Inspectors.

F. National Fire Protection Association (NFPA)

1. 70 - National Electric Code.

G. Occupational Safety and Health Administration (OSHA)

1. 1910.219 - Mechanical Power - Transmission Apparatus.

1.11 REFERENCE TO DESIGN DRAWING SCHEDULES

A. Maximum and Minimum Requirements

1. Refer to equipment schedules for equipment identification number and corresponding area location, capacity, and design requirements.
2. Wherever schedules or notes appear in the Contract Documents in which sizes and capacities of equipment are indicated or specified, provide equipment under the Contract which meets the following requirements under operating conditions:

   a. The rpm, the outlet velocities, tip speeds and the NC ratings specified are the maximum that will be accepted.
   b. The airflow (cfm), the static pressure on fans, the water flow (gpm) and the total head on pumps, are the minimum that will be accepted.

3. Motor horsepower ratings specified or shown: the minimum acceptable; indicated motor speeds: the maximum acceptable. If a motor is provided having a larger horsepower rating than specified, provide the associated increased wire, breaker, starter, fuses, overload protection, etc., at no additional cost. Provide the increased motor circuit in accordance with the "Motor Circuit Sizing Schedule" indicated. Do not provide increased motor horsepower which together add more than 5 percent to the load of an electrical distribution equipment item (i.e., Motor Control Center, Power Panel, etc.).

1.12 SUBMITTALS

A. Shop Drawings, Product Data and Samples

1. Submit Shop Drawings, Product Data and Samples for the materials, equipment and systems (products) so specified elsewhere in Divisions 22, 23 and 28.
2. Refer to Section 013300 for submittal requirements.
3. Refer to Section 016000 for product options and substitutions.
4. Submit MSDS or product data, highlighting VOC content, for all field-applied adhesives, sealants, paints and coatings installed within the building waterproofing envelope.
5. Acceptable Manufacturers: The Architect's mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. Alternate Manufacturers are listed as being acceptable. These are acceptable only if, as a minimum, they:

   a. Meet all performance criteria listed in the schedules and outlined in the specification. For example, to be acceptable, a pump must deliver equal flow against equal pressure using equal or less horsepower as the pump listed in the schedules.
   b. Have identical operating characteristics to those called for in the specification. For example, a reciprocating compressor will not be acceptable if a rotary model is specified.
   c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer’s name appears as acceptable shall not be taken to mean that the Architect has determined that the manufacturer’s products will fit within the available space - this determination is solely the responsibility of the contractor.

d. For rooftop mounted equipment and for equipment mounted in areas where structural matters are a consideration, the products must have a weight no greater than the product listed in the schedules or specifications.

e. Products must adhere to all architectural considerations including, but not limited to: being of the same color as the product scheduled or specified, fitting within architectural enclosures and details, and for diffusers and plumbing fixtures - being the same size and of the same physical appearance as scheduled or specified products.

B. Coordination Drawings

1. Refer to Section 013100.

C. Equipment Performance Curves

1. Fans

a. Submit performance curves on each fan for approval, indicating fan pressure volume and horsepower curves. The fan volume selection points: a minimum of fifteen percent greater than the volume at the peak of the pressure volume curve. No point on the pressure-capacity curves shall exceed the motor horsepower selected to drive the fan. Maximum motor horsepower at the selection point: 95 percent of the rated motor horsepower. On the performance curves, include the effects of all accessory items, such as inlet vanes or scroll dampers. Since some fans may be scheduled for future higher duty, select fans that meet both the flow and pressure scheduled on the Drawings.

2. Pumps

a. Submit certified performance characteristic curves on each pump for approval, indicating the pump flow (gpm), efficiency, head, brake horsepower and NPSHR curves throughout the entire range of the pump. No point on the head-capacity curve shall exceed the motor horsepower selected to drive the pump. Maximum motor horsepower at the selection point: 95 percent of the rated motor horsepower. Since some pumps may be scheduled for future higher duty, select pumps that meet both the flow and pressure scheduled on the Drawings.

D. Operation and Maintenance Manuals

1. Refer to requirements in Division 01, including section 017823 and the following:

a. In the parts lists for equipment, indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the building site.

b. Provide the manual complete in all respects for all equipment, controls, accessories, and associated appurtenances provided.

E. Posted Operating Instructions

1. Furnish operating instructions for each system and each principal piece of equipment as required under section 017823.

2. For operating instructions exposed to the weather, use weather-resisting materials or enclose suitably so as to be weather protected. Provide operating instructions which do not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.13 QUALITY ASSURANCE

A. New Products

1. Provide all piping, valves, ductwork, equipment and miscellaneous accessories and appurtenances which are new. Do not permit previously used material of any kind to be incorporated into any of the building systems.

B. Equipment Design

1. Design equipment and accessories not specifically described or identified by manufacturer's catalog numbers in conformity with applicable technical standards and suitable for maximum working pressure, test pressure and temperatures required.

C. Equipment Installation

1. Obtain manufacturer's printed installation instructions to aid in properly executing work of installing equipment whenever such instructions are available.
2. Erect equipment in a neat and workmanlike manner. Align, level and adjust for satisfactory operation. Install so that connecting and disconnecting of piping and accessories can be made readily, and so that parts are easily accessible for inspection, operation, maintenance and repair. Minor deviation from arrangements indicated may be made, as approved.

D. Packaged Equipment

1. Provide packaged equipment, where specified, which is completely factory assembled, including all mechanical and electrical components mounted on a common base or in a common enclosure with all piping, controls and wiring factory installed ready to be incorporated into the mechanical system.

E. Quietness of Operation

1. Pumps, fans, motors and other equipment with moving parts have been especially selected for quietness of operation.
2. For equipment other than that specified, submitted by the Contractor for approval, submit written statements from the manufacturer and the Contractor that said equipment is at least as quiet as that specified and include certified sound test data to support the claims made.

F. Vibration Isolation

1. Vibration isolation devices for isolating equipment, ductwork and piping from the building structure are specified under Section 230548. Procure these devices from a single vibration materials manufacturer through a local representative. Furnish the local representative with copies of Shop Drawings of all equipment requiring vibration isolation and access to the Drawings that show the ductwork and piping that require vibration isolation.
2. For equipment requiring factory installation of vibration isolators, furnish the equipment manufacturer with the identity of the supplier of the vibration isolation manufacturer selected for the Project. Submittals for equipment not equipped with the product of the vibration isolation manufacturer selected for the Project will be rejected.

1.14 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices.

D. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

E. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing concealment.

1.15 WARRANTIES

A. General

1. Submit Special Warranties for the products so specified elsewhere in Division 23.
2. Submit Statements of Compliance for the products so specified elsewhere in Division 23 & 28.
3. Guarantee the Work of this Section in writing for one year following the date of Substantial Completion. If the equipment is used for ventilation, temporary heat, or other use prior to initial beneficial occupancy by the Owner, the bid price shall include an extended period of warranty covering the one-year of beneficial occupancy by the Owner.
4. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Architect's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.
5. In addition to guarantee requirements of Division 01 and of Paragraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.
6. Replace material and equipment that require excessive service during guarantee period. Excessive service shall be defined as more than 3 service calls for the same material or equipment within a 12 month period.
7. Provide 24-hour service beginning on the date of Substantial Completion and lasting until the termination of the guarantee period. Service may be provided by a separate service organization subject to Owner approval. Submit name and a phone number that will be answered on a 24-hour basis each day of the week, for the duration of the service.
8. Submit copies of equipment and material warranties before final payment.
9. At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to Owner.
10. This Paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.
11. Division 23 specification Sections may specify warranty requirements that exceed those of this Paragraph.
12. Use of systems provided under this Section for temporary services and facilities shall NOT constitute Final Acceptance of work nor beneficial use by Owner, and shall not institute guarantee period.
13. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will suggest course of action.

B. Service During Contract Correction Period

1. In the event of the failure of any system or its component equipment items or the improper functioning thereof, within the period provided in The Conditions of the Contract for correction of the Work, or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required elsewhere in Division 23, have available and "on call" within eight hours or less, competent service personnel for the restoration of systems and equipment for complete operation.
2. Should the nature of the failure be such as to present an emergency, in the opinion of the Owner, make such personnel promptly available, regardless of the hour of the day or the day of the week.
3. Should the failure be such as to fall under this warranty, pay the cost of the services; otherwise the Owner will pay for such service at the prevailing rate.
4. Should the Contractor fail to make such service personnel available "on call" within eight hours or less, the Owner may employ such personnel as are available to the Owner, at the expense of the Contractor.

1.16 MODIFICATIONS IN LAYOUT

A. Drawings are diagrammatic. They indicate general arrangements of mechanical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.

B. In order to obtain the intended aesthetics in spaces used by building occupants, prior to installation of visible material and equipment (including access panels), review Architectural Drawings for desired locations and where not definitively indicated, request information from Architect.

C. Check Contract Drawings, as well as Shop Drawings, to verify and coordinate spaces in which work of this section will be installed.

D. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to paragraphs above. Systems shall be run in a rectilinear fashion.

F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

1.17 RELATED WORK IN OTHER SECTIONS

A. The following work is not included in Division 23 Sections and shall be performed under other Sections.

1. Concrete work, including concrete housekeeping pads and other pads and blocks for vibrating and rotating equipment.
2. Flashing of wall and roof penetrations.
3. Electric power wiring for all equipment shall be provided by Division 26 Electrical.

4. Installation of circuit breakers (furnished by ATC Contractor) and final electrical panel terminal connections for ATC control power wiring shall be provided by Division 26 Electrical.

1.18 SITE VISIT

A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer.

1.19 EXISTING CONDITIONS AND PREPARATORY WORK

A. Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or other Contracts or by the Owner. Report conditions that might adversely affect work in writing to the Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

PART 2 - PRODUCTS

A. Not Used.

PART 3 - EXECUTION

3.1 ERECTION, INSTALLATION, APPLICATION

A. Coordinate installation with Division 1 Section “Indoor Air Quality Management” requirements.

B. Pump Impeller Trimming For Energy Conservation

1. After the hydronic systems have been balanced and adjusted, remove the impellers from those pumps determined to require trimming by the analysis described in Section 230593 under Article “Pump Test Reports” and trim as directed.

C. Dimensions and Design

1. Provide apparatus and equipment of such dimensions and design as to be adapted to the arrangement of the installation and to fit within the limits of the space available.

D. Stand-Off Brackets

1. Provide insulated equipment, piping and duct work with stand-off brackets for attaching components to allow full insulation thickness.

E. Special Tools

1. Provide tools required to operate, adjust, or make minor repairs to the equipment and install them in a wall mounted wood or metal case. Provide the case with a lock and two keys.

F. Standard Products

1. Provide products and equipment that are essentially the standard product of the manufacturer. Where two or more units of the same product or type of equipment are required, provide these units as products of the same manufacturer.
2. Where the requirements of the Contract Documents exceed that of a manufacturer's standard product in terms of quality, performance or efficiency, the manufacturer shall make special provisions to ensure that the product proposed meets the requirements of the Contract Documents.

G. Substituted Items

1. Should a substitute item be offered and accepted and the substitute item requires services or utilities other than required by the item substituted for, provide those other services or utilities at no additional cost to the Owner.

H. Equipment Locations

1. Mechanical equipment and devices have been shown on the Drawings in the approximate location required for reasons of access, noise control or maintainability. Minor adjustments in location dictated by coordination with other work are permitted. Major relocations for reasons other than these are not to be made without specific written approval.

I. Interferences

1. Before proceeding with the installation of piping and ductwork, inspect the Contract Documents and determine that the location of the Work does not interfere with other work. In case of interference request clarification from the Architect in writing.

J. Holes Through Previously Constructed Walls and Floors

1. Cut holes for the passage of piping and ductwork through previously constructed walls and floors in a neat workman-like manner.
2. Make holes through floors and masonry walls by coring or saw-cutting the hole with minimum oversizing to allow for firesafing or caulking the peripheral space between the pipe or duct and the structure.
3. Make holes through gypsum board walls by sawing with minimum oversizing to allow for firesafing or caulking or for a flange or escutcheon to be placed in a manner to fill or cover the peripheral space between the pipe or duct and the wall.

K. Piping Clearance Over Electrical Equipment

1. Do not run piping over electrical equipment such as transformers, switchgear and panelboards.

L. Piping and Ductwork - Prohibited Locations

1. Do not install piping and ductwork of any kind in Electrical Rooms, tele-communications rooms, or elevator equipment rooms, except that which serves these rooms.

M. Offsets and Transitions

1. In general, some main offsets and transitions of piping and duct work are shown on the drawings in order to indicate approximate locations in plan and elevation where the systems are intended to be run.
2. The Contract Documents are not intended to serve as coordinated construction drawings showing all minor adjustments in locations and duct cross sections that are required for a fully coordinated installation that respects the work of all trades.
3. Fully coordinate the mechanical work within itself and with the work of other trades to ensure the avoidance of all interferences.

N. Lines and Grades

1. Construct Work in conformity with lines and grades as indicated.
2. Lay out the Work and be responsible for lines, elevations and measurements required for the installation of the Work.
3. Space axis lines within building on each floor level so that mechanical work may be laid out with metal tape measure having length of 100 feet maximum. The use of cloth tape for lay-out will not be permitted.

O. Personnel Protection From Suspended Work

1. Where suspended equipment, piping or ductwork or any of their supporting or reinforcing members extend 7 feet or less above the floor or any other walking surface, cover all edges, projecting surfaces and sharp corners with pre-fabricated soft rubber pads, elastomeric insulation, caps or equivalent to prevent injury to personnel.

P. Identification

1. For piping, ductwork, and equipment identification, refer to Section 230553.
2. Nameplates
   a. For each component of equipment, provide the manufacturer's name, catalog number and date of manufacture on a plate securely attached to the item of equipment, or the name and catalog number and date of manufacture may be stamped or cast into the body of the item. Also include data pertinent to the operation and characteristics of the equipment.
3. Charts and diagrams
   a. Provide as directed, the following framed and glass covered diagrams and charts:
      1) Diagrammatic layout of piping systems, showing equipment and giving location of each valve.
      2) Diagrammatic layout of each fan duct system, giving location of each damper, coil, humidifier, volume control box or other such devices.
      3) Diagrammatic layout of automatic temperature control systems, giving location of each instrument, damper and piece of equipment controlled.

Q. Painting

1. Painting is specified in Section 09910.

3.2 COMMISSIONING OF EQUIPMENT AND SYSTEMS

A. Refer to Division 01 for commissioning regarding additional submittal, quality assurance, and product requirements. Coordinate startup, checkout and testing procedures with the aforementioned specification. General contractor and subcontractors are responsible for reviewing, supporting and executing commissioning requirements as defined by this specification.

B. General

1. Completion of start up and commissioning shall be accomplished as a prerequisite for substantial completion.
2. Operate and maintain systems and equipment until final acceptance by the Owner.
3. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the Owner. Acceptance requires, at a minimum, complete systems commissioning.
4. The Owner maintains the right to have access to the entire project site to develop his own operational procedures.
5. The following shall be commissioned:
   a. Chilled Water System including chillers, cooling towers, associated pumps and accessories.
   b. Automatic Temperature Controls and Building Automation Systems as they relate to the new chilled water system.
   c. Refrigerant monitoring, purge and associated air exhaust system.

C. Commissioning Team

1. The commissioning team shall consist of: (a) the Contractor's Commissioning Project Manager ("CxPM"), plus the Project Manager for the controls vendor, plus designated representatives of piping and electrical subcontractors; (b) the Commissioning Authority ("CxA"), (c) a representative of the Owner, (d) if the HVAC engineer is not providing the CxA, then a representative of the HVAC engineer will be on the commissioning team.
2. The CxPM shall be assigned by the Construction Manager and shall be an employee of the Construction Manager, or, if there is no Construction Manager, then the CxPM shall be assigned by the General Contractor and shall be an employee of the General Contractor.
3. The CxPM shall serve as the construction team's single point of contact for the CxA. The CxPM shall be responsible for Contractor oversight and direction of the commissioning effort and for communications to all contractors' and subcontractors' representatives on the commissioning team. It shall be the CxPM's responsibility to ensure that all required parties, including technical representatives of equipment vendors, are present at commissioning related effort when required by this specification and/or when requested by the CxA. The CxPM shall witness all commissioning activities and shall initial commissioning forms to indicate satisfactory completion.
4. During the course of construction, in advance of pre-inspection and functional performance testing, the commissioning team shall meet periodically to plan the commissioning effort. Quantity and frequency of meetings shall be determined by the CxA, and will not exceed a total of four

D. Contractor's Responsibilities

1. The Contractor shall be responsible for the overall management of the commissioning process as well as the specific scheduling of all procedures.

2. Commissioning includes all meetings, planning, scheduling, coordination, inspection testing, adjustment, re-testing, and material and labor necessary to ensure that all commissioned systems operate according to the Construction Documents.
3. Commissioning Plan
   a. Definition: The detailed set of checking and testing procedures, sequences of events, schedules, staffing plans, and management or administrative procedures required to provide a comprehensive coordinated approach for commissioning the systems and equipment described herein.
   b. Prior to the start of construction of any system required to be provided with commissioning services, the Contractor shall prepare and submit for approval, a detailed commissioning plan.
   c. The commissioning plan shall detail the overall approach to commissioning, team organization, sequence and scheduling of activities, checks, tests, and procedures to be employed, coordination and integration of Owner training, methods of team communication and record keeping, and coordination with construction activities required in other Sections of the Project Specifications.
   d. Submit the commissioning plan to the CxA for review and approval.
   e. The completed and approved commissioning plan, and all subsequent revisions to the plan provided during the construction process, shall be provided to the CxA in hard copy and in electronic media form utilizing the same computer programs and the same, or later, program version numbers.
   f. Detailed project scheduling information may be provided in the computer program and format preferred by the Contractor, or may be provided as hard copy only, if a computerized scheduling program is not utilized by the Contractor.
   g. The Contractor shall complete all sections of the Manual and Plan, providing sufficient detail and expanded information as required to fully describe and detail the commissioning work.
4. The phases and overall scope of commissioning are as follows:
   a. Planning. Meeting, scheduling, and coordination to ensure that all parties, including vendors' representatives, know in advance the scope and schedule of what is required of them in the commissioning process.
   b. Commissioning Pre-Inspection (CPI). After equipment is installed, connected, and ready to operate, but before balancing and functional performance testing, the Contractor shall conduct pre-inspection to validate the installation of all equipment being commissioned. This shall be done in accordance with the pre-inspection forms (CPI forms) included in this section of the specification. The CxPM and the respective contractor's commissioning team member shall witness and shall certify the results of the pre-inspection by initialing the respective forms. The CxPM shall advise the CxA of the exact schedule for pre-inspection so that the CxA can witness parts or all of the pre-inspection. A representative of the electrical subcontractor shall be present throughout the CPI process to confirm electrical connections. A representative of the ATC subcontractor shall be present throughout the CPI process to confirm controls connections.
   c. Equipment Startup. After pre-inspection is complete, equipment shall be systematically started up according to the schedule approved by the CxPM and the commissioning team. Representatives of equipment vendors shall be present to observe and to assist in the startup process.
   d. After equipment has been successfully started up and operated, systems shall be tested and balanced. Testing shall include testing and verification of all controls sequences.

e. Functional Performance Tests (FPT). After systems are complete and equipment pre-inspection, startup, and testing and balancing have been completed, contractor shall conduct functional performance testing, in order to validate component and systems performance. This shall be done in accordance with the functional performance testing forms (FPT forms) included in this section of the specifications. The CxPM and the respective contractor's commissioning team members shall witness and shall certify the results by initialing the respective forms. The CxPM shall ensure that representatives of equipment vendors are present to observe and assist in the testing of respective equipment. The CxPM shall advise the CxA of the exact schedule for functional performance testing so that the CxA can witness parts or all of it. The functional performance tests shall be conducted over a continuous nominal one-month period in which the CxPM, and the controls project manager and controls technicians shall be constantly present and available, and the CxA shall be present periodically (on a discretionary basis). The continuous nominal one-month functional performance test period is a nominal duration only. The actual duration may be more or less than one month, but the commissioning effort shall be continuous day to day for whatever duration is required to complete it, and the CxPM, the controls project manager, and the controls technicians shall be constantly present and available.

5. Acceptance of Installation and Closeout
   a. Project Commissioning Record
   a. Prior to final acceptance of the commissioning process, and as a condition of final acceptance of the work, the Contractor shall prepare and submit a detailed project commissioning record to the CxA for review and approval.
   b. The project commissioning record shall detail the overall approach to commissioning, team organization, sequence and scheduling of activities, checks, tests, and procedures employed, Owner training activities, and methods of team communication and record keeping.
   c. The project commissioning record shall include all commissioning procedure results, test data, system or equipment descriptions, adjustments and set-up data, and the procedure descriptions and results of special testing, alignments, and calibrations.
   d. Contractor shall construct and format the project commissioning record utilizing the approved Project Commissioning Plan and information contained in the Project Commissioning Manual.
   e. The completed and approved project commissioning record shall be provided as directed by the Project Commissioning Manual
   b. Acceptance and closeout shall be accomplished when the following has been satisfactorily completed by the contractor and certified by the CxA:
   a. Pre-inspection
   b. Startup, testing, and balancing
   c. Functional Performance Testing
   d. Systems Operating and Maintenance Manual
   e. Warranties and 24 hour Service Phone Number Received
   f. Other requirements of Paragraph 3.7 "Project Closeout Procedure

3.3 COMMISSIONING OF EQUIPMENT AND SYSTEMS

A. General

1. Completion of start up and commissioning shall be accomplished as a prerequisite for substantial completion.
2. Operate and maintain systems and equipment until final acceptance by the Owner.
3. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the Owner. Acceptance requires, at a minimum, complete systems commissioning.
4. The Owner maintains the right to have access to the entire project site to develop his own operational procedures.

B. Comprehensive Work Plan & Reporting
1. Provide detailed, methodical, scheduled, start up and commissioning procedures and execution of same for every system and piece of equipment provided.
2. Attend start up and commissioning meetings on a regular basis.
3. Develop and provide a written work plan with detailed procedures for this work and submit, using shop drawing submittal procedure, within 3 months of the contract award. The work plan shall include provisions for an integrated start up plan and schedule. The plan and schedule shall identify tasks, start and completion dates, critical path items, interface requirements with other trades and major equipment start up, as minimum requirements of the plan.
4. The purpose of this work plan is to provide for smooth, quick, and efficient start up and commissioning of systems and equipment and to provide for a smooth transition to turn the complete, correctly operating building over to the Owner.
5. The Owner and Architect will have input to and be part of the approval process for the start up and commissioning plan.
6. Develop and submit for approval a specific start up, check out and sign off form for each and every system.
7. Develop and submit for approval a specific start up, check out and sign off form for every piece of major equipment.
8. Systems shall be operated under actual or simulated full load conditions. Identify the operating conditions in the work plan.
9. Work plan shall incorporate the "Demonstration of Successful Operation" described below.
10. The Architect/Owner may check the completed and commissioned installation either sequentially as different parts are completed, and/or when the entire installation is complete, at the sole option of the Architect/Owner.
11. Each trade shall arrange that an officer of the contracting company shall certify that each and every system has been tested. At the conclusion of the tests, submit a letter and enclosed commissioning forms signed by the officer stating:
    a. That he/she is an officer of the company.
    b. That he/she certifies that the specified testing of the systems has been performed by the company (give the name and dates of system testing).
    c. The results of the testing, as compared to specified performance, listing the name, title, and company affiliation of all those witnessing and performing these tests.

C. Commissioning
1. Commission equipment and systems in accordance with the approved work plan, completing the start up, check out and sign off forms for each piece of equipment and each system.
2. Provide qualified personnel, equipment, apparatus and services for start up and testing of equipment and systems, to obtain the performance data shown in schedules, as specified or

shown in commissioning forms in compliance with applicable codes, standards, regulations and authorities having jurisdiction including Municipal Inspectors, Owners and Architect.

3. Start up and testing procedures as may be outlined in the various sections of the specifications are the minimum effort required for the project. Use additional procedures required to properly start up and test the systems and equipment actually installed on the job.
4. Prove capacity and performance of equipment by field testing. Install thermowells and gauge connections and at no additional cost to Owner equipment and instruments required for testing.
5. Qualified representative of equipment manufacturer shall be present at test.
6. For each piece of equipment, copy nameplate data and include with the letter and start up, check out and sign off forms referred to above.
7. Do not cover or conceal work before testing and inspection and obtaining approval.
8. Leaks, damage and defects discovered or resulting from start up and testing shall be repaired or replaced by this contract to like new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.

D. Demonstration of Successful Operation

1. After components and systems have been commissioned, provide a 2 week, 24 hour per day fully functional automatic operation period of systems simultaneously. This shall be successfully concluded before systems are accepted by Owner.

3.4 SPECIAL RESPONSIBILITIES

A. Cooperate and coordinate with work of other Sections in executing work of this Section.

1. Perform work so that progress of entire project including work of other Sections shall not be interfered with or delayed.
2. Provide information as requested on items furnished under this Section which shall be installed under other Sections.
3. Obtain detailed installation information from manufacturers of equipment provided under this Section.
4. Obtain final roughing dimensions or other information as needed for complete installation of items furnished under other Sections or by Owner.
5. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under this and other Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance. In case of failure to provide sufficient information in proper time, provide cutting and patching or have same done, at own expense and to full satisfaction of Architect.
6. Provide information as requested as to sizes, number and locations of concrete housekeeping pads necessary for floor-mounted vibrating and rotating equipment provided under this Section. 7. Notify Architect of location and extent of existing piping, conduit, ductwork and equipment that interferes with new construction. In coordination with and with approval of Architect, relocate piping, ductwork and equipment to permit new work to be provided. Remove non-functioning and abandoned piping, ductwork and equipment. Dispose of or store items.

B. Installation Only Items

1. Where it is required that Division 23 install items that it does not purchase, coordinate the delivery and be responsible for their unloading from delivery vehicles and for safe handling and field storage up to the time of installation. Division 23 shall be responsible for:

    a. Necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
    b. Their connection to building systems including the purchase and installation of terminating fittings necessary to adapt and connect them to the building systems.

2. Carefully examine items upon delivery. Claims that these items have been received in a condition that their installation will require procedures beyond the reasonable scope of work of this contract will be considered only if presented in writing within one week of their date of delivery. Unless claims have been submitted, fully recondition or replace damaged items.

C. Maintenance of equipment and systems: Maintain equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

D. Use of premises shall be restricted as defined below:

1. Remove and dispose of dirt and debris, and keep premises clean. During progress of work, remove equipment and unused material. Put building and premises in neat and clean condition, and do cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of Architect.
2. Store materials in a manner that will maintain an orderly clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
3. Do not interfere with function of existing sewers and water and gas mains, electrical, or mechanical systems and services. Extreme care shall be observed to prevent debris from entering pipe, ductwork and equipment. Confer with Architect as to disruption of services or other utilities due to testing or connection of new work to existing. Interruption of services shall be performed at time of day or night deemed by Owner to provide minimal interference with normal operation. Obtain Owner's approval of the method proposed for minimizing service interruption.

E. Surveys and Measurements:

1. Base measurements, both horizontal and vertical, on reference points established by Contractor and be responsible for correct lay out of work.
2. In event of discrepancy between actual measurements and those indicated, notify Architect in writing and do not proceed with work until written instructions have been issued.

F. Fireproofing:

1. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, prior to start of spray fiber work.

2. Ducts, piping and other items that would interfere with proper application of fireproofing shall be installed after completion of spray fiber work.
3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this Section shall be performed by installer of fireproofing and paid for by trade responsible for damage and shall not constitute grounds for an extra to Owner.

G. Temporary Utilities:

1. Refer to Division 1.

H. Airbound Systems

1. If, after plant is in operation, piping systems, coils or other apparatus are stratified or air bound (by vacuum or pressure), they shall be repiped with new approved and necessary fittings, air vents, or vacuum breakers at no extra cost.
2. If connections are concealed in furring, floors, or ceilings, this trade shall bear all expenses of tearing up and refinishing construction and finish, leaving same in as good condition as before it was disturbed.

I. Miscellaneous

1. Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving electrical equipment on and around site, in building or on roof.

3.5 CONTINUITY OF SERVICES

A. Do not interrupt existing services without Owner's approval.

B. Schedule interruptions in advance, according to Owner's instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

C. Interruptions shall be scheduled at times of day and work so that they have minimal impact on Owner's operations.

D. Subcontractor shall coordinate shutdowns of existing systems as follows:

1. Give proper notice to Owner when making shutdowns; a minimum of fourteen full days are required.
2. Minimize shutdowns.
3. Provide temporary services where required and perform shutdowns and tie ins at a time convenient to Owner.
4. Subcontractor shall be responsible for completing and filing the Owner's shutdown notice questionnaire.
5. Perform required survey and inspection work required by the notice for shutdown.

E. Include premium time work associated with interruptions of services and/or shutdowns to avoid disruption to Owner's operations.

3.6 GUARDS FOR DRIVES AND ROTATING PARTS

A. Belt Guards

1. Provide guards for all belted motor drives unless furnished as an integral part of the equipment.
2. Provide guards of galvanized expanded metal, 1/2-inch mesh, U.S. Standard No. 16 gage minimum, constructed by riveting or bolting to a frame on five-inch centers using metal strips or clips to form washers for rivets and bolts or welding to frame on four-inch centers. Fabricate frame from minimum angle iron 1-1/2-inch by 1-1/2-inch by 1/8-inch, or metal construction of equivalent strength.
3. Rigidly brace guards every three feet or fractional part of guard height to some fixed part of the equipment or building structure and have at least four upright frame members each of which shall be extended to the floor or base and securely fastened.
4. Design guards to enclose the drive assembly on all sides and have a minimum clearance of two inches from moving parts, to be removable, and allow for one size increase in motor sheave without reconstruction.
5. Provide tachometer openings at shafts and an opening for checking belt tension, each with bolted covers.

B. Direct Drive Guards

1. Provide guards for all direct driven motor drives unless furnished as an integral part of the equipment.
2. Install a solid guard of No. 20 gage galvanized steel over the shaft and coupling of each item of direct driven equipment.

C. Fan Inlet and Outlet Guards

1. Provide screen guards with rigid angle frames on fan inlet and outlet openings which are accessible to personnel.

D. Extend all guards over exposed rotating shafts.

E. Provide guards that are in compliance with ASME B15.1 and OSHA 1910.219.

3.7 ACTIVATION OF HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS

A. Thoroughly flush and clean all new supply and return piping, strainers etc., before the air conditioning systems are activated. Clean all strainers at least once each week for the first month of system operation and then once each month thereafter until Owner's final acceptance of the work. Re-check systems for compliance with the Contract Documents to establish that they are free of all defects resulting from early activation of the permanent heating, ventilating and air conditioning systems. Before final acceptance of the work by the Owner, again flush, clean and adjust the systems and replace all strainer baskets.

B. Properly operate, and maintain the permanent heating, ventilating and air conditioning systems to the time of final acceptance by the Owner. Maintain the minimum temperatures called for under Temporary Heating during this period. Make any adjustments and repairs required to comply with

the Specifications, tests, and balancing of the permanent systems to the satisfaction of the Architect before final acceptance of the system by the Owner and Architect. Make all repairs and adjustments required to put the heating, ventilating and air conditioning systems and equipment into first class condition before final acceptance by the Architect and Owner.

C. Advise the Owner when the above has been done and the systems are ready for final balancing. Refer to Section 230593, for procedures.

3.8 PROTECTION

A. Piping Systems

1. Provide only new pipe, equipment and appurtenances and maintain clean and free from rust, dirt, scale, and other contaminants. Provide temporary air-tight covers at pipe openings at all equipment.
2. Do not leave piping open. At the end of each work day cap over ends of piping wherever they occur until such time as piping extensions or final connections are made to equipment, fixtures, etc.
3. Before starting up piping systems, provide temporary 20 mesh screens in each strainer. Remove temporary screens and replace them with permanent screens only after dirt and scale has been removed from the piping system.

3.9 FIELD QUALITY CONTROL

A. Lubrication

1. Rotating equipment

a. Lubricate rotating equipment in accordance with the manufacturer's directions before it is operated. Re-lubricate rotating equipment as required during construction and upon turning over to Owner.

2. Lubrication fittings

a. Mount grease and oil fittings directly on bearings except when bearings are not readily accessible. Provide readily accessible and secured copper or approved flexible tubing extensions to bearing lubrication fittings when equipment bearings are not visible or are inaccessible.

B. Welder Qualifications and Procedures

1. Specifications for the fabrication and erection of piping systems

a. Piping: ANSI B31.1.
b. Boiler external piping: Section I of the ASME Boiler And Pressure Vessel Code.
c. Before any welding is performed, submit a copy of the standard welding procedure specification together with the procedure qualification record as required by Section IX of the ASME Boiler and Pressure Vessel Code.
d. Welders of stainless steel tubing shall be qualified in the Tungsten inert gas (TIG) method of welding.

e. Before any welder shall perform any welding, submit a copy of the Contractor's record of welder or welding operator qualification tests as required by Section IX of the ASME Boiler and Pressure Vessel Code. Requalify welders who have been inactive with the welding process for a period of more than three months, or six months if allowed by the particular code for which their qualifications are being reviewed.
f. The types and extent of non-destructive examinations required for pipe welds are as shown in table 136.4 of ANSI B31.1. If requirements for non-destructive examinations are to be other than that stated above, the degree of examination and basis of rejection shall be a matter of prior written agreement between the fabricator, or Contractor and the purchaser. Qualifications for non-destructive testing personnel shall be as established by the American Society for Nondestructive Testing in their recommended practice No. SNT-TC-1A.
g. Welding inspectors shall meet requirements of AWS QC1.
h. The manufacturer or Contractor shall be responsible for the quality of welding done by his organization and shall repair or replace any work not in accordance with these Specifications.
i. Welding done to fabricate structures other than piping and vessels shall conform to the requirements of AWS D1.1.

3.10 FLUSHING, CLEANING AND CHLORINATION

A. Cleaning shall be performed prior to commissioning.

B. Flushing

1. Before turning the systems over to the Owner, thoroughly flush piping systems of scale and dirt.
2. Flush dead ends and other locations where debris may accumulate.
3. Operate all valves to dislodge any debris in the valve body.
4. Circulate water through piping at a minimum velocity of 1.8 meters (6 feet) per second while draining off water to sewer until water is "Potable water clear" and there is no sedimentation after an hour in a quiet standing sample.
5. Flush steam piping with steam, blowing to atmosphere.

C. Cleaning

1. Refer to Section 232113 for cleaning of recirculating systems.

3.11 PROJECT PUNCH LIST PROCEDURE

A. Refer to Division 01.

3.12 PROJECT CLOSE-OUT PROCEDURES

1. Refer to Division 01.

B. Project Close-Out Checklist

1. Review requirements of each section of the specifications and submit for approval to Architect the sign-off forms that shall become the project close-out checklist. These, at a minimum,

shall include the following information shown in attached Project Closeout Checklist Example. The Architect and/or Owner may incorporate additional specific items to the following checklist which shall become part of the project requirements.

PART 4 - BID ALTERNATES

4.1 GENERAL

A. Submit with bid, alternate prices as hereinafter requested stating the total difference in price (add or deduct) from the total base bid amount.

B. Prices of Alternates shall be the total price without further addition, mark-up, subtraction, change, discount or other changes to determine the cost of work.

C. Each alternate price shall include provision of work, material, connections, installation, related work, electrical and plumbing connections, control interface work, accessories, testing, adjusting and balancing, freight, rigging, labor, profits, overhead and taxes, and all other items necessary to provide complete and functional installation as required by Contract Document.

D. Alternate work shall in no way limit the provisions of the Contract Documents, nor change, reduce or limit the Contractor's responsibility to comply fully with the provisions of Contract Documents.

E. The Owner reserves the right to accept or reject any or all alternates. In accepting an alternate, the Owner understands that the bidder has examined the Contract Documents and is aware of all adjustments of affected work necessary to accomplish the stated desired results, whether or not all such adjustments are described within the alternates.

R. G. VANDERWEIL ENGINEERS, LLP
ELECTRONIC MEDIA DOCUMENTS
PROPERTY RIGHTS AND LIMITATION OF LIABILITY

_____ **(replace with appropriate Corporation name)** acknowledges and appreciates that as a favor, without compensation beyond the cost, if any, of special processing of the request, to _____, R. G. Vanderweil Engineers, LLP, (hereinafter RGV) will provide to us certain electronic computer aided drafting (hereinafter CAD) files for use on the above referenced project for our own preparation of shop and/or coordination drawings. We assume all responsibility to determine if this CAD information is applicable and/or accurate for intended use.

_____ agrees to accept the CAD files from RGV without any warranties, guarantees or other representation of any nature concerning the accuracy or completeness of any information described or depicted therein with respect to any dimensions, measurements, fit, field construction conditions, or criteria. _____ further agrees to release, indemnify and hold harmless RGV with respect to any claims, cost and/or liabilities between RGV and ourselves and/or a third party to whom we release information, arising out of or relating to the accuracy and/or completeness of this CAD information.

All materials in the nature of computer aided drafting files are instruments of RGV for use solely with respect to this Project and RGV shall be deemed the author of these documents and shall retain all common law and statutory and other reserved rights including copyright thereto.

Notwithstanding the foregoing, such copies of CAD documents shall not be used by the Contractor on other projects, for additions to this Project or for completion of this Project by others.

I certify that I am an officer of _____ and authorized by same to provide and agree to the above terms and conditions.

For _____

_____
Signature

_____
Print Name

_____
Title

_____
Date

Drawing List Requested

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PROJECT CLOSE-OUT				
PROJECT:				
DIVISION NO.:				
CONTRACTOR:				

ITEM[1]	DATES		OWNER'S SIGN-OFF
	COMPLETED	RECEIVED BY OWNER	
Permits			
City and County Inspection			
Manufacturer's Warranties			
Contractor's Warranties			
State Fire Rating Data			
Copy of Final Shop Drawings			
List and Possession of Spare Parts			
Pressure Tests			
Equipment Tests Required by Specs			
O & M Manuals			
Record Documents			
Coordination Drawings			
Sanitization Reports			
Commissioning Reports/Letters/Forms			
On Site Training Complete			
Protective Device Settings			
Valve Tags and Charts			
Final ATC Installation Drawings			
Insurance Underwriters Approvals			
Final Punch List (Initialed by contractor that items are complete)			
Building Certificate of Occupancy (CO)			
24 Hour Phone No. for Service During Guarantee Period			

END OF SECTION 230000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.

3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

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

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

D. Reference To Design Drawing Schedules

1. Refer to equipment schedules for equipment identification number and corresponding area location, capacity, and design requirements.

2. Wherever schedules or notes appear in the Contract Documents in which sizes and capacities of equipment are indicated or specified, provide equipment which meets the following requirements under operating conditions:

a. The rpm, the outlet velocities, tip speeds and the NC ratings specified are considered as maximum.
b. The airflow (cfm), the static pressure on fans, the fluid flow (gpm) and the total head on pumps, are considered as minimum.

3. Motor horsepower ratings specified or shown: the minimum acceptable; indicated motor speeds: the maximum acceptable. Do not provide increased motor horsepower which together add more than 5 percent to the load of an electrical distribution equipment item (i.e., Motor Control Center, Power Panel, etc.).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BCuP-5, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent cement-joint end.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC PVC CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300 psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300 psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel or ductile iron nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
   e. Thunderline Corp.

2. Description - Shall be modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening. Each link shall have a permanent identification of the size and manufacturer's name molded into it.
3. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Modular seal pressure plates shall be molded of glass reinforced Nylon Polymer. Include two for each sealing element.
5. Connecting Bolts and Nuts: Galvanized steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 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.

2.8 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 and rough brass. Selection finish by Architect

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish Polished chrome-plated and rough brass. Selection finish by Architect

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.10 Packaged Equipment

A. Provide packaged equipment, where specified, which is completely factory assembled, including all mechanical and electrical components mounted on a common base or in a common enclosure with all piping, controls and wiring factory installed ready to be incorporated into the mechanical system.

PART 3 - EXECUTION

3.1 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 exposed in finished spaces according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and above grade concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.

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.

2. 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. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

P. Verify final equipment locations for roughing-in.

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

3.2 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.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.
5. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

K. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.3 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, at flanged valves and at each piece of equipment.
3. Install mechanical couplings, in piping NPS 2-1/2 and larger, at grooved-ended valves and at each piece of equipment.
4. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
5. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are 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.

3.5 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.

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.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. 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 or drill anchor bolts for supported equipment that extend through concrete base according to anchor-bolt manufacturer's written instructions.
7. Cast-in-place concrete materials and placement requirements are subject to project conditions.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

B. 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.

3.10 ACTIVATION OF HVAC SYSTEMS

A. Flush and clean all supply and return piping, strainers etc., before the heating and air conditioning systems are activated. Clean all strainers on a regular basis. Before final acceptance of the work flush, clean and adjust the systems and replace all strainer baskets.

B. Install a set of the specified primary filters as temporary filters to prevent the accumulation of dust and dirt in all the duct systems before the heating, ventilating and air conditioning duct systems are activated. If the temporary filters become loaded to capacity during system activation, replace the filters. Install replacement filters upon completion of the Work and prior to final acceptance.

C. Clean all ductwork after early activation of the permanent heating, ventilating and air conditioning systems and before being turned over. Clean either by vacuum cleaning or blowing out with a pressure blower.

Properly operate, and maintain the permanent heating, ventilating and air conditioning systems to the time of final acceptance. Maintain the minimum temperatures called for under Temporary Heating during this period. Make any adjustments and repairs required to comply with the Specifications, tests, and balancing of the permanent systems before final acceptance of the system.

D. Advise the Owner and Architect when the above has been done and the systems are ready for final balancing.

3.11 PROTECTION

A. Piping Systems

1. Provide only new pipe, equipment and appurtenances and maintain clean and free from rust, dirt, scale, and other contaminants. Provide temporary air-tight covers at pipe openings at all equipment.
2. Do not leave piping open. At the end of each work day cap over ends of piping wherever they occur until such time as piping extensions or final connections are made to equipment, fixtures, etc.
3. Before starting up piping systems, provide temporary 20 mesh screens in each strainer. Remove temporary screens and replace them with permanent screens only after dirt and scale has been removed from the piping system.

B. Air Handling Systems

1. Continuously maintain adequate protection to keep dirt and foreign matter from getting into the air handling system.

2. Do not leave ductwork open. At the end of each work day seal open sections of duct and open fittings wherever they occur until such time as duct extensions or final connections are made to equipment, terminal units, grilles, registers and diffusers.

3.12 FLUSHING

A. Before turning the systems over, flush piping systems of scale and dirt.

B. Flush dead ends and other locations where debris may accumulate.

C. Operate all valves to dislodge any debris in the valve body.

D. Circulate water through piping at a minimum velocity of 1.8 meters (6 feet) per second while draining off water to sewer until water is "Potable water clear" and there is no sedimentation after an hour in a quiet standing sample.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC 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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

B. Electrical products pertaining to the Mechanical trades work that are:

1. Furnished, installed and wired under Divisions 23:

   a. All low voltage control devices and their related wiring. Low voltage is defined as any voltage system that is at or lower than the standard Project 120-volt, single phase, 60 hertz system (excluding fire alarm, security and other communications type systems).
   b. Disconnected components in package units that are so constructed that components of wiring must be disconnected for shipment and reconnected after installation.
   c. Electrical circuiting (120-volt) for DDC control panel power and other control power from spare circuit breakers located in receptacle panels as specified in Section 23 09 00.
   d. Thermostats: 120-volt electric thermostats for mechanical equipment or systems.
   e. Control devices
      1) Pressurestats.
      2) Limit switches.
      3) Flow and alarm switches that are not a part of the fire alarm system.
      4) Control relays and interlocks required between fans, pumps and other mechanical equipment.

2. Furnished and installed under Division 23 and wired under Division 26:

   a. Motors
      1) Electric motors as required for the mechanical equipment, unless otherwise specified or indicated.

   b. Package units
      1) Where "package unit" equipment is specified, provide the equipment complete with starters, main disconnects and control devices. Package units are defined as units which include component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection.

2) For package units with remote mounted control panels containing motor starters and auxiliary controls, provide mounting of the control panel and external wiring from the panel to the package unit.

c. Adjustable-frequency motor controllers.

3. Furnished and wired under Division 28 and installed under Division 23:

a. Refrigerant Detection and Alarm.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.
5. Division 26.

1.4 SUBMITTALS

A. Refer to Section 230500.

B. Control Wiring Diagrams

1. Require builders and suppliers of equipment provided under Division 23 to submit elementary wiring diagrams; make, type and symbol of equipment; operating sequence and installation layout.

2. Provide a nameplate listing voltage, phase, frequency, full load current or rated kVA, control circuit voltage and wiring diagram attached to equipment provided.

3. On equipment having only one motor and one starter, consider the control wiring diagram normally furnished with the starting equipment to be satisfactory, providing the diagram shows all of the electrical equipment.

4. When more than one starter or auxiliary device is used (if the starters or auxiliary devices are not entirely independent), include an elementary diagram in addition to the controller wiring diagram, when requested by the purchaser or deemed necessary by the equipment builder. Show a description of the sequence of operation when it is related to the electrical equipment.

5. Employ symbols in wiring diagrams according to the IEEE 315 and 315A.

C. Motor Protection Data

1. To enable close coordination with branch and feeder overcurrent protective devices, on motors over 74.6 kW (100 hp) submit time-current data for the motor protection scheme, include, as a minimum, locked-rotor trip current and time delay, and motor running overload trip current(s) and time delay(s).

D. Motor Load Tests

1. Furnish all motor load test readings.

E. Data Required

1. Provide complete data on mechanical Shop Drawings for all electrical equipment provided under Division 23.

F. Manufacturer's Field Reports

1. Submit a copy of all tests and checks of adjustable frequency motor control performed in the field, complete with meter readings and recordings, where applicable.

1.5 QUALITY ASSURANCE

A. Hazardous Areas

1. Provide wiring, conduit, starters, push buttons, control devices and other electrical devices furnished for any areas which are indicated as hazardous or in areas classified as hazardous by the National Electrical Code, the American Insurance Association, FM, or the NFPA, which meet all requirements for these classifications.

1.6 WARRANTY

A. Refer to Section 230000.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. All motors shall be premium efficiency type.

C. Comply with NEMA MG 1 unless otherwise indicated.

D. Comply with IEEE 841 for severe-duty motors.

E. Motors smaller than 1/2 hp: suitable for operation on 120-volt, single phase, 60 hertz, and wound for 115 volts except in cases where a piece of equipment is furnished with a standard motor that has other characteristics.

F. Motors 1/2 hp and larger: suitable for operation on 480-volt, 3-phase, 60 hertz, and wound for 460 volts.

G. Motors 40 hp and larger at 230 or 208 volts and wound for 200 volts: suitable for wye-delta starting for fans and pumps.

H. Motors 75 hp and above at 460 volts: suitable for two-step, part winding, closed transition starting (except for motors provided with variable frequency drives).

I. Motors provided with variable frequency drives: specifically rated for variable frequency drives and provided with insulated bearings.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Speed classification: as indicated or required for the service and in accordance with the established NEMA MG 1.

D. Provide motors which operate successfully at rated load with maximum voltage variation of plus-or-minus 10 percent at rated frequency.

E. Provide motors 30 hp and larger, having a maximum winding voltage of 600 volts, with thermal protective devices consisting of a set of six copper thermocouples wired to a terminal strip outside the motor.

F. Size pump and fan motors so that their design loads will not exceed 95 percent of their rated loads at 40 degrees C ambient (non-air-over). Indicate design loads on the name plate.

G. Provide motors which have code letters for locked rotor kVA per watt (horsepower) as defined and in accordance with NEMA MG 1.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.

2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

L. Provide the following motor accessories:

1. Grease lubricated bearings.

2. Type of mounting as required with standard dimensions in accord with NEMA MG 1, Part 3.

3. Junction box of adequate size to terminate the indicated conduit and wire. Provide special box extensions if necessary. Provide separate lug for ground connection on junction boxes.

4. Solderless connectors on all leads.

5. Motor space heater for motors 75 hp and greater where located outdoors or in areas of high humidity.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. Premium-Efficiency Motors: Class B temperature rise; Class F insulation.

3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 MOTOR ACCESSORIES:

A. Provide motor accessories including:

1. Grease lubricated bearings.

2. Type of mounting as required with standard dimensions in accord with NEMA MG 1, Part 3.

3. Junction box of adequate size to terminate the indicated conduit and wire. Provide special box extensions if necessary. Provide separate lug for ground connection on junction boxes.

4. Solderless connectors on all leads.

5. Motor space heater for motors 56 Kw (75 hp) and greater where located outdoors or in areas of high humidity.

2.7 Manufacturers

A. Baldor Electric Co.; Siemens Energy & Automation, Inc.; Marathon Electric; U.S. Electrical Motors (Emerson); or Reliance Electric.

PART 3 - EXECUTION

3.1 ERECTION, INSTALLATION, APPLICATION

A. Identification

1. Identify panels, control points, starters, disconnect switches, and transformers in accordance with the identification markings as shown.

2. Where nameplates and other identification labels are located in inaccessible or unreadable locations, provide duplicate identification in an exposed location.

3. Provide identification by means of anodized aluminum or laminated plastic nameplates.

4. Identify push buttons, selector switches, and other control devices, by the voltage and equipment controlled.

B. Package Units

1. Control enclosures

a. "Enclosure" means the metal housing for the control apparatus, whether such housing be a part of the equipment, mounted on the equipment, or separately mounted. "Compartment" means a space within the base, frame, or column of the equipment.

b. Mount controls in such a manner and position as to be guarded against dirt and dust and readily accessible.

c. Mount control equipment in a rigid and readily accessible manner, protected so that it cannot be operated by accident and with enough clearance from surrounding surfaces to facilitate removal and replacement.

d. Mount control enclosure to minimize the possibility of damage from moving equipment and protect against falling and splashing liquids. Minimum distance from bottom of panel to floor, and height and width of door opening shall be adequate for servicing. Do not set panel to such depth as to interfere with inspection and servicing.

e. Mount front of board-mounted starters, contactors, and other control devices on a rigid panel in such a manner that the complete control panel can be removed through the enclosure opening. Mount each device in turn with machine screws so any unit may be replaced without removing the panel.

2. Disconnect switches

   a. Provide package units with a main disconnect switch.
   b. Provide disconnect switches in accordance with the provisions of Division 26.

3. Motor starters and controllers: Provide motor starters and controllers in accordance with the provisions of Division 26.

4. Control devices: Provide control devices that meet the minimum requirements of the latest revisions of the ANSI and NEMA standards.

5. Conduit and wiring: Provide conduit and wiring in accordance with the provisions of Division 26.

C. Motor Installation

1. Mount motors where they are easily accessible for maintenance and protected from damage. Provide motor compartments, which are clean and dry and adequately vented directly to the exterior of the equipment.

2. When motors are mounted inside of equipment, provide motor compartments of sufficient size to accommodate a motor with terminal enclosures one frame size larger than the maximum frame size recommended by the equipment builder.

3. Arrange motors for ease in checking lubricant levels and replacing belts.

4. Limit static and dynamic balance and noise control for elimination of equipment trouble from these sources. Indicate specially balanced motors as such on the nameplate.

5. Install motors to conform to the requirements of NEMA MG 2.

3.2 FIELD QUALITY CONTROL

1. Load Tests : Conduct a load test on all motors and take the current readings. Do not allow the load current to exceed the nameplate rating of the motor under any condition. If this condition exists, notify the Architect immediately.

END OF SECTION 230513

SECTION 230519 - METERS AND GAGES FOR HVAC 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. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.
7. Sight flow indicators.
8. Orifice flowmeters.
9. Pitot-tube flowmeters.
10. Turbine flowmeters.
11. Venturi flowmeters.
12. Vortex-shedding flowmeters.
13. Impeller-turbine, thermal-energy meters.
14. Ultrasonic, thermal-energy meters.

1.3 SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

C. Product Certificates: For each type of meter and gage, from manufacturer.

D. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

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

   a. Ashcroft
   b. Trerice, H. O. Co.
   c. Weksler
   d. Milioco

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Back angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F .
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
   a. Design for Air-Duct Installation: With ventilated shroud.
   b. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch , with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

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. Ashcroft
   b. Miljoco Corporation.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.
   e. Weksler
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.
   a. Design for Air-Duct Installation: With ventilated shroud.
   b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR.
4. Material for Use with Steel Piping: 304 stainless steel
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch , with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

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. AMETEK, Inc.; U.S. Gauge.
   b. Ashcroft Inc.
   c. Ernst Flow Industries.
   d. Marsh Bellofram.
   e. Miljoco Corporation.
   f. Trerice, H. O. Co.
   g. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   h. Weiss Instruments, Inc.
   i. Weksler
   j. WIKA Instrument Corporation - USA.
   k. Winters Instruments - U.S.

2. Standard: ASME B40.100.

3. Case: cast aluminum or drawn steel; 4-1/2-inch nominal diameter.

4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 , ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.

6. Movement: Mechanical, with link to pressure element and connection to pointer.

7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi .

8. Pointer: Dark-colored metal.

9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.

B. Valves: Brass gauge cock, with NPS 1/4 or NPS 1/2 , ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

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. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2 , ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F .

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 TEST-PLUG 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. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F .

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F .

E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig .

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.8 SIGHT FLOW INDICATORS

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. Archon Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.
4. Ernst Co., John C., Inc.
5. Ernst Flow Industries.
6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
7. OPW Engineered Systems; a Dover company.
8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 150 psig .

E. Minimum Temperature Rating: 200 deg F .

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.9 FLOWMETERS

A. Pitot-Tube Flowmeters:

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. ABB; Instrumentation and Analytical.
b. Emerson Process Management; Rosemount.
c. Meriam Process Technologies.
d. Preso Meters; a division of Racine Federated Inc.
e. TACO Incorporated.
f. Veris Industries, Inc.

2. Description: Flowmeter with sensor and indicator.

3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

4. Sensor: Insertion type; for inserting probe into piping and measuring flow directly in gallons per minute .

a. Design: Differential-pressure-type measurement for indicated fluid type within this specification and on drawings (typical water, glycol solution, oil, etc.).
b. Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.
c. Minimum Pressure Rating: 150 psig .
d. Minimum Temperature Rating: 250 deg F .

5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.

6. Integral Transformer: For low-voltage power connection.

7. Accuracy: Plus or minus 3 percent.

8. Display: Shows rate of flow, with register to indicate total volume in gallons .

9. Operating Instructions: Include complete instructions with each flowmeter.

B. Turbine Flowmeters: Refer to 230900 Instrumentation and Controls for HVAC.

C. Vortex-Shedding Flowmeters: Refer to 230900 Instrumentation and Controls for HVAC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted industrial style thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids (except steam).

H. Install valve and syphon fitting in piping for each pressure gage for steam.

I. Install test plugs in piping tees.

J. Install flow indicators in piping systems in accessible positions for easy viewing.

K. Install flowmeter elements in accessible positions in piping systems.

L. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

M. Install connection fittings in accessible locations for attachment to portable indicators.

N. Install thermometers in the following locations:

1. Two inlets and two outlets of each chiller.
2. Inlets and outlets of each hydronic heat exchanger.

3. Where shown on the drawings.

O. Install pressure gages in the following locations:

1. Inlet and outlet of each chiller chilled-water and condenser-water connection.
2. Suction and discharge of each pump.

P. Install test plugs:

1. Inlet and outlet of each coil.
2. Where shown on the drawings.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers type as specified in 3.1 and type as following:

1. Liquid-in-glass type.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F .

B. Scale Range for Condenser-Water Piping: 0 to 150 deg F .

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages installed location as specified in 3.1 and type as following:

1. Direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 psi .

B. Scale Range for Condenser-Water Piping: 0 to 100 psi .

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC 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. Bronze ball valves
2. Iron ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Iron swing check valves with closure control.
8. Iron, center-guided check valves.
9. Bronze gate valves.
10. Iron gate valves.
11. Bronze globe valves.
12. Iron globe valves.
13. Plug valves.
14. Chainwheels.

B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer 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.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

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 handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every five plug valves, for each size square plug-valve head.

5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves 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. Conbraco Industries, Inc.; Apollo Valves
b. Cannon
c. Crane Co.; Crane Valve Group; Crane Valves
d. Grinnell
e. Hammond Valve
f. Kitz Corporation
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Rockwell
j. Stockham
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded or solder.
f. Seats: PTFE or TFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim – Drain and Vent:

1. Same as above with hose-end threaded connection, brass cap and chain connected to lever handle

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and 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. Bray
b. Grinnell
c. Keystone
d. Milwaukee
e. Mueller
f. Nibco

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig.
c. Body Design: Threaded Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece 416 stainless steel with bronze bushings.
g. Disc: Aluminum bronze.

2.4 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with 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. Grinnell
b. Metraflex
c. Milwaukee Valve Co.
d. Mueller
e. Stockham
f. Nibco

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.
f. Disc: Bronze.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with 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. Crane Co.; Crane Valve Group; Crane Valves
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Nibco
   f. Milwaukee Valve Company.
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.
   f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with 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. Crane Co.; Crane Valve Group; Crane Valves
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Nibco.
   e. Milwaukee Valve Company.
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.
   f. Disc: Bronze.

2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

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 Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Nibco
   f. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

2.7 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Wafer, Center-Guided Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Grinnell
c. Metraflex, Inc.
d. Milwaukee Valve Company.
e. Mueller Steam Specialty; a division of SPX Corporation.
f. Stockham
g. Nibco

2. Description:

a. Standard: MSS SP-125.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Material: ASTM A 126, gray iron.
e. Style: Wafer, spring loaded.
f. Ends: Flanged.
g. Seat: Bronze.

B. Class 150, Iron, Wafer, Center-Guided Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.
b. Grinnell
c. Metraflex, Inc.
d. Milwaukee Valve Company.
e. Mueller Steam Specialty; a division of SPX Corporation.
f. Stockham
g. Nibco

2. Description:

a. Standard: MSS SP-125.

b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
c. NPS 14 to NPS 24, CWP Rating: 250 psig.
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Style: Wafer, spring loaded.
f. Ends: Flanged.
g. Seat: Bronze.

2.8 BRONZE GATE VALVES

A. Class 125, RS Bronze Gate 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. Crane Co.: Crane Valve Group; Crane Valves
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Milwaukee Valve Company.
e. Grinnell
f. Nibco

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, 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

B. Class 150, RS Bronze Gate 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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Milwaukee Valve Company.
d. Jenkins
e. Nibco

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, 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

2.9 IRON GATE VALVES

A. Class 125, OS&Y, Iron Gate 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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Milwaukee Valve Company.
d. Nibco.

2. Description:

a. Standard: MSS SP-70, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. NPS 14 to NPS 24, CWP Rating: 150 psig.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Disc: Solid wedge.
h. Packing and Gasket: Asbestos free.

2.10 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with 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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Travel
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Grinnell
e. Milwaukee Valve Company.
f. Nibco.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

2.11 IRON GLOBE VALVES

A. Class 125, Iron Globe 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. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Grinnell
   e. Milwaukee Valve Company.
   f. Nibco.

2. Description:

   a. Standard: MSS SP-85, Type I.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Packing and Gasket: Asbestos free.

2.12 ECCENTRIC PLUG VALVES

A. 175 CWP, Eccentric Plug Valves with Resilient Seating.

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. Homestead
   b. DeZurik Water Controls.
   c. Mueller Steam Specialty
   d. Rockwell
   e. Resun
   f. Victaulic

2. Description:

   a. Standard: MSS SP-108.
   b. CWP Rating: 175 psig minimum.
   c. Body and Plug: ASTM A 48/A 48M, gray iron; ASTM A 126, gray iron; or ASTM A 536, ductile iron.
   d. Bearings: Oil-impregnated bronze or stainless steel.
   e. Ends: Flanged.
   f. Stem-Seal Packing: Asbestos free.
   g. Plug, Resilient-Seating Material: Suitable for potable-water service unless otherwise indicated.
   h. Operator: Gear w/memory indicator

2.13 SOLENOID VALVES

A. General:

1. 2-way, pilot operated slow closing type.
2. Solenoid enclosure: General purpose metal type.

3. Voltage: 120 / 208 / 480 volts, ac, 60 Hz, 6, 12, 24 volts dc to suit field conditions.
4. Coil: Continuous duty molded Class F.
5. Ambient temperature range: 0 degrees C to 52 degrees C (32 degrees F to 125 degrees F).
6. Body: Brass
7. Seals and Disc: Buna "N".
8. Core tube: 305 S.S.
9. Core and plug nut: 430F S.S.
10. Core spring: 302 S.S.
11. Shading coil: silver (stainless steel body).

B. Manufacturers:

1. ASCO “Red Hat Series 8221” or
2. Honeywell “Skinner Model 7321 GBN”.

2.14 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, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
4. Chain: Hot-dip, galvanized 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 chainwheels on operators for valves NPS 3 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

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 valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type
3. Throttling Service except Steam: Globe or Butterfly valves.
4. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze lift check valves with bronze disc.
b. NPS 2-1/2 and Larger: Iron body with spring loaded wafer, center-guided, metal-seat check valves.

5. Water Service Piping: Bronze or Iron Swing Check valves

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Sweat or threaded ends.
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 Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 and Larger: Flanged ends.

D. Provide shut-off isolation valves in piping services where branch lines connect to mains and risers.

E. Provide isolation valves where service is fully open or closed.

F. Provide throttling valves where pressure regulation or modulating flow are required.

G. Provide throttling valves to serve as drain valves at low points and at piping dead ends.

H. Provide ball valves on strainer blow down service.

I. Provide plugs or caps on all drain, vent or other open ended lines and valves.

J. Provide NPS ¾ (DN 20) drain valves on piping up through NPS 4 (DN 100) and NPS 1-1/2 (DN 40) drain valves on piping NPS 5 (DN 125) and larger.

K. Isolation Valves and Unions at Equipment

1. Provide isolation valves and unions at the individual connections to equipment, PRV stations and piping elements to permit complete servicing or removal of piping elements and items of equipment.

L. By-Pass Valves

1. Where by-pass valves are shown to be installed around pressure regulating valves and automatic control valves, size the by-pass valve the same size as the pressure regulating or automatic control valve.

M. Copper Tubing Adapters

1. When connecting copper tubing to valves, install adapters as follows:

a. Cast copper solder male adapter or union to screwed valves.
b. Copper solder joint companion flange unit.

3.5 CHILLED AND CONDENSER WATER VALVE SCHEDULE (Maximum 150°F and 275 psig)

A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: Threaded ends or soldered.
2. Ball Valves: 600 CWP, Two piece, full port, bronze with bronze -steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Iron Center Guided Check Valves: Class 150, bronze seat.
5. Bronze Globe Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves: Flanged ends.
2. Iron, Single-Flange Butterfly Valves: Class 150, EPDM seat, Aluminum Bronze disc.
3. Iron, Grooved-End Butterfly Valves: Not permitted.
4. Iron Swing Check Valves: Class 150, metal seats.
5. Iron, Center-Guided Check Valves: Class 150, wafer, metal seat.
6. Iron Globe Valves: Class 150.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Thermal-hanger shield inserts.
6. Fastener systems.
7. Pipe stands.
8. Equipment supports.

B. Related Sections include the following:

1. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
2. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
3. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Available Available Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. 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 D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. 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.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. National Pipe Hanger Corporation.
10. Piping Technology & Products, Inc.
11. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 RISER CLAMPS:

A. Description: Anvil "Fig. 261" or approved equal galvanized steel pipe clamp for steel and cast iron piping and Anvil “Fig. CT-121” or approved equal copper-coated steel pipe clamp for copper piping.

2.4 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.5 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. 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. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. 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. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Diversified Fastening Systems, Inc.
c. Empire Industries, Inc.
d. Hilti, Inc.
e. ITW Ramset/Red Head.
f. MKT Fastening, LLC.
g. Powers Fasteners.

2.8 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

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. ERICO/Michigan Hanger Co.
b. MIRO Industries.

C. Low-Type, Single-Pipe Stand: One-piece galvanized base unit with plastic roller, for roof installation without membrane penetration.

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. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

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. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. Portable Pipe Hangers.

2. Base: Stainless steel.

3. Vertical Members: Two or more cadmium-plated-steel or galvanized-steel, continuous-thread rods.

4. Horizontal Member: Cadmium-plated-steel or galvanized-steel rod with stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

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. Portable Pipe Hangers.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Space hangers for horizontal piping as follows:

Nom. Pipe Size (inches)	Max. Span (feet)	Min. Rod Size (inches)	Hanger Type
1¼ and Smaller	7	3/8	Clevis Hanger (MSS Type-1)
1½	9	3/8	Clevis Hanger (MSS Type-1)
2	10	3/8	Clevis Hanger (MSS Type-1)
2½	10	1/2	1 Rod Roll Hanger (MSS Type-43) or Clevis Hanger (MSS Type 1), Note 1
3	12	1/2	1 Rod Roll Hanger (MSS Type-43) or Clevis Hanger (MSS Type 1), Note 1
4	12	5/8	1 Rod Roll Hanger (MSS Type-43) or Clevis Hanger (MSS Type 1), Note 1
5	12	5/8	1 Rod Roll Hanger (MSS Type-43), Note 1
6	12	3/4	1 Rod Roll Hanger (MSS Type-43), Note 1
8 – 12	12	7/8 (two)	2 Rod Roll Hangers (MSS Type-41), Note 1
14 – 18	12	1 (two)	2 Rod Roll Hangers (MSS Type-41)
20	12	1¼ (two)	2 Rod Roll Hangers (MSS Type-41)
24	12	1½ (two)	2 Rod Roll Hangers (MSS Type-41)
30-36	12	1 ¾ (two)	2 Rod Roll Hangers (MSS Type-41)

Note 1: Clevis hangers acceptable for chilled water pipe up to 8-inch diameter pipe.

F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

J. Spring Hangers and Supports: Where indicated install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.

4. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.

5. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

7. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying as required.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use hanger shield sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

O. Support vertical piping not subject to expansion at each floor with steel riser clamps. Install riser clamps aligned in such a manner so as not to penetrate through partitions or column covers or project into walking areas; if necessary cut off extended leg of clamp to achieve this condition.

P. Support vertical pipes subject to thermal expansion, such as hot water, installed in shafts at least at every other floor and for 9.1 meters (30 feet) on the horizontal runs of pipe at top and bottom of the shaft by spring hangers to ensure adequate support for the pipe and permit flexibility without overstressing of the pipe.

Q. Support piping directly from the building structure and not from the supporting systems or equipment of other trades.

R. Piping up to NPS 4 may be supported from the concrete slab or composite slabs (metal deck and concrete) using self-drill drilled-in inserts installed in strict accordance with the composite slab manufacturer’s testing and recommendations. Do not support piping from the roof deck.

S. Provide a welded support at elbows in pump suction and discharge. Extend elbow support to pump foundation or to steel bracket welded to pump base.

T. Provide concrete housekeeping pads under floor supports where piping, ductwork or equipment is supported from floors.

U. Install and support piping in a manner to isolate vibration and prevent sagging and movement other than that caused by thermal expansion and contraction.

V. When piping NPS 8 or larger is suspended from the structure, coordinate the location of supports of plumbing, heating and cooling and fire protection trades to insure that the total load suspended from a particular beam is not excessive.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Provide structural supports, miscellaneous steel members, anchors, platforms, braces or tie rods and hangers required for the suspension and placement of the piping, valves and mechanical equipment required for the installation. Prime paint all miscellaneous iron work and touch-up after erection. Ensure that no support members penetrate the building's exterior vapor barrier

B. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

C. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

D. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

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

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROLS FOR HVAC 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. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding and restrained spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Restrained vibration isolation roof-curb rails.
12. Restraining braces and cables.
13. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

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

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation and for designing vibration isolation bases.

   a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

C. Welding certificates.

D. Qualification Data: For qualified professional.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.5 DESIGN REQUIREMENTS

A. Vibration Isolator Requirements

1. All vibration isolators shall have calibration markings or some method to determine adjustment and the actual deflection under the imposed load after installation and adjustment.

2. All isolators shall operate within the linear position of their load vs. deflection curves. Load vs. deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.

3. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than +10%.

B. Deflections

1. The isolation materials manufacturer is to be responsible for the proper selection of spring rates to accomplish the scheduled minimum static deflections for spring and pad type isolators based on the weight distribution of equipment to be isolated. Refer to the equipment schedules.

2. Weight changes

a. Mount equipment with operating weight different from the installed weight such as chillers on spring mountings as described, but use a housing that includes vertical limit stops to prevent spring extension when weight is removed. Design the housing to be used as blocking during erection. Provide for the installed and operating heights to be the same. Maintain a minimum clearance of 12.5 mm (1/2 inch) around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Provide limit stops to be out of contact during normal operations.

C. Weather protection

1. Where mountings are exposed to the weather, provide cadmium-plated hardware, neoprene-coated springs and hot-dip galvanizing for all other parts.

D. Structural data

1. The isolation materials manufacturer is to be responsible for the structural design of steel beam bases and concrete inertia bases to support mechanical equipment scheduled to receive a supplementary base.

E. Provide the following with vibration isolation from the building:

1. Motor driven mechanical equipment.
2. Piping on pumped systems NPS 2 (DN 50) in diameter and larger located in mechanical equipment rooms.
3. Piping on pumped systems NPS 2 (DN 50) in diameter and larger not in mechanical equipment rooms but connected to vibration isolated equipment: Isolate such piping for a distance from the equipment connection of 50 feet or 100 pipe diameters, whichever is the greater.
4. Piping connected to coil in assembly where fan is separately isolated by vibration isolators and duct flexible connections do not require piping vibration hangers.
5. Piping risers on pumped systems NPS 2 (DN 50) in diameter and larger.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control and restraint products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

1. Except as otherwise indicated, obtain vibration control and restraint products from single manufacturer.
2. Engage manufacturer to provide technical supervision of installation of vibration control and restraint products.

C. All vibration isolators shall have calibration markings or some method to determine adjustment and the actual deflection under the imposed load after installation and adjustment.

D. All isolators shall operate within the linear position of their load vs. deflection curves. Load vs. deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.

E. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than +10%.

F. The use of internally isolated equipment in lieu of the isolation specified in this section, is acceptable provided all conditions of this section are met to the satisfaction of the Architect. The equipment manufacturer shall provide a letter of guarantee stating that the specified noise and vibration levels will be obtained or the cost of converting to the specified external vibration isolation shall be borne by the equipment manufacturer.

G. These specifications describe spring hangers with 30 degree misalignment feature. This requirement is mandatory. The contractor shall replace any hangers without a 30 degree capability discovered on site at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Single Source Manufacturer: Furnish the materials and systems specified in this Section from a single vibration isolation materials manufacturer for all isolation materials and systems used on the Project

B. Mason Industries, Inc.; Vibration Eliminator Co.; Amber Booth; or Vibration Mountings & Controls, Inc.; Kinetics or as approved

2.2 VIBRATION ISOLATORS

A. Type 1 - floor mounted - 3-mm (1/8-inch) steel plate bonded between neoprene pads.

1. Type 1 isolators: Mason Industries, Inc. type “WSW”; Vibration Mounting & Controls type “Shear-Flex, Flex-Plate”; Amber Booth “SP-NRC”; or Vibration Eliminator Co.

B. Type 2 - floor mounted - free-standing - springs

1. Type 2 isolators: free-standing, unhoused, laterally stable, steel springs, wound, using high strength, heat-treated spring alloy steel, and having a horizontal spring stiffness equal to or greater than 0.8 times the rated vertical spring stiffness. To assure stability, provide the outside spring coil diameter to be a minimum of 0.8 times the rated vertical operating spring height. Select springs to provide the tabulated minimum operating static deflections and provide a 50 percent overload capacity before reaching a solid state. Provide springs that reach a solid state before exceeding the spring steel fatigue point. Spring assembly to include a 6-mm (1/4-inch) neoprene pad between the base plate and the support. Baseplate to be galvanized steel drilled for fastening to floor or base.

2. Type 2 Spring mounts: Mason Industries, Inc. type “SLF”; Amber Booth “SW STYLE A”; Vibration Eliminator Co. type “OST” or Vibration Mountings and Controls series “ACB”.

C. Type 3 - floor mounted - restrained - springs

1. Type 3 isolators: incorporate spring vibration isolators having the spring characteristics of type 2 spring isolators as previously specified, into a steel mount assembly designed to limit vertical movement of isolated equipment if equipment loads are reduced or equipment is subjected to external loads, and limit vertical movement without degrading the vibration isolation of the spring element during normal equipment operating conditions.

2. Provide mounts with a flat steel top load plate for welding to supported equipment and that are vertically restrained by noise isolated bolts. Bond the base plate to a 6-mm-thick (1/4-inch-thick) ribbed neoprene noise stop pad and drill for bolting to supporting structures. Provide tapped steel load plate and level bolt assembly to carry equipment loads by lifting the top load plate during normal equipment operating conditions. Load transfer and leveling are to be internal.

3. Type 3 Mounts: Vibration Eliminator Co. type “KW” and “ONSL-HD”; Mason Industries, Inc. type “SLR”; Amber Booth “CT”; or Vibration Mountings and Controls series “AWR”.

D. Type 3A – floor mounted-all directional restrained – springs

1. Type 3A isolators: all directional restrained isolators housed in a steel mount assembly incorporating elastomeric snubbing in all directions with the snubber adjustable in the vertical direction to allow 6mm (1/4-inch) travel in all directions before contacting the resilient snubbing collars,.

2. Fabricate springs of high strength, heat-treated spring alloy steel, having a horizontal stiffness equal to or greater than 0.8 times the rated vertical spring stiffness. To assure stability, provide the outside spring coil diameter to be a minimum of 0.8 times the rated vertical spring height. Select springs to provide the tabulated minimum operating static deflections and provide a 50 percent overload capacity before reaching a solid state. Provide springs that reach a solid state before exceeding the spring steel fatigue point. Provide housing with a minimum of two spring inspection ports.

3. Furnish submittals that include spring diameters, deflections and calculations signed by a registered engineer showing that the seismic loads the mountings are to resist have been properly calculated.

4. Type 3A isolators: Vibration Eliminator Co. type “OST SM”, Mason Industries, Inc. type “SSLFH”, Amber Booth “SWSR” or “SWPQ” or Vibration Mountings and Controls “AEQM” series.

E. Type 4 - suspension mounted - springs and neoprene or rubber in shear

1. Type 4 hangers: steel spring and a neoprene isolator, each with a load transfer plate, placed in series and encased in a stamped or welded steel bracket. Provide the spring element of the hanger to meet specified characteristics of a type 2 spring as previously specified. Color code springs for ease of load capacity identification. Design mount so that springs are removable for field correction of overloaded hangers.

2. Design the hanger bracket to carry a five times overload without failure and allow up to 15-degree rod misalignment without metal-to-metal contact or other short circuit. Provide the neoprene element and spring neoprene cup with molded isolation bushings.

3. Type 4 Hangers: Mason Industries, Inc. model “DNHS” or ”30N”; Vibration Eliminator Co. type “SNRC”, Amber Booth “BSRA”, or Vibration Mountings and Controls series “RSH”.

F. Type 5 - riser supports - neoprene or rubber in shear

1. Type 5 riser isolation systems: supports and anchors having type 1 neoprene or rubber-in-shear noise and vibration isolation pads bonded to steel load transfer plates suitable for welding to pipe collar extensions. Provide riser isolation guides to incorporate neoprene isolation mounts bolted to drilled structural steel mounting angles.

2. Provide riser supports, anchors and guides selected by the manufacturer and space as required for risers to be supported and isolated.

3. Type 5 riser isolation systems: Mason Industries, Inc. type “ADA”; Mason Industries, Inc. type “ADA”; Amber Booth “AG”, Vibration Eliminator Co. “types “AGR”, “VERA”, “VERS” or Vibration Mountings and Controls type “RPG”.

G. Type 6 - fan head thrust restraints

1. Type 6 - Install fan head isolation systems on all ducted vane-axial and centrifugal fans when fan static pressures are 996 Pa (4 inches w.g.) and above and/or the air thrust exceeds 10 percent of the equipment weight. Provide fan head isolation systems that consist of pre-compressed thrust restraint assemblies bolted at the ducted inlet or outlet fan connection at the horizontal centerline on both sides of the fan.
2. Provide thrust restraint assemblies that are comprised of angle brackets with back plates, threaded rod, spring and steel and neoprene cups.
3. Securely bolt back-up plates to the fan inlet or outlet and to the duct across the flexible connection.
4. Type 6 fan head thrust restraints: Mason Industries type “WB"; Amber Booth “TRK”; Vibration Eliminator Co. or Vibration Mountings and Controls type “HTR”.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

A. General: All curbs and roof rails are to be bolted or welded to the building steel or anchored to the concrete deck to attain at a minimum 110 mph wind load resistance requirement or as required by local codes if greater than 110 mph.

B. Type A – No base (on housekeeping pad), isolators attached directly to equipment

C. Type B - Structural Steel Base

1. Provide type B equipment bases that consist of structural steel support members, with welded on isolator support brackets, and prelocated and drilled anchor bolt holes, designed and supplied by the isolation materials manufacturer.
2. Provide the structural steel bases that have base members equal to a minimum section depth of 10 percent of the longest span, at least 150 mm (6 inches), or as indicated, and be of sizes and shapes required for equipment to be supported. Weld isolator support brackets to the structural beam base as required to provide the lowest possible mounting height of supported equipment. Prelocate anchor bolt holes and drill into equipment bases to bolt down equipment.
3. Provide structural steel bases that provide a rigid, distortion free, mounting base for supported equipment, which will allow no excessive differential motion between driving and driven equipment components. Base member depth need not exceed 356 mm (14 inches).
4. Provide bases with a natural frequency at least 25 percent higher than the maximum fan/pump speed.
5. Type B equipment base: Mason Industries, Inc. type “MSL”; Vibration Eliminator Co. type “OSK”; Amber Booth “SFB”; or Vibration Mountings and Controls type “SCA”.

D. Type C - Inertia base

1. Type B bases: concrete slab, cast into a prefabricated inertia base frame assembly designed and supplied by the isolation materials manufacturer. Concrete to be provided by the Contractor.
2. Provide steel frames with a minimum section depth of 150 mm (6 inches) unless otherwise indicated and include welded-in steel reinforcing rods. Provide base thickness that is a minimum of eight percent of the longest span between isolators, or at least 150

mm (six inches). Fix prelocated equipment anchor bolts into position and house in steel bolt sleeves allowing minor bolt location adjustment. Weld isolator support brackets, when required, into the corners or sides of the perimeter channel frames.

3. Provide inertia bases that are used to support horizontally split case pumps to be wide enough to support pipe elbows; these may be rectangular or T-shaped at manufacturer's option.

4. Type C inertia base: Mason Industries Inc. model “BMK/KSL”; Vibration Eliminator Co. type “SN”; Amber Booth “CPF”; or Vibration Mountings and Controls type "WPF".

E. Type E: Computer Room Unit Base (Mason CRFS-1)

1. Computer room A. C. units shall be welded or bolted to welded structural steel stands having a minimum ½ “G” certified lateral acceleration capabilities.

2. Stand shall have +/-2” of adjustment to accommodate floor irregularities.

3. Bolting or welding required to meet criteria.

2.4 FLEXIBLE CONNECTORS

A. Install all connectors on the equipment side of shutoff valves, horizontal and parallel to shafts whenever possible.

B. Provide flexible connections for all piping connected to rotating or reciprocating equipment, equipment mounted on vibration isolators, and heating coils mounted on floor. Flexible connections are not required for duct-mounted heating coils.

C. Provide flexible connection suitable for pressure, temperature and fluid involved.

D. Unless otherwise specified, select minimum live length of metal flexible hose to provide transverse movement of ± 3/4", but not less than 12" for hose nominal diameter 2-1/2" and smaller, 18" for hose nominal diameter 3" through 6", and 24" for hose nominal diameter 8" and larger.

E. Provide flexible piping connections and piping vibration hangers for piping connected to coil in assembly mounted on vibration isolator. Piping connected to coil in assembly where fan is separately isolated by vibration isolators and duct flexible connections do not require flexible piping connectors or piping vibration hangers.

F. Type FC-1: Elastomer connector (Mason SafeFlex SFDEJ)

1. Manufactured of Kevlar cords and EPDM, both molded and vulcanized in hydraulic presses.

2. Straight connectors to have two (2) spheres reinforced with a molded-in, external ductile iron ring between the spheres. Raised face rubber flanges shall encase solid steel rings to prevent pull out. Flexible cable wire shall not be acceptable.

3. Rated at 250 psi/170°F, for sizes 14” and smaller, 180 psi/170°F for sizes 16” through 24”.

4. Sizes 10" and 12" at 200 psi and greater operating pressure, to employ control cables with neoprene end fittings isolated from anchor plates by means of ½" bridge bearing neoprene bushings.

5. Connectors shall be pre-extended per manufacturer's recommendation to prevent elongation under pressure.
6. Minimum safety factor of 3:1 at maximum pressure ratings with reduction of 20 dB in vibration accelerations and 10 dB in sound pressure levels at typical blade passage frequencies.
7. Connectors bolted to victaulic type couplings or gate, butterfly or check valves to have a minimum 1/8” flange spacer installed between the connector and the coupling flange.

G. Type FC-2: Flexible stainless steel hose (Mason Type BSS)

1. Stainless steel hose and braid rated with 3:1 safety factor.
2. 2" and smaller with male nipples, 2½” and larger with fixed steel flanges.
3. Lengths as follows:

½ x 9	¾ x 10	1 x 11
1¼ x 12	1½ x 13	2 x 14
2½ x 12	3 x 14	4 x 15
5 x 19	6 x 20	8 x 22
10 x 26	12 x 28	14 x 30
16 x 32		

H. Type FC-3: Unbraided exhaust hose (Mason Type SDL-RF)

1. Low pressure stainless steel angularity corrugated with flanged ends.
2. Maximum temperature of 1500 degrees F.
3. Lengths as follows:

2½ x 15	8 x 22
3 x 16	10 x 26
4 x 17	12 x 28
5 x 18	14 x 30
6 x 19	16 x 32

I. Type FC-4: Bronze braided flexible hose (Mason Type BFF)

1. Bronze hose and braid rated with a minimum 3:1 safety factor. (Minimum 150 PSI).
2. Copper tube ends
3. Lengths as follows:

1/8 x 7½	¾ x 11½	3 x 27
¼ x 8¼	1¼ x 14¾	3½ x 32
3/8 x 9	1½ x 17	4 x 33
½ X 9 ¾	2 x 20	5 x 41

5/8 x 10 2 ½ x 24 6 x 48

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

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

1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic[- and wind]-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION-CONTROL INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Manufacturer's Instructions

1. Install the vibration isolation materials and supplemental equipment bases specified following the manufacturer's written instructions.

C. Equipment Restraints:

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

2. Install thrust limits at centerline of thrust, symmetrical on either side of equipment

D. Place floor mounted equipment on concrete housekeeping pads properly doweled or expansion shielded to the deck. Mount vibration isolators and/or bases on housekeeping pads. Concrete work specified in other Divisions.

1. Maintain 2"minimum operating clearance under inertia bases.

2. Maintain 1” minimum operating clearance under other.

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

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

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

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

I. Clean-Up

1. On completion of installation of isolation materials and before start up of isolated equipment, clear debris from areas surrounding and from beneath vibration-isolated equipment, leaving equipment free to move on the isolation supports.

J. Non-Rigid Connections

1. Do not make any rigid connections between equipment and building structure or piping connections to vibration isolated equipment that degrade the noise and vibration isolation system. Install electrical conduit connections to isolated equipment as specified in Division 26 to allow free motion of isolated equipment.

3.3 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

3.4 HVAC VIBRATION-CONTROL SCHEDULE

A. Centrifugal Fans - all power ratings - suspended - all floors - all spans

RPM	Isolator type	Min. deflection in mm (inches)
to 500	4	38 (1.5)
500 & up	4	19 (.75)

B. Axial and Tubular Fans - all HP - floor mounted.

RPM	Base Type	Isolator Type	Min. deflection in mm (inches) - for a span in meters (feet) of:				
				To 6.1(20)	To 9.1 (30)	To 12.2 40)	To 15.2 (50)
to 300	C*	2*		64 (2.5)	64 (2.5)	89 (3.5)	89 (3.5)
301-500	C*	2*		38 (1.5)	64 (2.5)	64 (2.5)	64 (2.5)
501 & up	C*	2*		38 (1.5)	64 (2.5)	38 (2.5)	64 (2.5)

C. In-Line Centrifugal Pumps and Axial and Tubular Fans - all power ratings - suspended - all floors - all spans

RPM	Isolator type	Min. deflection in mm (inches)
to 500	4	38 (1.5)
501 & up	4	19 (.75)

D. Pumps - base mounted centrifugal

HP	Base Type	Isolator Type	Min. deflection in mm (inches) - for a span in meters (feet) of:			
			To 6.1 (20)	To 9.1 (30)	To 12.2 (40)	to 15.2 (50)
to 15	B*/C	2	19 (.75)	38 (1.5)	38 (1.5)	64 (2.5)
20-50	C	2	19 (.75)	38 (1.5)	64 (2.5)	64 (2.5)
60-100	C	2	19 (.75)	38 (1.5)	64 (2.5)	64 (2.5)

* applies only to pumps on grade or basement floor slabs in low seismic risk areas

Note:

For base mounted centrifugal pumps provided as part of a skid-mounted pre-piped package such as a water pressure booster system, provide isolators per the above for the entire skid-mounted package.

E. Refrigeration Machines:

Type	Base Type	Isolator Type	Min. deflection in mm (inches) - for a span in meters (feet) of:			
			To 6.1 (20)	To 9.1 (30)	To 12.2 (40)	to 15.2 (50)

Reciprocating.	C	3	19 (.75)	38 (1.5)	64 (2.5)	64 (2.5)
Centrifugal / Screw	C	3	19 (.75)	38 (1.5)	64 (2.5)	64 (2.5)
Open Centrifugal	C	3	19 (.75)	38 (1.5)	64 (2.5)	64 (2.5)

F. Horizontal Piping and Ductwork (where indicated) and Unit Heaters.

Pipe size	Isolator type	Min. deflection in mm (inches)
to NPS 3 (DN 80)	4	19 (.75)
over NPS 3 (DN 80)	4	38 (1.5)
ductwork & unit heaters		19 (.75)

G. Piping and Ductwork Risers (where indicated)

Pipe & Duct	Isolator type	Min. deflection in mm (inches)
All	5	25 (1.0)

H. Flexible Duct Connections

1. Flexible duct connections are specified under Section 233300.

I. Flexible Piping Connectors

1. Pipe extension and alignment connectors: Provide Type FC-2 connectors at riser takeoffs, cooling and heating coils and elsewhere as required to accommodate thermal expansion and misalignment.
2. Provide Type FC-1 (FC-4 for refrigerant piping) flexible connectors at all connections of pipe to equipment such as pumps, chillers, cooling towers and as shown on the drawings.
3. Alternative Connection to Cooling Towers and Non-rotating Equipment Mounted on Vibration Isolators - Seamless corrugated bronze or stainless steel flexible hose with braided cover for 2" and smaller with threaded or flanged connections; seamless corrugated stainless steel flexible connector with braided cover for 2-1/2" and larger with flanged connections.
4. Provide FC-2, FC-3 or FC-4 type connectors only at locations which exceed temperature or service (fuel oil or refrigerant) limitations of FC-1.
5. Do not provide flexible piping connectors for gas piping.

J. Refer to Table 48, Sound and Vibration Control, ASHRAE Handbook – HVAC Applications for all other equipment not listed above.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC 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. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 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.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch or Aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. 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-fourths the size of principal lettering.

4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 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-fourths 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.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

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), plus 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. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. 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-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to fully cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, 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: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. 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 minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. 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.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: 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 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. At access doors and similar access points that permit view of concealed piping.
4. Near major equipment items and other points of origination and termination.
5. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
6. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Chilled-Water Piping:

   a. Background Color: Blue.
   b. Letter Color: White.

2. Condenser-Water Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3. Refrigerant Piping:

   a. Background Color: Brown.
   b. Letter Color: White.

3.4 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 HVAC terminal devices 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. Chilled Water: 1-1/2 inches, round.
   b. Condenser Water: 1-1/2 inches, round.
   c. Refrigerant: 1-1/2 inches, round.

2. Valve-Tag Color:

   a. Chilled Water: Natural.
   b. Condenser Water: Natural
   c. Refrigerant: Natural

3. Letter Color:

   a. Chilled Water: Black.
   b. Condenser Water: Black..

c. Refrigerant: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

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 testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Measuring sound and vibration.
7. Performing readings associated with selective demolition and upgrades.
8. Reporting results of the activities and procedures specified in this Section

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. ETS: Environmental Tobacco Smoke

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Readings Prior to Selective Demolition of Systems: Within 30 days of Contractor’s notice to proceed and prior to start of demolition activities, whichever comes first, submit flow, pressure and temperature readings associated with systems affected by selective demolition.

C. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit 6 copies of the Contract Documents review report as specified in Part 3.

D. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit 6 copies of the TAB strategies and step-by-step procedures as specified in "Preparation" Article. Include a complete set of report forms intended for use on this Project.

E. Certified TAB reports. Submit sixcopies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

F. Sample report forms.

G. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

H. Warranties specified in this section

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

B. The TAB Agency shall be hired and retained directly by the General Contractor and shall be completely independent from the Contractor.

C. TAB Conference: Meet with Architect, Construction Manager and Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

D. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing." TABB "Contractors Certification Manual.".

F. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation.", AABC's "National Standards for Testing and Balancing Heating,

Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

1.6 SYSTEM DESCRIPTION

A. Performance Requirements

1. Adjusting and balancing shall be performed in accordance with the latest edition of the Associated Air Balance Council (AABC) National Standards, National Environmental Balancing Bureau (NEBB) Procedural Standards or Testing, Adjusting and Balancing Bureau (TABB), and in accordance with the scope of Work specified in the Contract Documents.

2. Adjusting and balancing shall not begin until systems are complete, temporary filters and strainers are removed and permanent filters installed, piping systems are cleaned, flushed and chemically treated, all as properly scheduled and approved in advance by the Architect.

3. In addition to demonstrating that the systems are capable of achieving design load point flows, the adjusting and balancing agency shall demonstrate, and so include in the report forms, that the automatic control systems respond properly to load variations.

4. Upon the completion of the Work, the adjusting and balancing agency shall submit four copies of the complete adjusting and balancing report.

5. One agency shall be responsible for all phases of adjusting and balancing.

6. The adjusting and balancing agency shall permanently mark the settings of all valves, dampers and other adjusting devices in a manner that will allow the settings to be restored. If a balancing device is provided with a memory stop, it shall be set and locked.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

J. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

K. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

L. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

M. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine system pumps to ensure absence of entrained air in the suction piping.

Q. Examine operating safety interlocks and controls on HVAC equipment.

R. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

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

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."

2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 BALANCING SYSTEMS AFFECTED BY SELECTIVE DEMOLITION

A. Where a portion of any existing HVAC system is altered, rebalance the entire affected system to ensure that previous flow, temperature and pressure readings to unaltered spaces are maintained.

B. Prior to the disruption of any existing system, measure and record the existing airflow and/or water flow rates and pressures in all mains, sub mains and branch distribution systems that are to be restored to their previous readings. Determine the best locations in main and branch ducts for accurate duct-airflow and water flow measurements.

C. Readings of existing airflow and/or water flow rates, temperature and pressure shall be submitted to the Architect prior to the start of demolition activities.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

b. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-

heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect and comply with requirements in Division 23 Section "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.11 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Check settings and operation of safety and relief valves. Record settings.

3.12 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.13 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.

6. Capacity: Calculate in tons of cooling.

3.14 PROCEDURES FOR COOLING TOWERS

A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:

1. Measure condenser-water flow to each cell of the cooling tower.
2. Measure entering- and leaving-water temperatures.
3. Measure wet- and dry-bulb temperatures of entering air.
4. Measure wet- and dry-bulb temperatures of leaving air.
5. Measure condenser-water flow rate recirculating through the cooling tower.
6. Measure cooling-tower spray pump discharge pressure.
7. Adjust water level and feed rate of makeup water system.
8. Measure flow through bypass.

3.15 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

3.17 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.18 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.19 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Zero to 10 percent.
2. Air Outlets and Inlets: Zero to 10 percent.
3. Heating-Water Flow Rate: Zero to 10 percent.
4. Cooling-Water Flow Rate: Zero to 5 percent.

3.20 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.21 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.

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

2. Test Data (Indicated and Actual Values):

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

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:
a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

G. Packaged Chiller Reports: For each chiller, include the following:

1. Unit Data: Include the following:

a. Unit identification.
b. Make and model number.
c. Manufacturer's serial number.
d. Refrigerant type and capacity in gal. (L).
e. Starter type and size.
f. Starter thermal protection size.

2. Condenser Test Data: Include design and actual values for the following:

a. Refrigerant pressure in kPa (psig).
b. Refrigerant temperature in deg C (deg F).
c. Entering-water temperature in deg C (deg F).
d. Leaving-water temperature in deg C (deg F).
e. Entering-water pressure in kPa (feet of head or psig).
f. Water pressure differential in kPa (feet of head or psig).

3. Evaporator Test Reports: Include design and actual values for the following:

a. Refrigerant pressure in kPa (psig).
b. Refrigerant temperature in deg C (deg F).
c. Entering-water temperature in deg C (deg F).
d. Leaving-water temperature in deg C (deg F).
e. Entering-water pressure in kPa (feet of head or psig).
f. Water pressure differential in kPa (feet of head or psig).

4. Compressor Test Data: Include design and actual values for the following:

a. Make and model number.
b. Manufacturer's serial number.
c. Suction pressure in kPa (psig).
d. Suction temperature in deg C (deg F).
e. Discharge pressure in kPa (psig).
f. Discharge temperature in deg C (deg F).
g. Oil pressure in kPa (psig).
h. Oil temperature in deg C (deg F).
i. Voltage at each connection.
j. Amperage for each phase.
k. The kW input.
l. Crankcase heater kW.
m. Chilled water control set point in deg C (deg F).
n. Condenser water control set point in deg C (deg F).
o. Refrigerant low-pressure-cutoff set point in kPa (psig).
p. Refrigerant high-pressure-cutoff set point in kPa (psig).

5. Refrigerant Test Data: Include design and actual values for the following:

   a. Oil level.
   b. Refrigerant level.
   c. Relief valve setting in kPa (psig).
   d. Unloader set points in kPa (psig).
   e. Percentage of cylinders unloaded.
   f. Bearing temperatures in deg C (deg F).
   g. Vane position.
   h. Low-temperature-cutoff set point in deg C (deg F).

H. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:

1. Unit Data: Include the following:

   a. Unit identification.
   b. Location.
   c. Unit make and model number.
   d. Manufacturer's compressor serial numbers.
   e. Compressor make.
   f. Compressor model and serial numbers.
   g. Refrigerant weight in kg (lb).
   h. Low ambient temperature cutoff in deg C (deg F).

2. Test Data: Include design and actual values for the following:

   a. Inlet-duct static pressure in Pa (inches wg).
   b. Outlet-duct static pressure in Pa (inches wg).
   c. Entering-air, dry-bulb temperature in deg C (deg F).
   d. Leaving-air, dry-bulb temperature in deg C (deg F).
   e. Condenser entering-water temperature in deg C (deg F).
   f. Condenser leaving-water temperature in deg C (deg F).
   g. Condenser water temperature differential in deg C (deg F).
   h. Condenser entering-water pressure in kPa (feet of head or psig).
   i. Condenser leaving-water pressure in kPa (feet of head or psig).
   j. Condenser water pressure differential in kPa (feet of head or psig).
   k. Control settings.
   l. Unloader set points.
   m. Low-pressure-cutout set point in kPa (psig).
   n. High-pressure-cutout set point in kPa (psig).
   o. Suction pressure in kPa (psig).
   p. Suction temperature in deg C (deg F).
   q. Condenser refrigerant pressure in kPa (psig).
   r. Condenser refrigerant temperature in deg C (deg F).
   s. Oil pressure in kPa (psig).
   t. Oil temperature in deg C (deg F).
   u. Voltage at each connection.
   v. Amperage for each phase.
   w. The kW input.

x. Crankcase heater kW.
y. Number of fans.
z. Condenser fan rpm.
aa. Condenser fan airflow rate in L/s (cfm).
bb. Condenser fan motor make, frame size, rpm, and horsepower.
cc. Condenser fan motor voltage at each connection.
dd. Condenser fan motor amperage for each phase.

I. Cooling Tower or Condenser Test Reports: For cooling towers or condensers, include the following:

1. Unit Data: Include the following:

a. Unit identification.
b. Make and type.
c. Model and serial numbers.
d. Nominal cooling capacity in kW (tons).
e. Refrigerant type and weight in kg (lb).
f. Water-treatment chemical feeder and chemical.
g. Number and type of fans.
h. Fan motor make, frame size, rpm, and horsepower.
i. Fan motor voltage at each connection.
j. Sheave make, size in mm (inches), and bore.
k. Sheave dimensions, center-to-center and amount of adjustments in mm (inches).
l. Number of belts, make, and size.

J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.

c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

3. Pump Impeller Trimming For Energy Conservation

a. After systems with constant speed base mounted centrifugal pumps, 15 hp and larger, have been adjusted and balanced, using flow and amperage readings and the pump curves, determine whether a minimum of 3 horsepower could be saved by impeller trimming in accordance with ASHRAE Standard 90.1. If such is the case, submit results for approval prior to advising the installing contractor of the amount of trimming required.

K. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.22 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.

2. Check the following for each system:

Measure airflow of at least 10 percent of air outlets.

a. Measure water flow of at least 5 percent of terminals.
b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
c. Measure space pressure of at least 10 percent of locations
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. Government shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.

2. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
3. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
4. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
5. Request a second final inspection. If the second final inspection also fails, Design Build Contractor shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.23 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 230593

SECTION 230700 - HVAC SYSTEMS INSULATION

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Drawings and General Provision of Contract, including General and Supplementary Conditions and Division 1 specifications, apply to this section.

1.2 SUMMARY

A. This Section specifies insulation for HVAC systems including the following:

1. Ductwork.
2. Piping.
3. Equipment.

1.3 RELATED WORK

A. Duct Lining: Refer to Section 233113 - METAL DUCTS

1.4 QUALITY ASSURANCE

A. All insulating products delivered to the construction site shall be labeled with the manufacturer's name and description of materials.

B. Installer Qualifications: Skilled mechanics with applicable experience.

C. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency. Insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DEFINITIONS

A. Concealed areas, where indicated in this section, shall apply to shafts, furred spaces, space above finished ceilings, low tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

B. ASJ: All-service jacket

C. FSK: Foil, scrim, Kraft paper

D. SSL: Self-sealing lap

1.6 SUBMITTALS

A. Submit shop drawings for the following:

1. Schedule for all insulating materials, including adhesives, fastening methods and fitting materials. Submittal shall include catalog sheets indicating density, thermal characteristics, jacket, and installation instructions, and a schedule of insulation for intended use.

1.7 SYSTEM DESCRIPTION

A. Design Requirements

1. Insulate ductwork, piping and equipment as described below and in accordance with ASHRAE Standard 90.1 2010.
2. Ambient and chilled piping systems to be insulated
   a. Chilled water supply and return.
   b. Condenser water.
   c. Heat traced piping.
3. Ambient and chilled piping systems not to be insulated
   a. Underground condenser water piping starting at 36-inches below grade.
4. Cold piping systems to be insulated
   a. Refrigerant piping.
5. Ambient and chilled equipment to be insulated
   a. Chilled water tanks including expansion tanks and air separators.
   b. Refrigeration machine components (if not factory insulated).
   c. Chilled water pumps.
   d. Chilled water heat exchangers.
   e. Cooling coil drain pans.
6. Cold equipment to be insulated
   a. Low temperature heat exchangers and storage vessels.
7. Air handling apparatus and ductwork to be insulated
   a. Outside air intake plenums and ducts upstream of outside air isolation damper.
   b. Unlined, single wall air conditioning supply ducts.
   c. Exhaust / Relief air ducts downstream of the relief air damper.
8. Air handling apparatus and ductwork not to be insulated
   a. Double wall air handling unit housings and plenums.
   b. Double wall supply ducts.
   c. Acoustically lined ducts, unless otherwise specified or shown.

1.8 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.

1.9 COORDINATION

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

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

C. Coordinate installation and testing of heat tracing.

1.10 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, or on straight pipe runs with no joints.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide insulation, binders, vapor barriers, jackets, adhesives, coatings, tapes and sealers furnished under this Section which are listed and labeled by a nationally recognized certifying organization such as Underwriters Laboratories Inc., OmegaPoint, or Southwest Research Institute as having a flame spread rating of 25 or less and smoke development rating of 50 or less when tested in accordance with ASTM E84, unless otherwise specified.

B. Provide pipe insulation in pre-molded, three-or-six-foot-long sections, split ready for application or split with factory applied vapor barrier attached.

C. Do not use wheat paste, mold-breeding and mold-sustaining organic materials.

D. Provide insulation materials which are 100 percent mercury and asbestos free.

E. Field-applied adhesives and sealants shall have no more than the following VOCs:

1. PVC Welding: 510 g/l
2. CPVC Welding: 490 g/l
3. ABS Welding: 325 g/l
4. Plastic Cement Welding: 250 g/l
5. Adhesive Primer for Plastic: 550 g/l
6. Glass Fiber Adhesive 80 g/l
7. Foamed Plastic Adhesives 50 g/l
8. All Other Welding & Installation Adhesives & Sealants: 250 g/l

2.2 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:

B. Fiberglass Insulation

1. Owens-Corning Fiberglas Corporation;
2. Johns Manville, Manson
3. Knauf Fiber Glass.

C. Elastomeric Cellular Thermal Pipe Insulation

1. Armacell "AP Armaflex";
2. Accessible Products Co. "Techlite"; "Imcoshield";
3. Rubatex Corp. Insulation with self-sealing longitudinal joints is acceptable.

D. Calcium Silicate Insultation

1. Pittsburgh Corning Corporation “Foamglass”
2. Cell U Foam Corp “Ultra CUF 1031”

E. Silica Fiber Insulation

1. 3M “Fire Barrier Duct Wrap 15A”
2. Thermal Ceramics Fastwrap XL

F. Mineral Wool Insulation

1. Fibrex Insulations Inc.;
2. Owens Corning “Paroc”;
3. Roxul “1200”;
4. Rock Wool Mfg. Co. “Delta PF” or “Delta PC”.

G. Adhesives, Mastics, Coatings and Sealants

1. Foster Products Div., H.B. Fuller Co.;
2. I-C Adhesives Co.;
3. Chicago Mastic Co.;
4. Childers Products Co.
5. St. Clair Rubber Co.;
6. And as specified in Part 3 - Execution.

H. Vapor Barrier Tape

1. Factory supplied vapor barrier tape, FED Spec HHB-100 Type I pressure sensitive adhesive backed.
2. Manufacturer:

   a. LAMTEC 70JASJ,
   b. Ideal Tape Company
   c. Approved equal.

I. Vapor Barriers

1. Ambient and chilled systems indoor: All Service Jacket (ASJ) consisting of 0.00035 inch thick aluminum foil laminated to two sheets of Kraft paper by flame retardant adhesive or 0.001-inch–thick aluminum foil. Provide the complete laminated product reinforced with yarn spacing at 5 per inch, Dow “Saran 540” or VyTech “Atlas VRP”.
2. Ambient and chilled systems outdoor and cold systems indoor and outdoor: Dow “Saran 560”, Alpha “Alaflex Style 13 MAM” or Polyguard “Insulrap 30”
3. Outdoor Waterproofing
    a. Smooth aluminum jacketing, 0.016-inch thick for pipe and 0.024-inch thick with vapor barrier for equipment.

2.3 PIPE INSULATION SCHEDULE

A. Glass fiber, pre-formed, rigid, molded insulation, factory jacketed with a white polymer jacket, with an absorbent wicking cloth extending to the outside of the system to evaporation holes in the jacket with self sealing longitudinal laps and butt strips. Provide insulation with a thermal conductivity 'k' of 0.033 W/m.K (0.23 Btu/hr/sq. ft./degree F/in.) at 24 degrees C (75 degrees F) mean temperature with a minimum service temperature of 13 degrees C (55 degrees F) and a maximum service temperature of 454 degrees C. (850 degrees F). Provide insulation and jacketing conforming to the following standards:

ASTM C335, C356, C411, C518, C547, C795, C1136.

B. Pre-formed half-cylinder felted mineral wool insulation bonded with a high temperature binder, with a thermal conductivity ‘k’ of 0.035 W/m.K (0.24 BTU-inch per hour per sq. ft. per degree F) at a mean temperature of 24 degrees C (75 degrees F) with a minimum service temperature of 13 degrees C (55 degrees F) and a maximum service temperature of 650 degrees C (1200 degrees F), with a melting point of 1093 degrees C (2000 degrees F) and a flame spread rating of 5 and a smoke developed rating of 0 when tested in accordance with ASTM E84. Provide insulation that conforms to the following:

ASTM C356, C411, C518, C547, C585, E84, E136

C. Elastomeric cellular pipe and fitting insulation with a maximum flame spread rating of 25 and a maximum smoke developed rating of 50 or less at the thickness of intended use when tested in accordance with ASTM E84. Seal longitudinal and butt seams with a waterproof vapor retardant adhesive. Provide insulation with a conductivity 'k' of 0.035 W/m.K (0.27 Btu/hr/sq. ft./degree F/in.) at 24 degrees C (75 degrees F) mean temperature with a minimum service temperature of 4 degrees C (40 degrees F) and a maximum service temperature of 93 degrees C (200 degrees F). Elastomeric cellular pipe insulation in excess of 25 mm (1 inch) thickness will be permitted in Mechanical Equipment Rooms not used as return plenum and outdoor locations only. Provide insulation conforming to the following standards:

ASTM C177, C335, C534, D1056, D1149, E84, E96.

D. Calcium silicate molded high temperature, block insulation, provided in half sections. Provide insulation with a maximum flame spread and smoke developed rating of 0 in accordance with ASTM E84, with a minimum service temperature of 200 degrees F and a maximum service temperature of 1200 degrees F. Provide insulation with a thermal conductivity, ‘k’ of 0.05 W/m.K (0.36 Btu/hr/sq.ft/degree F/in.) at 100 degrees F. Provide insulation that conforms to the following:

ASTM C 533, C795, E84, E136

E. Pipe Insulation Minimum Thickness (Based on ASHRAE 90.1 2010).

PIPE INSULATION SCHEDULE					
Design Operating Temperature (Deg F)	Pipe Diameter (Inch)				
	Less than 1	1 to 1-1/4	1-1/2 to 3-1/2	4 to 6	8 and up
Minimum Insulation Thickness (Inch)					
Ambient and Chilled Systems					
40-60	0.5	1.0	1.0	1.0	1.5
Cold Systems					
Below 40	0.5	1.0	1.0	1.0	1.5

1. Insulation thicknesses are based on glass fiber insulation (k = 0.23). Adjust the thicknesses for insulations with other k factors to provide the equivalent insulating efficiency, based on the following formula:

   Thickness of other insulation = (thickness of glass fiber x ‘k’ for other insulation) / 0.23

2. Heated Systems

   a. Heating Hot Water. Indoor: (glass fiber, phenolic foam 200 deg. F max., calcium silicate, perlite, mineral wool, polyisocyanurate or cellular glass insulation). Outdoor: (cellular glass, phenolic, polyisocyanurate, or perlite insulation).

3. Ambient and Chilled Systems

   a. Chilled Water, Glycol Heat Recovery, Domestic and Service Cold Water, Storm, Sanitary, Condensate Drain, and Condenser Water. (glass fiber, elastomeric, polyisocyanurate, extruded polystyrene, or cellular glass insulation)

4. Cold Systems

   a. Refrigerant and Low Temperature Glycol. (glass fiber, polyisocyanurate, extruded polystyrene or cellular glass insulation)

F. For piping installed in outdoor locations, increase insulation thickness one inch.

2.4 AMBIENT AND CHILLED EQUIPMENT INSULATION SCHEDULE

A. Elastomeric cellular sheet insulation with vapor barrier coating applied to all outer surfaces, with a maximum flame spread rating of 25 or less and a smoke developed rating of 50 or less for thicknesses up to 1 inch thick, in accordance with ASTM E84. Seal joints with a waterproof vapor retardant adhesive. Provide insulation with a thermal conductivity ‘k’ of 0.039 W/m.K (0.27 Btu/(hr/sq. ft./degree F/in) at 75 degrees F mean temperature. Elastomeric cellular sheet insulation over 1 inch thickness will be permitted in mechanical equipment rooms not used as return plenums and outdoor locations only.

   ASTM C177, C335, C534, D1056, D1149, E84, E96.

B. Insulation Thickness Schedule

1. Insulation minimum thickness: 1/2 inch based on phenolic foam (k = 0.13).
2. Adjust the thicknesses for insulations with other k factors to provide the equivalent insulating efficiency, based on the following formula:

   Thickness of other insulation = (thickness of phenolic foam x ‘k’ for other insulation) / 0.13

3. For equipment installed in outdoor locations, increase insulation thickness by 25 mm (one inch). Note: 25/50 flame/smoke requirements not applicable.

2.5 COLD EQUIPMENT INSULATION SCHEDULE

A. Cellular glass insulation with vapor barrier consisting of inorganic, foamed or cellular glass, annealed, rigid hermetically sealed cells with an ASTM C921, Type 1, factory-applied, polymer-modified bituminous compound reinforced with a 4-mil, high density, cross laminate, polyethylene top film. Provide insulation with a thermal conductivity 'k' of 0.046 W/m.K (0.32 Btu/hr/sq. ft./degree F/in.) at 75 degrees F mean temperature with a minimum service temperature of --60 degrees F and a maximum service temperature of 900 degrees F. Provide insulation and jacketing conforming to the following standards:

   ASTM C177, C203, C240, C303, C518, C552, C623, E96, E228.

B. Insulation Thickness Schedule

1. Insulation minimum thickness 1/2-inch for polyisocyanurate (k = 0.19). Adjust the thicknesses for insulations with other k factors to provide the equivalent insulating efficiency, based on the following formula:

   Thickness of other insulation = (thickness of polyisocyanurate x ‘k’ for other insulation) / 0.19.

2. For equipment installed in outdoor locations, increase insulation by 25 mm (1-inch). Note: 25/50 flame/smoke requirements not applicable.

2.6 AIR HANDLING APPARATUS AND DUCTWORK INSULATION SCHEDULE

A. Exposed Locations

1. Glass fiber, rigid board insulation with a minimum service temperature use of 55 degrees F and a thermal conductivity ‘k’ of 0.33 W/m.K (0.23 Btu/hr./ sq.ft./(degree F/in) at 75 degrees F mean temperature and a density of 48 kg/cu. m (3 lb./cu.ft.) and a vapor barrier jacket consisting of Kraft paper bonded to aluminum foil, reinforced with fiber glass yarn secured with UL listed pressure sensitive tape. Provide insulation conforming to the following standards:

   ASTM C612, C795, C1136; NFPA 90A, 90B.

B. Insulation Thickness: 1-1/2 inch.

C. For equipment and ductwork installed in outdoor locations, increase insulation thickness by one inch. Note: A minimum thermal insulation value of R-8 will be provided in conjunction with internal duct liner applications for ductwork located outdoors.

2.7 INSULATION PROTECTION

A. Indoor Applications

1. Heated and cooled piping, equipment and ductwork: None
2. Piping fittings, flanges, grooved pipe couplings, valves and pipe terminations: None

B. Outdoor Applications

1. 0.4-mm (0.016-inch) smooth aluminum with factory-applied moisture barrier liner.

PART 3 - EXECUTION

3.1 GENERAL APPLICATION REQUIREMENTS

A. Prior to the installation of insulating material, verify its thickness in accordance with the operating temperature and diameter of pipe or equipment. Should there be any discrepancies, notify the Architect and request resolution of the conflict; do not establish a new thickness or select different material without written approval.

B. Protect insulating materials from moisture and weather before and during installation.

C. Conduct required tests on piping, equipment and ductwork, and make correction, if required, prior to the application of insulation.

D. Install insulation, adhesives, coatings, mastics, sealants and tapes, only by experienced pipe coverers, in compliance with NAIMA standards and manufacturer's recommendations, including all safety requirements.

E. Maximum thickness of a single layer of insulation: 63 mm (2-1/2 inches). Minimum thickness of each layer of multi-layer pipe covering: 25 mm (1 inch).

F. Fabricate pipe covering and curved shapes in accordance with ASTM C450 and C585 with a minimum number of joints.

G. When building structures or equipment interfere with the insulation, coordinate installation with other trades.

H. Protect work of other trades from debris caused by the insulation work. Remove debris daily.

I. Provide removable sections of insulation or insulation boxes at all points where access is required. Assemble sections and boxes and install so disassembly, removal, and replacement will not damage the insulation.

J. Clean surfaces to be insulated, and make dry and free of loose scale, rust, dirt, oil and water before insulation, adhesives or mastics are applied.

K. Install insulation smooth and clean. Make joints tight and finished smooth. Do not use cracked, chipped, or torn insulation sections in the Work.

L. Provide thickness of the insulation the minimum specified or shown.

M. Make joints tight with insulation lengths and segments tightly butted against each other. Where lengths or segments are cut, make cuts smooth and square and without breakage of end surfaces.

N. Fit insulation tightly against surface to which it is applied.

O. Do not apply sealant or cement until previous applications of adhesives and cement have thoroughly dried.

P. Provide pre-molded pipe insulation with extended leg when used on pipes heat-traced with piping or cable.

Q. On heat-traced piping NPS ½ to 1-1/4 (DN 15 to 32), increase pipe insulation by one pipe size.

R. Above nonplenum ceilings, extend duct insulation on air conditioning supply air systems up to and around the supply air diffuser body.

S. Interrupt insulation at ductwork fire dampers in rated walls and floors.

T. Restore existing insulation and surface finishes disturbed or damaged during the course of the work to original condition.

U. Provide insulation jackets as specified.

V. Provide insulated surfaces ready to receive a final coat of paint without the necessity of sizing or priming.

3.2 PIPING SYSTEMS APPLICATIONS

A. Insulate piping up through NPS 16 (DN 400) with two-piece, sectional pipe insulation; insulate piping larger than NPS 16 (DN 400) with sectional pipe covering or prefabricated curved sidewall segments. Trim all insulation segments and butt tightly to each other to eliminate voids, gaps or open joints; do not use joint sealer to fill these imperfections. Rub insulation ends against each other to achieve a tight fit prior to the application of joint sealer.

B. Install multiple layers of insulation so the butt and longitudinal joints of one layer do not coincide with those of any other layer. Stagger the outer joints by half sections over the inner joints with a minimum overlap of 450 mm (18 inches).

C. On all indoor and outdoor applications, on chilled, ambient and cold piping systems, apply a vapor sealing joint sealer, in full bed coverage (not a bead), for sealing all joints of insulation and pvc slip joints of the vapor barrier type, moisture and water resistant, 97 percent solids by weight, non-hardening and flexible with a service temperature range from -45 degrees C (-50 degrees F) to 93 degrees C (200 degrees F); Childers “CP-76”, Foster “44” or “95-50” or as approved.

D. Fasten insulation circumferentially with 19-mm (3/4-inch) -wide tape, 50 mm (2 inches) from each end and in the middle of each pipe section and a minimum of two tapes per each section of equipment insulation. Employ bands in lieu of tape on all piping above NPS 16 and an all curved wall sections where tape does not close the insulation joints tightly. Apply tape at least 50 percent on itself. Do not tighten tape or bands so as to crush or crack the insulation; replace any broken insulation. Fasten the outer layer or single layer of equipment insulation with 13 mm (1/2-inch), type 304 stainless steel bands on 300 mm (12 inch) centers.

E. Provide rigid cellular insulation fittings for flanges, valves including bonnet flanges, elbows, tees and other such fittings on both cold and hot systems, of pre-fabricated two-piece fly-cut or routed or two-piece mitered design (urethane spray foam fill is not acceptable) fabricated in accordance with ASTM C450 and ASTM C585. Allow bolt length plus 25 mm (1 inch) from flange for bolt removal. Provide insulation on flanges with overlap of the adjacent pipe covering by 50 mm (2 inches) and pack the void space with insulation and finish with molded fitting covers. Cut back insulation at valve packing glands and fill the space between the insulation and valve body with joint sealer with termination sealed with vapor barrier mastic.

F. On chilled, ambient and cold piping systems, provide a vapor barrier mastic, compatible with the insulation material, to seal the insulation on all fittings, valves, flanges including bonnet flanges,

elbows, tees and other such fittings prior to the application of outer covering, that is water based and will remain flexible at the ambient temperature; Foster “30-80”, Viamsco “Vapor-Block”, Childers “Chil-Perm # CP-35” or as approved. Apply mastic on two coats with reinforcing fabric consisting of 6 x 6 glass fiber reinforcing mesh; Childers “Chil Glas #5” or Pittsburgh Corning “PC-79” fabric with 5 x 5 mesh or as approved.

G. Carry the vapor barrier mastic from the outer surface of the insulation to the uninsulated metal parts of the chilled and cold piping system to provide a continuous vapor seal at all terminations, nozzles, caps, etc. Extend vapor barrier on attachments, such as hangers and supports that are in direct contact with the cold surface, an additional 150 mm (6 inches) over the uninsulated surface. Install the reinforcing cloth so as to be completely covered with the mastic and ensure that there are no cracks, holes, thin spots or open joints in the vapor barrier. Allow the vapor barrier to dry per manufacturer’s instructions before application of jacketing.

H. Check the vapor barrier for final dry thickness, continuity, cracks, thin spots, pinholes, etc. Repair unsatisfactory areas.

I. Seal openings on chilled, ambient and cold piping through insulation vapor tight by applying joint sealer between the protrusion and insulation.

J. On piping NPS 2-1/2 (DN 65) and larger, provide insulation support rings in each layer on vertical piping for each run over 6.4 m (21 feet) and provide a contraction/expansion joint immediately below each support ring. Provide contraction/expansion joints in each layer of horizontal piping located midway between pipe supports and other protrusions through the insulation systems. Install contraction/expansion joints comprised of a 25mm (1 inch) space between insulation segments, filled in with 16 kg/cu.m.(1-lb/cu.ft.) density 75 mm (3 inch) long fiberglass blanket compacted to 25mm (1-inch) in length. Provide contraction/expansion joints in both single and multiple layer applications with a 300mm (12-inch) long additional layer of equivalent thickness insulation installed as an outer cover over the contraction/expansion joint. On chilled and cold piping, maintain vapor barriers continuous over contraction/expansion joints by stepping up and then down back to the pipe insulation.

K. On all chilled, ambient and cold piping provide vapor stops at all pipe supports and all changes in configuration such as elbows, flanges, insulation terminations and at all locations on piping requiring maintenance including instrumentation connections. Provide vapor stops consisting of reinforced vapor barrier mastic, and after drying, install adjacent segment of insulation using joint sealer.

L. 360-degree, high density, pre-insulated, pipe supports employing 360-degree shields are provided on insulated piping NPS 2-1/2 (DN 65) and larger under Section 15060 of these Specifications. On chilled and cold piping, abut the pipe insulation at these supports employing a vapor stop and reinforced vapor barrier mastic overlapped circumferential seal and onto the pipe surfaces.

M. Provide fabricated insulation for chilled, ambient and cold piping with a factory applied integral vapor barrier jacket: ASJ, Dow “Saran 560, “Alaflex Style 13 MAM” or Polyguard “Insulwrap 30”. Provide the vapor barrier jacket wrinkle free, covering all outer surfaces of the insulation sealed longitudinally by an integral self sealing lap (SSL) and a 75 mm (3-in) wide sealing tape for butt joints. Use of staples for securing jacket laps is prohibited. Install longitudinal laps at ten o’clock or two o’clock.

N. Cover and completely seal all chilled, ambient and cold piping with a vapor barrier, continuous on all surfaces, prior to the application of jacketing. Seal weld all circumferential and longitudinal laps with pvc solvent welding adhesive. Install 38-mm (1-1/2-inch) -wide self-sealing lap tape on

the joints of the jacket in addition to the adhesive. Apply laps with a minimum of 50 mm (2 inches) on both the circumferential and longitudinal joints.

3.3 AMBIENT AND CHILLED AND COOLED EQUIPMENT APPLICATION

A. For Elastomeric Insulation (on ambient and chilled equipment only)

1. Apply sheet insulation over all surfaces without stretching.
2. Cover all devices on tanks and heat exchangers with mitered sections of insulation so as to facilitate their servicing and removal without disturbing the equipment insulation.
3. Install insulation on pumps so that the pump casing can be separated without damaging the insulation on the casing body.
4. If sheet insulation is not provided with a factory-applied contact adhesive, then apply sheet insulation with the smooth or skin side out. Adhere insulation with complete coverage of adhesive. Apply a thin but adequate coat on both surfaces to be joined. Allow the adhesive films to air-dry until dry to touch but tacky under slight pressure before joining surfaces. Avoid open time in excess of 20 minutes. Apply moderate pressure to entire areas, insuring complete contact. Since adhesive is an instant-bonding type, position surfaces accurately as contact is made. Apply adhesive at temperatures above 4 degrees C (40 degrees F). Do not apply to heated surfaces or to insulation over heated surfaces. Allow adhesive joints applied with full adhesive bonding to dry for 7 days before applying solvent-base finishes.
5. Ensure that metal surface is clean and dry and free of all dirt, scale, loose paint, plaster, oil, etc.
6. If the metal surface has been primed, apply adhesive with a brush to a test area approximately 0.19 square meters (two square feet) to determine whether the solvent in the adhesive will loosen or lift the primer. If there is any indication of loosening or lifting the primer, do not apply insulation until primer has been removed and re-applied properly.
7. Do not apply insulation over asphaltic surfaces.
8. Provide adhesives that are compatible with the insulation employed.
9. Apply adhesive to the surface to be insulated with brush or short-nap paint roller, covering enough area to receive one sheet of insulation.
10. Apply adhesive to the back of the sheet with brush or short-nap paint roller, leaving 13-mm-wide (1/2-inch-wide), uncoated border around the perimeter of the sheet.
11. Allow the adhesive to dry to the touch before bringing the two surfaces into contact.
12. Position the sheet in such manner that it overlaps the edges of the previously installed sheet or sheets by 3 mm (1/8 inch). While held in this position, spot-adhere the center of the sheet. Compress the butt edges into place to achieve a tight joint. Bond the remainder of the sheet by pressing firmly into place.
13. Spread the joint and, by means of a small brush, apply adhesive to both butt edges - do not fill joint with adhesive. No open time is required for this adhesive application; however, align the butt edges for good appearance.
14. Stagger the vertical joints where sheet insulation is applied to vertical tanks. In the case of horizontal tanks, stagger the horizontal joints.
15. If insulation with a self-adhering back is employed, wipe all surfaces with an alcohol soaked damp rag before applying sheet.

B. For Other Insulations

1. Provide vessel head segments curved, double radius contoured for the exact curvature of the vessel head. Provide curved sidewall segments for vessels and equipment fabricated per ASTM C450 to fit the contour of the surface in equal pieces to go around the vessel with the minimum number of through joints.
2. Provide a water based vapor barrier mastic, that is compatible with the insulation material and that remains flexible at the environmental temperature, to seal all insulation joints on the equipment prior to the application of the outer covering; Foster “30-80” or “30-90”, Viamsco “Vapor-Block #749” or Childers “Chil-Perm #CP-35”, or as approved.
3. Provide a membrane for reinforcement for the vapor barrier mastic that is 6 X 6 glass fiber reinforcing mesh; Childers “Chil Glas #5”, Pittsburgh Corning “PC-79 Fabric” with 5 X 5 mesh, or as approved.
4. Provide the vessels, tank ends, irregular surfaces, contraction/expansion joints, valves and fittings vapor sealed with the reinforced vapor barrier mastic applied to a minimum total dry (cured) film thickness of 0.95 mm (0.038 inch) or as recommended by the mastic manufacturer. Evenly apply the first layer of mastic by suitable means as a tack coat over the insulation or vapor barrier with an approximate 0.8-mm (0.032-inch) wet film thickness. Then apply reinforcing cloth, stretched tight, embedded into the still tacky first layer of mastic with a 75-mm (3-inch) overlap. Apply the second layer of mastic with 0.8-mm (0.032-inch) wet film thickness.
5. Carry the vapor barrier mastic from the outer surface of the insulation to the uninsulated metal parts of the vessel to provide a continuous vapor seal at all terminations, projections, nozzles, caps, etc. Extend vapor barrier on attachments, such as hangers and supports, an additional 150 mm (6 inches) over the uninsulated surface. Install the reinforcing cloth so as to be completely covered with mastic and ensure that there are no cracks, holes, thin spots or open joints in the vapor barrier. Allow the vapor barrier to dry per manufacturer’s instructions before the application of any jacketing.
6. Check the vapor barrier for final dry thickness, continuity, cracks, thin spots, pinholes, etc. Repair unsatisfactory areas.
7. Cover and completely seal all equipment with a vapor barrier, continuous on all surfaces, prior to the application of the jacketing. Seal weld all joints with pvc solvent welding adhesive. Follow manufacturer’s recommendations in handling and application of the adhesive. Install 38-mm (1-1/2-inch) -wide self-sealing lap tape on the joints of the jacket in addition to the adhesive. Apply tape with a minimum overlap of 50 mm (2 inches) on the joints.

3.4 AIR HANDLING APPARATUS AND DUCTWORK INSULATION APPLICATION

A. General

1. Insulate flexible connections to ducts where ducts are insulated.
2. Insulate standing seams with same material and thickness as duct.

B. Rigid Board Insulation

1. Impale rigid board insulation over mechanical fasteners on 300-mm (12-inch) to 450-mm (18-inch) centers. Use a minimum of two rows of fasteners per side. Secure insulation with speed fastener or clip, and point up fasteners, joints and breaks with vapor barrier coating of Foster “30-35”, Childers Products “Encacel V”, or as approved.
2. Paste laps of covering in place with adhesive, such as Foster “85-20” or Childers Products “CP-82”. Where insulation has been trimmed flush, seal joints with 100-mm (4-inch) –wide butt strips of 2-mil foil facing material or as recommended by the

manufacturer of the insulation. Tape pin penetrations, punctures and joints. Tightly seal strap and angle hanger penetrations.

C. Flexible Insulation

1. Wrap flexible insulation around ducts using the lap seal butt-joint method with factory-supplied vapor-barrier tape. Stapling is not permitted.
2. On ducts 600 mm (24 inches) or more in width, use mechanical fasteners on the bottom of the duct to guard against possible sagging. Provide mechanical fasteners and spacing as specified for rigid board insulation.
3. Tape pin penetrations, punctures and joints. Tightly seal strap and angle hanger penetrations.

3.5 INSULATION PROTECTION APPLICATION

A. Outdoor Applications: all outdoor insulated piping, fittings, equipment and ductwork.

1. General

a. Install metal jacket weatherproofing over the outer surfaces of all insulation work on all piping, ductwork and equipment located outdoors. Fabricate all metal jacketing of aluminum.
b. Install metal jacketing as soon as possible after the insulation work has been completed. At the end of the day apply the metal jacketing to all insulation materials applied on that day. Temporarily protect any exposed insulation with a combination moisture and/or UV barrier such as black polyethylene film, sealed to the pipe, duct or equipment.
c. Do not apply mastics when the ambient temperature is, or is expected to be in the next 24 hours, below 34 degrees C (40 degrees F) unless specifically approved for that use by the manufacturer.
d. Cut all openings in the metal jacketing for nozzles, brackets, protrusions, etc. as close as possible to achieve a tight fit. Use silicone or butyl based caulking compounds to seal all projections and penetrations.

2. Piping

a. Provide a minimum of 50-mm (2-inch) overlap on all circumferential and longitudinal joints. Locate the longitudinal lap on horizontal piping alternatively at either the ten o'clock or two o'clock position to shed rainwater. Support metal jacketing on vertical piping by means "S" clips made from stainless steel metal bands.
b. Provide preformed RPR "Insul-Mate" metal elbows, Childers "ELL-Jac" or "Univers-Ells" for fittings on piping up to NPS 12 and metal gore elbows on piping above NPS 12. Provide smooth metal jacketing over flanges and flanged fittings. Use stainless steel bands for securing metal jacketing on preformed and gored elbow covers. Provide metal jacketing with raised bead for proper closing of gores. Wherever possible, avoid using screws, pop rivets, etc; however where they must be used to secure irregular shapes, drill all holes before the metal jacketing is put in place over the insulation. Tape a 75 mm (3-inch) wide by 0.5 mm (0.020 inch) aluminum strip over the insulation under the seam of the metal jacketing.

3. Ductwork and Equipment

   a. Apply metal jacketing for horizontal and vertical ductwork and equipment surfaces with 75 mm (3-inch) joint laps.
   b. Fabricate metal jacketing for equipment vessel heads of a one-piece dish or conical sections fitted to the insulation. Install head covers to overlap the shell jackets by 100 mm (4 inches) and fasten by means of 13-mm x 0.5-mm (1/2-inch x 0.020-inch) stainless steel band, one for every gore. Install an additional band, 100 mm (4 inches) wide and secure with stainless steel bands.
   c. Secure metal jacketing on horizontal and vertical ductwork and equipment with 13-mm x 0.5-mm (1/2-inch x 0.020-inch) stainless steel bands spaced on 300-mm (12-inch) centers. Wherever possible, avoid using screws, pop rivets, etc.; however where they must be used to secure irregular shapes, drill all holes before the metal jacketing is placed over the insulation. Support metal jacketing on vertical equipment by means of “S” clips on 300-mm (12-inch) centers.

END OF SECTION 230700

SECTION 230905 – INSTRUMENTATION AND CONTROLS DOR CHILLER PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. This Section provides for the automatic control of the chilled water system, complete with components and accessories necessary for completely automatic operation, completely installed, adjusted, fully tested and ready for normal operation.
2. It is not the purpose of this specification to include the details of construction methods, workmanship quality levels, materials and equipment quality levels, or a complete listing of the materials and equipment which will be required in the work.
3. Provide for the control system to be furnished, installed, supervised and tested by personnel regularly employed by the water chiller manufacturer.
4. Provide controls that are electric, pneumatic, electronic, or a combination system of components necessary to accomplish the automatic control requirements of the chilled water system mechanical work.

B. Performance Requirements

1. Provide a BACNet Standard 135 compliant chilled water system instrumentation and control capable of full interface with a future DDC based Building Automation System (BAS).
2. Provide the chilled water system instrumentation and control system with an interface with the current pneumatic based BAS. This interface will consist of remote monitoring equipment status and alarm functions from the current operators terminal station.

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME)

1. B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

B. American Society for Testing and Materials (ASTM)

1. B32 - Specification for Solder Metal.
2. B88 - Specification for Seamless Copper Water Tube.
3. B88M - Specification for Seamless Copper Water Tube [Metric].
4. D1693 - Test Method for Environmental Stress-Cracking of Ethylene Plastics.

C. American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

1. Standard 135

D. National Fire Protection Association (NFPA)

1. 90A - Installation of Air Conditioning and Ventilating Systems.

1.3 SYSTEMS DESCRIPTION

A. The mechanical systems controlled include:

1. Refrigeration control.
2. Cooling tower control.

1.4 SUBMITTALS

A. General

1. Include with submittals system piping and electrical connections and a written description of operation. Include with equipment submittals data on equipment used including flow measuring devices.
2. Furnish graphic flow diagram drawings for the system.
3. Label items and devices shown and indicate the following information:
   a. Coordination with submitted catalog information.
   b. Proper settings and adjustments of instruments.
   c. Normal condition of devices, such as normally closed dampers, normally open valves and contacts.
   d. Sizes of devices and accessories included with devices.

B. Data Communications Protocol Certificates: Certify that each proposed DDC system component is BACnet ASHRAE Std. 135 compliant

C. System Sequences

1. Provide with the control diagram for the system a complete written sequence of operation pertaining to the diagram and show on the same Drawing.

D. Catalog Information

1. Include with control diagram submittals catalog sheets for each item used in the system.
2. Mark catalog sheets showing two or more devices or models of a device to show the specific model and/or accessories being used in the control diagram.
3. Refer to Section 230000.

1.5 TEST

A. Performance Verification Test (PVT): Perform a PVT under the Owner's supervision prior to system acceptance. During the PVT, demonstrate the system performs as specified, including but not limited t demonstrating that the system is Open and correctly performs the Sequences of Operation.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ASHRAE Standard 135 for DDC system components.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.8 WARRANTY

A. Refer to Section 230000.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Trane, McQuay, or York.

2.2 MATERIALS

A. Air Piping

1. Copper

a. Air piping: hard drawn type M seamless copper tubing, ASTM Spec. B88, with wrought copper solder fittings, ASME B16.22, joined with lead free solder composed of 95.5 percent tin, 4 percent copper and 0.5 percent silver of the wire type, per ASTM B32. Provide flux used with lead free solder as recommended by the manufacturer.
b. Use compression type fittings only for connections to control devices.
c. Soft copper tubing may be used in maximum 600-mm (2-foot) lengths for connections to control devices.

2. Plastic

a. Plastic tubing will be permitted only where specifically described as acceptable; refer to Article "INSTALLATION".
b. Where permitted, provide plastic tubing that is rodent proof with a smoke and flame resistant rating in accordance with NFPA 90A. Provide plastic tubing that is black virgin polyethylene tubing conforming to modified ASTM D1693 test with a burst pressure of 600 psi at 72 degrees F, tensile strength 1750 psi and water absorption of 0.8 percent.
c. Plastic tubing: Dekoron Type 1219 FR 94V-2, for single lines and Polycor Type 1224 FR bundles for multiple lines.
d. Fittings for plastic tubing: UL-approved rod or forged brass rated to 1380 kpa (200 psi) at 38 degrees C (100 degrees F).

2.3 DIRECT DIGITAL CONTROL (DDC)

A. Provide direct digital controllers that are microprocessor based, distributed control system, complete with all hardware, software, and operator/programmer terminals. Provide systems capable of stand-alone operation, multiple controller operation, with a common operator terminal. Provide the hardware complete with all relays, digital to analog converters, analog to digital converters, and terminal strips factory wired. Provide ram memory with at least 36-hour battery backup with an automatic battery charger. Provide communication between controllers and the building automation system.

B. Include with controller software a complete operating system, standard control algorithm application packages to produce the sequences shown on the drawings, and a user custom control and calculation application package complete with interpreter. Provide complete user documentation.

C. Provide the operating system software to be EEPROM resident. Provide the operating system to control communications between the system controller, the I/O modules and the operator's terminal and accept true analog and digital inputs, produce true analog and digital outputs. Provide alarm monitoring, control application programs, interface a variety of sensor and actuator types, and contain built-in diagonistic routines.

D. Provide all modulating control capable of PID control.

E. Provide the digital system controller capable of performing all the energy management functions necessary to control and reduce energy consumption. These programs shall include the following:

1. Optimum start using an adaptive algorithm to prevent the need for manual adjustment of parameters.
2. Client tailored programs. The library routines available in firmware capable of generating additional programs as may be required for specific client tasks.
3. Chilled water and cooling tower water reset
4. Chiller efficiency.
5. Trending of variables.
6. Totalizing.
7. Holiday programming.
8. Demand limiting.

F. Provide an operator/programmer terminal for the system that incorporates a local display and adjustment input output device (keypad and display). Design the display to provide visual indication of analog variables, binary (status) condition, adjustment values, automatic operation, trouble, alarm condition and value, manual or override condition.

G. Provide a plasticized flow diagram of the chiller systems controlled by DDC that clearly shows all system components and all points monitored and controlled in the system with DDC address numbers. Locate the flow diagrams at each DOC panel for the systems it controls.

H. Provide the associated keypad with numerical keys to call-up the desired point and type of value to be displayed.

I. Adjustments available through the keypad:

1. Setpoint change
2. Proportional gain (sensitivity)
3. Integral rate
4. Velocity and acceleration constants (derivative)
5. On/off values for two-position control

J. Provide one printer and 330-mm (13-inch) CRT and modem for the system.

K. Provide calibration compensation to maintain long term analog accuracy and integrity in the controller sensing circuits. Design the controller to monitor the voltage being supplied to the resistance sensing element and through firmware compensate for power supply changes due to long term drift or drift due to ambient temperatures changes at the power supply.

2.4 CONTROL AIR

A. Tap into the compressed air system as shown on the Drawings. Provide pressure gages, filters and regulators to reduce the plant compressed air to 138 kPa (20 psi) required for pneumatic control devices. Provide a pressure relief valve to protect the control system from an over-pressure condition. Provide gages, filters, and regulators, etc., as described above for control air high pressure main of 345 kPa (50 psi), if required.

2.5 SENSOR-TRANSMITTERS FOR DIRECT DIGITAL CONTROL (DDC)

A. General

1. Provide the analog and digital sensor-transmitters required to meet the DDC system function requirements as shown on the control diagrams and input/output summary.

B. Wells and Taps

1. Wells required for immersion type temperature sensors are furnished under this Section and installed under Sections 230513, 230519 and 232113.
2. Pressure sensing devices required are furnished under this Section of the specifications and valved outlets off the piping provided under Sections 230513, 230519 and 232113.

C. Sensor-Transmitters

1. Provide 100 ohm, platinum temperature sensor-transmitters. Provide a 4 to 20 mA transmitter if required by the DDC. The temperature control manufacturer's transmitters are acceptable provided they are compatible with the DDC.
2. Provide pressure sensor-transmitters to produce a 4 to 20 mA output signal

D. Instrumentation Ranges and Accuracy.

1. Provide the sensor-transmitters for the DDC system to produce an end to end accuracy, consistently throughout the warranty period for sensor to operator's terminal display.
2. Water temperatures: -1 to 38 degrees C (30 to 100 degrees F) within plus or minus 0.42 degree C 0.75 degree F; 38 to 121 degrees C (100 to 250 degrees F) within plus or minus 0.3 degree C (0.5 degree F). Provide matched sensors for purposes of using differential temperatures for joule (Btu) calculations.
3. Low temperatures: minus 107 to 93 degrees C (minus 160 to 200 degrees F), plus or minus 1.1 degrees C (2.0 degrees F).
4. Pressure: plus or minus 2.0 percent of range.
5. Flow: plus or minus 3.0 percent of range; and plus or minus 2.0 percent of range for BTU calculations.
6. KWh and kW demand: plus or minus 1.0 percent of reading for the specific range.

2.6 LEVEL CONTROL

A. Custom design the level controller with induction relays, probe holders, and probes to indicated high level, low level, makeup water valve open and close and low level to stop the condenser water pumps. Provide the controller with pilot light indicators for high level, low level make up water open and an alarm horn with silencing button. Provide a separate probe for a controller ground. Levels are shown on the control detail on the drawings. Design the controller to provide a 4-20 mA output signal for remote monitoring.

B. Manufacturers: B/W Controls, or as approved.

2.7 WATER FLOW METER

A. Provide an insertion type water flow meter suitable for a "hot tapped" installation. Provide the meter with a turbine element, an insertion mechanism and a preamplifier/transmitter. Design the flow meter to mount on a 50-mm (2-inch) fully opening gate valve. Design the assembly of the flow meter so that the meter may be inserted into or removed from the metered pipe through the 50-mm (2-inch) valve without disturbing the metered flow nor requiring to shut down the metered system.

B. Provide the insertion mechanism with a tubular shroud to protect the turbine element during installation of the meter. Design the insertion mechanism to indicate how far into the pipe the turbine has been inserted as well as the relationship of the centerline of the turbine to the centerline of the pipe. Provide the insertion mechanism with a calibrated scale to permit positioning of the turbine element within plus or minus 1.3 mm (0.05 inch) of the required insertion point.

C. Provide the meter with 316 stainless steel wetted parts. Design the flow meter to be compensated for changes in temperature and pressure. Provide all pressure and temperature transmitters integrally mounted on the meter not requiring an additional

connection to the metered pipe. Provide water flow meters as manufactured by ONICON, or as approved.

D. Provide the preamplifier/transmitter electronics for the insertion turbine meter in a NEMA 12 enclosure and mounted on the insertion mechanism. Design the flow meter to generate a 4-20 mA output signal using an external 24 Vdc power supply for operating power. Provide local indication of the flow rate in gpm. The preamplifier/transmitter interconnecting cable using 3 wires including:

1. Power supply positive (plus) wire.
2. Signal wire.
3. Power supply and signal return wire.

E. Provide the insertion turbine meter guaranteed to meet or exceed:

Limits of error (includes linearity and repeatability)	plus or minus 1 percent of heading
Variations in output due to changes in temperature	0.005 percent of span per degree C (F)
Variations in output due to changes in power supply	0.02 percent of span
Voltage	change in voltage
Turndown	as required by the Drawings
Ambient limits for operation within these specifications	minus 40 degrees C (F) to 82 degrees C (180 degrees F), 0 percent to 100 percent RH

2.8 PNEUMATIC-ELECTRIC SWITCHES

A. Provide low pressure bellows type pneumatic-electric (PE) switches with suitable current rating. Locate switches adjacent to interconnecting electrical devices.

2.9 ELECTRIC-PNEUMATIC VALVES

A. Provide electric-pneumatic (EP) valves of suitable ratings, located adjacent to interconnecting electrical devices.

2.10 AUTOMATIC VALVES AND OPERATORS

A. General

1. Furnish all automatic valves shown on the Drawings.

2. Provide automatic valves that are normally open or closed as required. Utilize positive positioning relays for sequence operation. Unless otherwise noted, provide valves that are single seated with replaceable composition disc and seat ring, equal percentage high lift plug, stainless steel stem and spring loaded, self-adjusting teflon cone packing.
3. Select valves such that the head loss at maximum flow will not exceed 30 kPa (10 feet water gage) or the loss through the heat exchanger served, which ever is greater.
4. Provide valves capable of closing off against the maximum shutoff differential head between the pumps and the return line.
5. Where butterfly valves are used, provide solid ring type suitable for flange mounting and be designed for bubble tight shut off and modulating service. Provide valves with Buna "IV" or Hycar replaceable liners for intended service and temperature to 93 degrees C (200 degrees F) and full lug type design, drilled and tapped iron body, aluminum bronze disk and steel shaft, non corrosive for service as shown on Drawings, and be rated for 1030 kPa (150 psi).

B. Pneumatic Valve Operators

1. Provide pneumatic valve operators that are rolling, neoprene or silicone diaphragm operated valve actuators. Incorporate positive positioning relays for sequencing. Size operators to operate smoothly through the control pressure range and to move the respective valve without hunting or sticking. Flat diaphragm operators may be used in lieu of rolling type if they are provided with positive positioning devices.

C. Electric Valve Operators

1. Provide electric valve operators with an oil immersed gear train. Provide an integral spring so that the operator will return to a positive position on power failure. Provide an integral 120V to 24V transformer. Design the control circuit to function on 240-volt 60 hertz electrical power and have a 60-second stroke. Include a linkage for operating the valve with the operator and valve body.

2.11 PRESSURE GAGES

A. Mount pressure gages on duct or immersion thermostats, damper motors and other temperature control equipment. Provide gages that are 50-mm (2-inch) diameter, stem mounted, 0-207 kPa (0-30 psi) range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Air Piping

1. General

a. Install the system free of pockets and pitch to drain at the air tank.
b. Conceal all control piping except in mechanical rooms, storage rooms and other areas which will only be accessible to maintenance personnel where piping may

be exposed if run in a neat manner, parallel to building structure and supported so as to prevent sagging.

c. Mechanically attach piping to supporting surfaces. Sleeve through concrete surfaces in minimum 25-mm (one-inch) sleeves, extended 150 mm (6 inches) above floors and 25 mm (one inch) below surface of slabs.

d. Adequately strap and support piping every 0.9 meter (3 feet) except for hard temper copper mains which maybe supported every 1.5 meters (5 feet).

e. Do not run piping along surfaces which may reach a surface temperature below 13 degrees C (55 degrees F).

f. Test piping during and after installation as specified. Purge piping with dry, oil free compressed air before connection to control instruments.

2. Copper Piping

a. Use copper piping in areas where piping is subject to physical damage (e.g. from moving machinery, sharp edges, maintenance traffic, etc.), is subjected to temperatures in excess of 82 degrees C (180 degrees F) or where control piping is run adjacent to hot (i.e. above 32 degrees C (90 degrees F)) pipes passing through a common sleeve or raceway.

b. Where low points in the copper piping system occur, install drip legs with drain cocks.

c. Copper piping may be run exposed in equipment areas but shall be concealed in all other areas.

3. Plastic Tubing

a. Where control piping is not readily accessible for service and/or replacement - polyethylene tubing may be used providing it is enclosed in a raceway between accessible points.

b. In mechanical rooms, above accessible ceilings, in store rooms or other accessible areas where piping is not subject to damage or heat as indicated above - bundled polyethylene tubing with flame retardant jacket and suitable junction boxes may be used or single polyethylene tubing in trays or raceways may be used.

c. Use single unsheathed polyethylene tubing only within control panels, raceways, trays or other enclosures.

B. Electrical Components

1. For installation standards and procedures for electrical components, refer to Division 26 Specifications.

C. Automatic Valves

1. The installation of automatic valves is specified in Section 230523.

3.2 FIELD QUALITY CONTROL

A. Air Pressure Test

1. After completion and before acceptance of the work, test the entire control piping system at 207 kPa (30 psi). Maximum pressure drop: 34 kPa (5 psi) in twenty-four hours.

A. Function Test

1. Test, calibrate and adjust control equipment in terms of design, function and performance, ready for the required acceptance tests. Control devices and operators shall operate smoothly and freely without cycling or hunting.
2. Two weeks after acceptance and after the systems have operated in normal service, return to the site and check the adjustments on instruments and devices and correct items malfunctioning, at no expense to the Owner.

B. Acceptance Tests

1. Upon completion of the installation test, adjust the various control systems to function satisfactorily in compliance with the requirements of the Specifications and as shown.
2. Supply instruments required to conduct the control air testing and balancing operations.
3. Remedy any defects or malfunctions that are determined by these tests and repeat tests until defects have been corrected to the complete satisfaction of the Architect.

3.3 DEMONSTRATION

A. Operating and Service Instructions

1. Furnish the Owner with two copies of complete operating and service instructions, covering control equipment and its relationship to, and interlock with, the chilled water system.
2. Furnish the service of a fully competent operational instructor for three eight-hour days training sessions on systems operation, maintenance, repair and adjustment and two eight-hour days training sessions on system software and user changeable software. In addition, the Owner shall schedule during the first year of operation, two additional eight-hour days training sessions which shall consist of a user-defined combination of the above listed topics. An eight-hour day shall consist of eight hours of instruction, exclusive of travel time.
3. Install under as described in Section 230000, a complete control diagram of all systems. Locate diagram as shown or as directed.
4. Furnish the Owner with a recommended list of required spare parts to be stocked on site.
5. Minimize requirements for special tools. When special tools are required for the operating and adjustment of controllers, instruments and dampers, furnish them, including necessary duplicates required for normal use.

END OF SECTION 230905

SECTION 232113 - HYDRONIC 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. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Chilled-water piping.
2. Condenser-water piping.
3. Makeup-water piping.
4. Air-vent piping.
5. Safety-valve-inlet and -outlet piping.
6. Strainers.
7. Pipe sleeves above grade.
8. Vacuum relief valve.
9. Condenser water centrifugal separator.
10. Centrifugal separator purged liquid recovery unit.
11. Air vents.
12. Test ports.
13. Suction diffusers.
14. Multi-purpose valves.
15. Air separation apparatus.
16. Automatic flow control valves

B. Related Sections include the following:

1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Chilled-Water Piping: 125 psig at 100 deg F.
2. Condenser-Water Piping: 100 psig at 150 deg F.
3. Makeup-Water Piping: 80 psig at 150 deg F.
4. Air-Vent Piping (cooled / ambient piping): 150 deg F.

5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
2. Pressure-seal fittings.
3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
4. Air control devices.
5. Chemical treatment.
6. Hydronic specialties.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

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.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.7 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 GENERAL

A. Field-applied adhesives and sealants within the building waterproofing envelope shall have no more than the following VOCs:

1. PVC Welding: 510 g/l
2. CPVC Welding: 490 g/l
3. ABS Welding: 325 g/l
4. Plastic Cement Welding: 250 g/l
5. Adhesive Primer for Plastic: 550 g/l
6. All Other Welding & Installation Adhesives & Sealants: 250 g/l

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Unions: ASME B16.22.

E. Wrought-Copper Fittings: ASME B16.22.

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

a. Victaulic Company.

2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 250 deg F for use with housing, and steel bolts and nuts. Victaulic Style 607 “QuickVic”.

F. Copper or Bronze Pressure-Seal Fittings:

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

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide Stadler - Viega “ProPress” or Vivtaulic “PressFit”
4. Housing: Copper.
5. O-Rings and Pipe Stops: EPDM.
6. Tools: Manufacturer's special tools.
7. Minimum 200-psig working-pressure rating at 250 deg F.

G. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.

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

a. T-DRILL Industries Inc.

H. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 125; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:

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

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to

accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

   a. 2-1/2” through 12”:

      1) Rigid Type: Housings cast with offsetting, angle-pattern bolts pads to provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style 07 or 107 (QuickVic)
      2) Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 77 or 177 (QuickVic)

I. Steel Pressure-Seal Fittings:

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

   a. Victaulic Company.

2. Housing: Steel.
3. O-Rings and Pipe Stop: EPDM.
4. Tools: Manufacturer's special tool.
5. Minimum 300-psig working-pressure rating at 230 deg F.

J. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic:

1. Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in "Piping Application" Article.

2. Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

3. Solvent Cements: ASTM F 493.
   a. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. PVC Plastic:

1. Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in "Piping Application" Article.

2. Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

3. Solvent Cements: ASTM D 2564. Include primer according to ASTM F 656.
   a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cemented-joint end.

2.6 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Fiberglass, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BCuP-5, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.7 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

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

   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.

2. CPVC and PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

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

   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.
   d. NIBCO INC.

2. MSS SP-107, CPVC and PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.8 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, provide products by one of the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Wilkins; a Zurn company.

2. Description:

   a. Standard: ASSE 1079.
   b. Pressure Rating: 225 psig minimum at 180 deg F.
   c. 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. Capitol Manufacturing Company.
   b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   c. Wilkins; a Zurn company.

2. Description:

   a. Standard: ASSE 1079.
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Factory-fabricated companion-flange assembly, for 225-psig minimum working pressure as required to suit system pressures.
   d. 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. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

3. Separate companion flanges and steel bolts and nuts shall have 225-psigminimum working pressure where required to suit system pressures.

E. Dielectric Couplings:

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

   a. Calpico, Inc.
   b. Lochinvar Corporation.

2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 225-psig minimum working pressure at 225 deg F.

F. 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.
   b. Grinnell Mechanical Products.
   c. Matco-Norca, Inc.
   d. Precision Plumbing Products, Inc.
   e. Victaulic Company.

2. Description:

   a. Standard: IAPMO PS 66
   b. Electroplated steel nipple. complying with ASTM F 1545.
   c. Pressure Rating: 225 psig**at** 190 deg F.
   d. End Connections: Male threaded or grooved.
   e. Lining: Inert and noncorrosive, propylene.

2.9 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for Chiller Plant."

C. Bronze, Combination Balancing//Shutoff Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Griswold
   e. Taco.
   f. Tour & Anderson; available through Victaulic Company of America
2. Body: Bronze, ball, plug, or Y-pattern globe type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position or 4-turn digital readout handwheel with memory stop to retain set position.
9. Readout Meter Kit:
   a. Portable readout meter kit by the manufacturer of the balancing devices, housed in a durable case complete with two 10' color coded hoses with shut-off valves at the end that connects to the balance valve so that water does not drain out between readings.
   b. Meter: 6" diameter face and ±1.75% full-scale accuracy, forged brass body and a three-valve manifold for over-range protection. Dual scale reading inches and feet W.C.
10. CWP Rating: Minimum 300 psig.
11. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Combination Balancing/Shutoff Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Griswold Controls.
   e. Taco.
   f. Tour & Andersson; available through Victaulic Company of America.
2. Body: Cast-iron or steel body, ball, plug, or globe Y-pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position or 8-turn digital readout handwheel with memory stop to retain set position

10. CWP Rating: Minimum 300 psig.
11. Maximum Operating Temperature: 250 deg F.

E. Combination Shutoff Valves/Y-Strainer and P/T Ports

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flow Design Inc.
   b. Tour & Andersson; available through Victaulic Company of America.
   c. Approved equal
2. Body: brass ball valve or ductile iron lug type butterfly valve
3. Ball: brass body with seven accessory port locations;
   a. Ball valve with Teflon packing, blowout proof stem, handle with vinyl grip. Strainer easily removable for maintenance without breaking piping. Dual P/T ports.
   b. Sizes: ½”- 2” PSI ranges: 2-32, 5-60
   c. Flow ranges: 0.33-70 gpm Rating: 400 psig @ 250° F
4. Butterfly:
   a. Ductile iron lug type resilient seated butterfly valve, bi-directionally designed for dead-end service.
   b. Rounded and polished disc for minimum flow restriction and lower torque. Handle with memory stop.
   c. Sizes: 2” – 8”
   d. Rating: 240 psi @ 250 °F
5. Strainer:
   a. Cast iron Y-body flanged strainer, machine tapered seat, removable stainless steel screen, flanged blow-off cover, gasket and plug. Male ended ball valves used for blow-off valves.
   b. Sizes: 2 ½” – 8”
   c. Rating: 125 psi @ 350 °F

F. Bronze Combination Series Shut-off Valve with Memory Stop / Dual P/T Ports

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flow Design Inc. UA/UB Series Shut-off Valves
   b. Tour & Andersson; available through Victaulic Company of America.
   c. Approved equal
2. Body: brass body with three accessory port locations; ball valve with Teflon packing, blowout proof stem, standard adjustable memory stop and dual P/T ports
3. Sizes: ½” – 2” CV : 0.28-68.0
4. Flow ranges: 0.2-103.3 gpm Rating: 600 psig @ 250° F

G. Series Adjustable Pressure Controllers:

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

a. Flow Design Inc. DA series
b. Tour & Andersson; available through Victaulic Company of America.
c. Approved equal

2. Inline differential pressure controller to stabilize differential pressure across multiple circuits within a branch. Differential pressure adjustable between 1 to 15 psi.
3. Sizes: ½” – 5” Max Differential Pressure: 230 psi
4. Rating: 360 psig@ 284°F

H. Diaphragm-Operated Safety Valves:

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

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump; a division of ITT Industries.
d. Conbraco Industries, Inc.
e. Spence Engineering Company, Inc.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: Stainless Steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

I. Automatic Flow-Control Valves:

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

a. Flow Design Inc.
b. Griswold Controls.
c. Approved equal

2. Body: 2" and smaller threaded bronze valves 2½" and larger flanged iron or steel body.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 225 psig.
9. Maximum Operating Temperature: 200 deg F.

10. Factory set and automatically limit the rate of flow to required engineered capacity within +5% accuracy over an operating pressure differential of at least 14 times the minimum required for control.
11. The control mechanism of the valve consists of self contained, open chamber cartridge assembly with unobstructed flow passages that eliminate accumulation of particles and debris. Provide stainless steel or nickel plated brass internal working parts. Body material: ductile iron, cast iron or bronze.
12. The cartridge assembly shall consist of a spring loaded cup. The cup shall utilize the full available differential pressure across the valve to actuate the cup and, thereby, reduce friction and hysterisis and eliminate binding.
13. Valves shall be available in minimum of three pressure differential ranges, with the minimum range requiring less than 2 psig to control flow. Valve bodies shall be provided with extended (for pipe insulation) inlet and outlet tappings suitable for connection of instruments for verification of flow rates and temperature and shall be marked to show direction of flow.
14. Certified performance data for the flow control valve, based on independent laboratory tests, supervised and witnessed by a registered professional engineer, shall be available.
15. All flow control valves shall be supplied by a single source responsibility.
16. Furnish each automatic flow control valve with a valve kit consisting of ¼" x 2" minimum size nipples, quick disconnect valves (to be located outside of insulation), and fittings suitable for use with the measuring instruments specified, as well as temperature.
17. Provide a metal identification tag, with chain, for each installed valve. The tag to be marked with zone identification, valve model number and rated flow in GPM.
18. Provide warranty for a period of five years from date of start up.
19. Provide dual hose meter kit including pressure gauge with 4 ½" dial, 3 way push button operated valve, 5' long dual connection hoses, dual shutoff and vent valves, dual special valves for connection to standard valve kit, flow conversion chart and carrying case.

2.10 AIR CONTROL DEVICES

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

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.

3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 3000 psig
7. Maximum Operating Temperature: 240 deg F.

D. Bladder-Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

4. Select the unit for less than 3 kPa (1 foot of water) pressure drop and a velocity not to exceed 1.2 meters (4 feet) per second entering and leaving unit at the specified flow.

5. Include manufacturer's performance curves with the equipment submittal.

6. Provide units with a copper coalescing medium or a galvanized steel strainer and stainless steel collector tube. Provide the unit with a high capacity vent mounted on the top of the unit and a bottom blow-down connection. Spirotherm Model "Spirovent Senior", Thrush "Aar-O-Vent", Bell & Gossett "Rolairtrol R" or Armstrong Model "VAS".

7. Provide in the vent connection from each air separator a combination pressure reducing fill valve and non-code relief valve both equipped with an EPDM diaphragm. Provide the pressure reducing valve with a brass inlet strainer and integral low pressure check valve. Provide unit with a fast fill feature and with the required pressure settings. Bell & Gossett "Model F-8TU" or as approved.

8. Furnish and install as shown for the air purger a float type air vent suitable for a maximum working pressure of 860 kPa (125 psi), with float of solid material suitable for an operating temperature of 116 degrees C (240 degrees F).

E. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.

2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.

3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.

4. Blowdown Connection: Threaded.

5. Size: Match system flow capacity.

F. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.

2. Maximum Working Pressure: Up to 175 psig.

3. Maximum Operating Temperature: Up to 300 deg F.

G. Air Purgers:

1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.

2. Maximum Working Pressure: 150 psig.

3. Maximum Operating Temperature: 250 deg F.

2.11 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Refer to section 232500 HVAC Water Treatment.

2.12 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

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

a. Armstrong
b. Cobranco
c. Keckly
d. Muller
e. Spence
f. SSI.
g. Watts.
h. Victaulic

2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

3. End Connections: Threaded ends for NPS 2 and smaller; flanged or grooved ends for NPS 2-1/2 and larger.

4. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

5. CWP Rating: 300 psig.

B. Basket Strainers:

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

a. Hayward Model 750
b. Kraissl.
c. Plenty
d. SSI.
e. Muller.

2. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.

3. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.

4. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

5. CWP Rating: 300 psig.

6. Provide the strainers with the following features.

   a. Right or Left hand drive.
   b. Mechanical cover lift.
   c. Chain drive between hand wheels.
   d. Back-flush arrangement.

C. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.

2. End Connections: Threaded or flanged to match equipment connected.

3. Performance: Capable of 3/4-inch misalignment.

4. CWP Rating: 300 psig.

5. Maximum Operating Temperature: 250 deg F.

D. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.

2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.

3. Performance: Capable of misalignment.

4. CWP Rating: 300 psig.

5. Maximum Operating Temperature: 250 deg F.

E. Fire Stopping of Penetrations to Fire Rated Floors and Walls

1. Provide UL classified firestopping systems at all mechanical penetrations of fire rated walls and floors.

2. These penetrations are to include all metallic and non-metallic, insulated and un-insulated piping systems specified in Divisions 23.

3. Refer to Section 07840 for approved manufacturers and materials.

F. Pipe Sleeves Above Grade

1. Sleeves in Non-Rated Walls

   a. Provide pipe sleeves of steel pipe in masonry or concrete walls and of 24 gage galvanized steel in non-masonry walls or partitions.

2. Sleeves in Exterior Walls and Floors

   a. For piping penetrating exterior walls or exterior floors above grade, provide sleeves as specified for pipe sleeves on or below grade.

G. Vacuum Relief Valve

1. Brass body, high heat-resisting disc, quick and tight closing under pressure, opening on vacuum of not over 1/2-in. hg. Watts "No. N36", Conbraco "No. 37" or as approved.

H. Condenser Water Centrifugal Separator

1. Provide a centrifugal vortex separator for installation in the condenser water pump discharge line to remove separable solids from the system. Design separator to have 98 percent efficiency down to 40-micron particles.

2. Design the separator with a tangential inlet connection and a pressure relief line from the collection chamber to a venturi located in the tangential inlet connection.

3. Fabricate the separator from carbon steel with 150 lb. raised face flanged piping connections and hand-hole clean-out at collection chamber.

4. Lakos “Model LAX” or approved product of The Metraflex Co., Griswold Controls, or Superior Enterprises.

I. Centrifugal Separator Purged Liquid Recovery Unit

1. Provide the separator with a purged liquid recovery unit consisting of a carbon steel retention vessel, carbon steel dome with T-bolt closures, stainless steel internal baskets with stainless steel screens, 50 micron polyester-felt purge collector bags and a right-angle, push-button air relief valve.

2. Furnish the recovery unit with an indicator package for field installation, consisting of 2 ball valves, nipples, 2 in-line sight glasses, annunciator, flow control orifice, clamp and tubing.

3. Unit solids selection capacity: 75 lbs. Unit liquid retention capacity: 30 gallons.

4. Lakos “Model CRS- 836-B” or approved product of The Metraflex Co., Griswold Controls, or Superior Enterprises.

J. Test Ports (P/T)

1. Where indicated on the Drawings; provide a NPS 1/4 (DN8) NPT fitting to receive a 3-mm (1/8-inch) temperature or pressure probe. Construct fitting of solid brass with two nordel valve cores and fit with a color coded cap strap with gasket and extra long neck to accommodate the pipe insulation.

2. Furnish 4 125-mm-long (five-inch-long) stem, 10-260 degrees C (50-500 degrees F), pocket testing thermometers and 4 pressure gage adapters with 3-mm (1/8-inch) od probe.

3. Test ports manufacturers: Peterson Equipment Co. Inc., "XL Petes Plug II", Watts "TP" detectors, MG Piping Products Co. "PT Plugs," or Flow Design Inc. "Superseal".

K. Suction Diffusers

1. Provide angle pattern flow straightened fittings, equipped with a combination diffuser-strainer-orifice cylinder, flow straightening vanes, start-up strainer, and adjustable support foot.

2. Design the combination diffuser-strainer-orifice cylinder to withstand a pressure differential equal to the system pump shut-off head (maximum 1200 kPa (175 psi), have

a free area equal to 5 times the area of the pump suction and straightening vanes with a minimum length of 2-1/2 times the diameter of the pump suction connection.

3. Provide the straightening fittings of cast iron construction with NPS system and pump end connections on sizes up to NPS 2 (DN50) and flanged on sizes NPS 2 1/2 (DN65) and larger (ductile iron construction with grooved system end connection may be supplied on pumps handling cool liquids).

4. Provide the fitting with a stainless steel combination diffuser-strainer-orifice cylinder with 4.7-mm (3/16-inch) -diameter perforations and full length stainless steel flow straightening vanes.

5. Position the permanent magnet in the flow stream so as to protect the pump seals from metallic particles and provide with a valved blow-down connection.

6. Provide the fitting with a removable end cap with reusable “O”-ring, pressure gauge tappings and a mesh bronze start-up strainer.

7. Provide the unit with an adjustable support foot designed to insert into a length of unthreaded pipe cut to the appropriate length.

8. Manufacturers: ITT Bell & Gossett, Taco, Armstrong, Victaulic, or Wheatley.

L. Multipurpose Valves

1. Provide pattern valves designed to perform the functions of a non-slam check valve, throttling valve, shutoff valve and calibrated balancing valve.

2. Provide the valves of cast iron construction with NPS and pump end connections on sizes up to NPS 2 (DN50) and flanged on sizes NPS 2 1/2 (DN65) and larger (ductile iron construction with grooved system end connection may be supplied on pumps handling cool liquids).

3. NPS connections: per ASME B1.20.1, suitable for 175 psi working pressure. 125 psi ANSI flanged connections: suitable for 175 psi working pressure: Grooved connections: suitable for 300 psi working pressure (straight pattern models only).

4. Fit valves with a bronze seat, renewable bronze disc with EPDM seat insert, stainless steel stem on flanged and grooved models, brass stem on NPT models and chatter-preventing stainless steel spring.

5. Design valves to be capable of being repacked under full system pressure and equip with brass read-out valves for taking differential pressure readings across the orifice.

6. Size valves so as to have a minimum pressure drop of 9.0 kPa (1.3 psi).

7. Provide valve with a minimum Cv rating at full open position as follows:

Valve Size (inch)	Min. Cv	Min. GPM	Max. GPM
2	77	100	150
2-1/2	117	152	240

3	191	248	430
4	336	437	640
5	497	646	900
6	701	910	1100

8. Manufacturers: ITT Bell & Gossett, Taco Armstrong, or Wheatley.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Chilled Water, Condenser Water- Above Ground

ITEM	JOINT TYPE	SIZE	CLASS OR PRESSURE RATING	MATERIAL AND/OR SPECIFICATION	REMARKS
Tubing		up through NPS 2 (DN 50)	Type L	Type L Copper ASTM B88M (B88)	Hard drawn*
Pipe		NPS 2-1/2 (DN 65) through NPS 10(DN 250)	Sch. 40	ASTM A53 ASME B36.10M	ERW Blk.Stl. Grade B
Pipe		NPS 12 (DN 300) & up	9.5 mm(.375 in.) wall thick	ASTM A53 ASME B36.10M	ERW Blk.Stl. Grade B
Fittings	Solder	up through NPS 2 (DN 50)	Type L	ASME B16.22	Wrought Cop-per
Fittings	Weld.	NPS 2-1/2 (DN 65) & up	Std. Wt.	ASTM A234	Forged Steel
Flanges		NPS 2-1/2 (DN 65) & up	150 lb	ASTM A105 ASTM A181 ASME B16.5	Forged Steel Welding Neck
Unions	Solder	up through NPS 2 (DN 50)	150 lb	ASTM B62	Brass
Gaskets		NPS 2-1/2 (DN 65) & up	1/8-in.	Garlock Style 3000	Compressed Non-asbestos w/Nitrile binder
Thread Sealant		13 mm (1/2 inch) wide x 0.1 mm (4 mils) thick		Teflon	Ribbon

ITEM	JOINT TYPE	SIZE	CLASS OR PRESSURE RATING	MATERIAL AND/OR SPECIFICATION	REMARKS
Bolts				ASTM A307 Grade B Thread ASME- B1.1 ASME B18.2.1 Class 2B Fit	Carbon Steel Machine Bolts

As an alternate to the above specification provide Type L copper tubing up thru NPS 4 (DN 100) pipe size and provide “Mechanical Joint” copper press fittings as manufactured by Viega “ProPress”, Tubeline or Victaulic “Pressfit” conforming to the material and sizing requirements of ASME B16.18 or ASME B16.22. Provide copper press fittings with EPDM O-rings.

As an alternate to the above specification on water systems; for piping up through NPS 2 (DN 50) pipe size, provide the following: Schedule 10 ERW, stainless steel pipe, ASTM A312 with Victaulic "Vic-Press 304" fittings with EPDM O-ring.

Bolts and nuts cadmium plated for outdoor installation.

B. Makeup-water piping installed aboveground shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

C. Makeup-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

D. Condensate-Drain Piping: Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Copper DWV pipe ASTM B306 with cast bronze drainage pattern fittings with soldered joints, ASTM B32.

E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

F. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

G. Refrigerant Vent Piping

1. Refrigerant Vent Piping: Schedule 40 black steel, ASTM A53.

H. Mechanical Grooved Pipe and Couplings

1. As a Contractor's option, mechanical grooved steel pipe or type L ASTM B88 copper tube with couplings, fittings and valves, as manufactured by Victaulic may be used for piping systems listed below in lieu of welded, flanged and threaded connections as specified in exposed (non concealed) locations within mechanical equipment rooms and outdoors.

a. Chilled water
b. Condenser water

2. Provide mechanical grooved pipe couplings, fittings and valves which are suitable for the temperature range and operating pressures specified for each system and have the approval of state and local codes having jurisdiction. Other applications or uses of mechanical grooved pipe couplings, fittings, valves or other types of coupling accessories not herein specified are not permitted without prior approval.
3. Provide all mechanical grooved pipe, fittings and couplings of the same manufacture to avoid non-compatible intermingling. Grooving tools are to be of the same manufacture as the grooved components.
4. Provide piping for systems as specified, and grooved in compliance with the coupling manufacturers specifications.
5. Couplings

    a. General runs of pipe: Rigid Couplings: Victaulic “Style 07, 107 or W07”
    b. At connections to chillers, cooling towers, coils, pumps, etc.: Flexible Couplings: Victaulic “Style 77, 177 or W77”.
    c. Fabricate coupling housings in two or more parts of ductile iron castings, in accordance with ASTM A395 and A536. Coupling gasket: EPDM Grade "E", green color code, molded synthetic rubber, complying with ASTM D2000, designation CA615 A25B4F17Z, or Nitrile Grade “T”, orange color code, complying with ASTM 2000 designation 5BG615A14B24. Coupling bolts: square or oval neck track head type with hexagonal heavy nuts, per ASTM A183.

6. Grooved Joints for Copper Tubing:

    a. Mechanical Couplings: Fabricate coupling housings in two parts of ductile iron castings, in accordance with ASTM A395 and A536, cast with offsetting, angle-pattern, bolt pads. Housing coated with copper colored alkyd enamel. Coupling gasket: FlushSeal® type, EPDM Grade “E”, green color code, molded synthetic rubber, complying with ASTM D2000, designation CA615A25B4F17Z, or Nitrile Grade “T”, orange color, code complying with ASTM D2000, designation 5BG615A14B24. Coupling bolts: track head type with hexagonal heavy nuts, per ASTM A183. Coupling shall be manufactured to connect copper tubing and sized tube and fittings. (Flaring of tube and fitting ends to IPS dimensions is not allowed.)
    b. Manufacture grooved fittings used with copper tubing sized mechanical pipe couplings of wrought copper, conforming to ASTM B75 or B152 or bronze sand castings per ASTM B584. Fittings shall be manufactured with copper tubing sized grooved ends. (Flaring of tube and fitting ends to IPS dimensions is not allowed.)

7. Butterfly Valves

    a. Steel Pipe – NPS 2-1/2 (DN 65) thru NPS 12 (DN 300)

        1) 300 cwp, suitable for dead-end or bi-directional service; black alkyd enamel coated ductile iron body conforming to ASTM A536; electroless nickel coated ductile iron disc; stainless steel stem; disc and stem offset to provide full 360-degree seating; pressure responsive elastomer seat; grooved ends. (EPDM for oil or hydrocarbon service). Victaulic “Vic-300 MasterSeal” or Victaulic AGS Butterfly valve or as approved.

8. Fabricate grooved pipe fittings used with mechanical pipe couplings of ductile iron castings in accordance with ASTM A395 and A536 fabricated from carbon steel pipe conforming to ASTM A53 or forged steel conforming to ASTM A234. Fittings: Victaulic ductile fitting pattern fittings with grooved ends.
9. Provide pipe and fitting surfaces at gasket contact areas which are clean and free from oil, grease, paint, etc.
10. Provide slip-type expansion joints at all building expansion joints: Victaulic style 150 or Anvil Style 150 or as approved.
11. Provide flange washers where flange adapters do not have a smooth hard surface at a mating flange.
12. Provide pipe ends for grooved pipe and fittings which are smooth and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing, dimensions according to the standard roll groove specifications as recommended by the manufacturer.
13. Provide groove width, depth and outside diameter which conforms to the standard groove specifications of the manufacturer.
14. Pipe: roll-grooved on all pipe up through standard wall; cut-grooved on heavy wall and ductile iron piping.

Use standard and long radius ells whenever possible, in changing pipe directions on grooved pipe lines.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each supply and return main riser serving two or more terminal units.

B. Install shutoff-duty valves at each branch connection to supply and return connection to each piece of equipment.

C. Provide all reducers/increasers required to install flow control valves in larger piping than the flow control valve. Reducers and increasers shall be located immediately prior to and after the flow control valve.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping 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.

C. Install pipe and pipe fittings in accordance with recognized industry practices to achieve permanently leak proof systems, capable of performing the indicated service without failure.

D. Install each piping run with a minimum number of joints and couplings but with adequate and accessible unions/flanges for disassembly and maintenance/replacement of valves and equipment.

E. Provide pipe size as indicated on the drawings making equipment/fixture connection adjustments at point of connection.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping to permit valve servicing.

H. Install piping at indicated slopes.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install piping with sufficient clearance from other piping, building structure and other systems to allow for the piping insulation to be properly applied.

L. Keep horizontal runs of piping as high as possible to provide maximum head room.

M. Install piping in equipment rooms so as not to interfere with aisleways and to allow unhindered egress from any point in the space.

N. Run pipe to avoid interference with ducts, wires or apparatus and with approved offsets around columns, beams and other obstructions.

O. Install piping that penetrates a vapor retarder to respect the vapor retarder integrity by sealing the opening around the pipe with vapor retardant tape.

P. Install piping with sufficient clearance from building structural members so as not to interfere with the application of steel fireproofing.

Q. Establish piping elevations prior to installation to avoid interferences with other piping and materials and equipment of other trades.

R. Keep vertical lines straight in the partitions or furring or as close to the columns as possible.

S. Select system components with pressure rating equal to or greater than system operating pressure.

T. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

U. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

V. Pitching of Piping

1. Pitch horizontal water and air lines to low points to provide for complete drainage of the system. Minimum pitch, unless otherwise shown: 0.2 percent upward in direction of flow. Install drain valves at low points and air vents at high points and at locations where air may pocket on water lines.

2. Pitch gravity condensate return piping at a uniform grade of 0.4 percent in the direction of condensate flow.

W. Pipe drains from items such as water relief valves, tanks, cooling coil drain pans, air vents, evaporator condensate drain pans, and drip-pan elbows, to the nearest floor drain.

X. Reducing Fittings

1. For proper drainage and air elimination, provide eccentric type fittings when decrease in pipe size is necessary. Bushings will not be permitted.

2. For water and other liquid lines, install the top of pipe on a continuous straight line.

3. For steam, gas, gravity condensate, and air lines, install the bottom of the pipe on a continuous straight line.

Y. Install branch connections to mains using tee fittings or branch outlets in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

Z. Separation of Piping: Separate cold piping from hot piping with a minimum of 150 mm (six inches) air gap between outside diameters of the piping.

AA. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

BB. Install unions in piping**,** NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

CC. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

DD. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

EE. Equipment condensate drains shall be trapped at equipment connection. Drain lines shall run full size of drain tapping to nearest floor drain or as shown on Drawings at the specified pitch.

FF. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

GG. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

HH. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

II. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.4 COPPER TUBING

A. Swaging copper tubing to couple two lengths together instead of using an approved solder type coupling will not be permitted. Incompletely filled solder joints are not acceptable.

B. Make up horizontal joints on piping NPS 2-1/2 (DN 65) and larger in the vertical position before assembly and erection.

C. Clean surfaces to be soldered both the inside of the fitting and the outside of the tubing, with steel wool or fine sandpaper until all discoloration is removed and metal is smooth and bright.

D. In assembling copper tube systems, take care to establish proper grade and alignment in the system before soldering. Installations will not be approved where tube and fittings are subjected to strain in order to obtain grade or alignment.

E. Do not bend copper drainage or vent tubes.

F. File or ream cut tube ends to the full original bore.

G. The inter-membering of copper and brass with ferrous metal is not permitted.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 100 feet long or for chilled water systems.

2. Adjustable roller hangers and spring hangers for individual horizontal piping 100 feet or longer with the exception of chilled water systems.

3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 100 feet or longer, supported on a trapeze.

4. Spring hangers to support vertical runs where indicated and at base of risers.

5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at roof, and at each floor.

3.6 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Steel Pipe:

1. Provide steel pipe NPS 2 (DN 50) and smaller with Victaulic Vic-Press 304 ends or threaded ends and screwed joints. Provide sizes NPS 2-1/2 (DN 65) and over flanged or grooved with gaskets or welded. Welding of galvanized pipe is not permitted. Connect galvanized pipe with screwed fittings, companion flanges or approved mechanical couplings.
2. Make screwed joints with oil and graphite or other approved compound. Apply joint compound to male thread only and take care to prevent compound from reaching interior of pipe.
3. Install unions and companion flanges in the pipe lines at locations as required to permit the removal of fixtures, apparatus and equipment without dismantling. Do not install unions and companion flanges in walls, partitions or other inaccessible locations.
4. “Victaulic “Vic-Press 304” joint connections

   a. Square cut plus or minus 7.62 mm (0.030 in.) and properly de-burr pipe ends. Mark pipe ends to indicate proper insertion length and insert into the coupling/fitting to the internal pipe stop so that pipe is fully engaged.
   b. Employ an electro-hydraulic crimping tool, provided by Victaulic “PFT” series, fitted with interchangeable jaws designed to provide consistent, reliable crimps.

E. Copper Pipe

1. Solder joint connections

   a. Use ASTM B813, water flushable, lead-free flux; ASTM B32, lead-free solder; and ASTM B828 procedure, unless otherwise indicated.

   b. Use a multiple-flame circular torch for soldering tubing NPS 2-1/2 (DN 65) and larger.

   c. For joints in potable water systems, use flux and solder which complies with NSF 61.

2. Make copper press fittings in accordance with the manufacturer's installation instructions. Fully insert the tubing into the fitting and mark the tubing at the shoulder of the fitting. Before pressing the fitting, check the fitting alignment against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. Press the joints on the tubing using the tool approved by the manufacturer.

3. T-Drill" Tube Branching System

   a. Copper tee fittings may be made by means of the "T-Drill" tube branching system, providing:

      1) The size and wall thickness of both the run tube and the branch tube are listed by the manufacturer of forming equipment as "Acceptable Application".
      2) The mechanically extracted collars are formed by means of a continuous operation consisting of drilling a hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the branch tube wall so as to comply with the American Welding Society lap joint weld. Employ a collaring device that is completely adjustable to ensure proper tolerance and complete uniformity of the joint.
      3) The end of branch tube is notched to conform to the inner curve of the run tube, and dimpled to set the exact penetration depth into the collar.

   b. Braze all joints in accordance with the CDA Copper Tube Handbook, using BcuP series filler metal. Soft soldered collar joints are not permitted.

4. "T-Drill" Tube Coupling System

   a. Copper couplings may be made by means of mechanically formed couplings, providing:

      1) The couplings are formed by first annealing the area at the end of the tube where the expansion is to occur, inserting the tube expander to the die size required and expanding the tube to accept tubing of the same size.

F. The resulting joint is a minimum of three times as long as the thickness of the tube and is brazed using B-CuP series filler metal.

G. 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.

H. 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.

I. 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.

J. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

L. Grooved Joints:

1. Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid or flexible, where required, grooved-end-pipe couplings.
2. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
3. A factory trained field representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.
4. AGS Installation: Install the Victaulic AGS piping system in accordance with the latest Victaulic installation instructions. Use Victaulic grooving tools with AGS roll sets to groove the pipe. Follow Victaulic guidelines for tool selection and operation. AGS products shall not be installed with standard grooved end pipe or components as this could result in joint separation and/or leakage.

M. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

N. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

O. Metallic Pipe Threads

1. Provide screwed pipe and fitting threads that comply with ASME B1.20.1. Discard pipe with threads that are stripped, chipped, corroded or otherwise damaged.
2. Do not use any pipe on which a weld has opened up during the operation of cutting or threading.
3. Field thread metallic pipe in accordance with the following table:

Iron Pipe Size NPS	(DN)	Approx. Length of Threaded Portion mm	(in.)	Approx. No. of Threads to be Cut
½	(15)	18.75	¾	10
¾	(20)	18.75	¾	10
1	(25)	21.88	7/8	10
1-1/4	(32)	25	1	11
1-1/2	(40)	25	1	11
2	(50)	25	1	11

Use only those thread compounds that are compatible with the liquid or gas being carried in the pipe and that are resistant to the action of the liquid or gas or to any other chemical constituents of the carried liquid or gas.

P. Pipe Welding

1. Perform steel pipe welding by either oxy-acetylene or electric arc method and perform by approved welders qualified in accordance with the "Welder Qualifications and Procedures" in Section 230000. Use welding procedures and provide joint quality which strictly conforms to above procedures.
2. Make tee connections in welded piping with a factory fabricated butt welding tee or with weld-o-let of butt, socket or threaded type. When weld-o-lets are used provide a branch connection which is 2 pipe sizes the diameter of the main or less. Scarf welding or direct butt welding of side connections will not be permitted. Tees fabricated from pipe will not be permitted.
3. Use long radius welding ells wherever possible, in changing pipe directions of welded pipe lines. Mitered joints are not acceptable.

Q. Grooved Pipe and Fittings

1. Tighten all nuts to assure firm metal contact of the coupling pads.
2. Before assembly of couplings, lightly coat pipe ends and outside of gasket with cup grease or graphite paste to facilitate installation.
3. Independently support branch piping to eliminate stress on coupled joint.
4. For spacing and location of the pipe hangers for the grooved piping, follow the requirements provided under Div 23 "Hangers and Supports".

R. Misalignment Couplings

1. Provide misalignment couplings in the suction and discharge piping of end and double suction pumps. Misalignment couplings shall be "dresser" couplings consisting of a four-diameter length of pipe between connections.

S. Flanges

1. Provide flanges with 1.6-mm (1/16-inch) raised and drilled face, of the weld-neck type. .
2. Where flanges with raised faces are joined to companion flanges with a flat face, machine the raised face down to a smooth matching surface and use full face gasket.

3. Provide gaskets suitable for the liquid or gas service intended. Gaskets containing asbestos material will not be permitted.

3.7 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Pipeline Strainers:

1. Install strainers before all traps and pressure reducing stations, temperature regulating valves, automatic control valves condensate return pumps, circulating pumps and other locations where indicated.

2. Install basket type strainers in a horizontal position only.

3. Provide a blow-off valve on all strainers NPS 2-1/2 (DN 65) and larger.

4. Before starting up systems employing strainers, provide temporary size 20 mesh woven metal wire mesh in the strainers and run the system with the strainer blow-down valves open, thoroughly flushing all slag and dirt from the system. Install drains at the system low points to facilitate this process. After systems have been thoroughly cleaned, remove and dispose of the temporary screens and install the permanent screens.

F. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

G. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

H. Install expansion tanks with air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.

2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

I. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

J. Flexible piping connectors

1. Provide flexible piping connectors at the following locations:

a. Suction and discharge of pumps
b. Inlet and outlet of refrigeration units.
c. Inlet and outlet of cooling towers.
d. Inlet and outlet of water coils.
e. Building expansion joints.

K. Piping Wells and Taps

1. Provide the appropriate type and size thermometer wells, automatic control systems sensing wells and pressure gage and flow sensing taps as required.

2. Refer to Division 23, INSTRUMENTATION AND CONTROL FOR HVAC for sensing wells and flow taps.

L. Air Vents

1. Provide vents where shown and at each high point in closed water systems, each coil, pump, heat exchanger, unit heater, piece of radiation and where otherwise required to properly expel air from systems.

2. Provide shut-off ball valves on inlet lines to all vents.

3. Pipe outlets of automatic vents to nearest floor drain, service sink or open site drain.

4. Provide temporary hoses when venting air through vent valves.

M. Suction Diffusers

1. Provide suction diffusers at the pump suction connection of all end-suction centrifugal pumps.

2. After systems in which suction diffusers are installed are flushed and cleaned, remove and dispose of the fine mesh start-up strainer provided with the suction diffuser.

3.8 PIPE SLEEVES AND COVER PLATES

A. Pipe Sleeves Above Grade

1. Install pipe sleeves for piping passing through all floors and walls.

2. Extend pipe sleeves through mechanical equipment room floors, kitchen floors and any other floors likely to have water present, 100 mm (four inches) above finished floor.

3. Where pipe sleeves extend through floors with a waterproof membrane, provide flashing that maintains the membrane integrity.

B. Cover Plates

1. Provide chromium-plated cover plates on piping extending into finished areas of the building, through ceilings, walls and floors. Provide cover plates of the proper size to afford complete coverage of the opening. Where pipe insulation is carried through a pipe sleeve, provide a cover plate of sufficient size to fit around the sleeve. Install cover plate to fit snugly against ceiling, wall or floor surface.

3.9 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.10 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test.
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232123 – HYDRONIC PUMPS

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. Horizontal centrifugal pumps.
   2. In-line centrifugal pumps.
   3. Vertical turbine pumps.
   4. Positive displacement pumps.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

A. Refer to Division 23 Section “Common Work Results For HVAC”.

B. Product Data:
   1. Include certified performance curves and rated capacities, shipping, installed, and operating weights, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
   2. Submit certified performance characteristic curves on each pump for approval, indicating the pump gpm, efficiency, head, watts (brake horsepower) and NPSHR curves throughout the entire range of the pump. No point on the head-capacity curve shall exceed the watts (motor horsepower) selected to drive the pump. Maximum watts (motor horsepower) at the selection point: 95 percent of the rated watts (motor horsepower). Since some pumps may be scheduled for future higher duty, select pumps that meet both the flow and pressure scheduled on the Drawings.
   3. Submit Product Data on the following:
      a. Horizontal centrifugal pumps.
      b. In-line centrifugal pumps.
      c. Vertical turbine pumps.
      d. Positive displacement pumps.
      e. Grout.
      f. Centrifugal pump test reports.

C. Shop Drawings:
   1. Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
   2. Wiring Diagrams: Power, signal, control systems and differentiate between manufacturer-installed and field-installed wiring.

D. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

B. Submit certified performance characteristic curves on each pump for approval, indicating the pump cu. m/s (gpm), efficiency, head, watts (brake horsepower) and NPSHR curves throughout the entire range of the pump. No point on the head-capacity curve shall exceed the watts (motor horsepower) selected to drive the pump. Maximum watts (motor horsepower) at the selection point: 95 percent of the rated watts (motor horsepower). Since some pumps may be scheduled for future higher duty, select pumps that meet both the flow and pressure scheduled on the Drawings.

1.8 WARRANTY

A. Refer to Division 23 Section "Common Work Results for HVAC".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS – TYPE IL

A. Manufacturers:
   1. American Marsh;
   2. Armstrong Model 4360
   3. Dean Pump;
   4. Deming;
   5. Grundfos;
   6. ITT Bell & Gossett Series 80
   7. Paco;
   8. Thrush;
   9. Approved equal

B. Provide in-line centrifugal pumps of the close-coupled, single stage, bronze-fitted design with internals capable of being serviced without disturbing piping connections, with the following provisions:

C. Class 30 cast iron casing, cast bronze, closed type, dynamically balanced impeller, keyed to the shaft and secured by a locking capscrew.

D. Designed with the liquid cavity sealed off at the motor shaft by means of an internally flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for operation at 107 degrees C (225 degrees F). A bronze shaft seal to completely cover the wetted area under the seal.

E. Rating of 175 psi working pressure and with gauge tappings at the suction and discharge nozzles complete with vent and drain ports.

F. Motors meeting NEMA specifications of the scheduled size and voltage and with heavy-duty, grease-lubricated ball bearings, adequate for the maximum motor load for which the pump is designed.

G. Factory test each pump in accordance with the Hydraulic Institute standards, clean and paint with one coat of machinery enamel prior to shipment, and furnish pumps with a set of installation instructions with shipment.

H. Factory test each pump in accordance with the Hydraulic Institute standards, clean and paint with one coat of machinery enamel prior to shipment, and furnish pumps with a set of installation instructions with shipment.

2.3 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS TYPE CCES

A. Manufacturers:
1. Armstrong 4280
2. ITT Bell & Gossett Series 1531
3. Thrush PCE300
4. Taco 1900
5. Ingersol-Dresser SMP
6. Approved Equal

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally. Rate pump for a minimum working pressure of175-psig continuous water temperature of 225 deg F.

C. Factory test each pump in accordance with the Hydraulic Institute “Centrifugal Pump Test” Standard. Include test reports with submittal data. Thoroughly clean, prime and finish paint pump, motor and base assembly with high-grade machinery enamel prior to shipment.

D. Pump Construction:
1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a Type 304 stainless steel key and secured with a Type 304 stainless steel locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
4. Mechanical Seal: Liquid cavity sealed off at the shaft by means of an internally-flushed mechanical seal with carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Ceramic seal seat of at least 98 percent alumina oxide content. Carbon seal ring, suitable for operation at 107 degrees C. Replaceable ASTM B111 aluminum bronze shaft sleeve completely covers the wetted area under the seal.

E. Motor: Meet NEMA specifications and non-overloading at any point on the pump curve for pumps designed to operate in parallel and non-overloading at 125 percent of design flow if designed for 100 percent of design flow. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment." for additional motor specifications

F. Bearings: Permanently lubricated bearings for motors up to 3.7kW and grease lubricated bearing for larger motor applications. Grease-lubricated double row, deep groove type, insulated, ball bearings, selected for a minimum of L-10 life 100,000 hours under continuous loading in accordance with ABMA 9; each bearing capable of carrying the line loads and the outboard bearing also capable of carrying thrust loads with the thrust bearing securely held to the shaft by means of a bearing locknut and washer or retaining rings with adjustable alignment.

G. Pump inlet and outlet sizes as shown on the Drawings with a maximum inlet velocity of 3 mps.

H. Properly align pump and motor at the factory prior to shipment and again after grouting at the job site. (Refer to Part 3 of this Section of the Specifications).

2.4 NOT USED

2.5 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS – TYPE SCES

A. Manufacturers:
1. Armstrong Series 4030
2. Aurora Pump, Division of Pentair Pump Group
3. Bell & Gossett Series 1510
4. Goulds Pump

B. Description: Factory-assembled and -tested,, centrifugal, single stage, bronze-fitted design with foot mounted volute, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for a minimum working pressure of 175-psig continuous water temperature of 225 deg F.

C. Factory test each pump in accordance with the Hydraulic Institute “Centrifugal Pump Test” Standard. Include test reports with submittal data. Thoroughly clean, prime and finish paint pump, motor and base assembly with high-grade machinery enamel prior to shipment.

D. Pump Construction:
1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
2. Impeller: ASTM B 584, cast bronze; enclosed type, statically and dynamically balanced, keyed to shaft, with a stainless steel key and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Steel, with copper-alloy shaft sleeve.

4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Liquid cavity sealed off at the shaft by means of an internally- flushed mechanical seal with ceramic seal seat of at least 98 percent alumina oxide content and with a carbon seal ring, suitable for operation at 107 degrees C. Provide a replaceable ASTM B111 aluminum bronze shaft sleeve to completely cover the wetted area under the seal.

E. Shaft Coupling: Flexible type coupling with an EPDM center-drop-out spacer-type, Manufacturer: Wood's type "J" or "S" sized for the power of the driving motor and capable of absorbing the developed torsion vibration..

F. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

G. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles Fabricate to mount pump casing, coupling guard, and motor with fully enclosed sides and ends and fully open grouting areas,.

H. Motor: Meet NEMA specifications and non-overloading at any point on the pump curve for pumps designed to operate in parallel and non-overloading at 125 percent of design flow if designed for 100 percent of design flow. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment." for additional motor specifications.

I. Bearings: Permanently lubricated bearings for motors up to 3.7kW and grease lubricated bearing for larger motor applications. Grease-lubricated bearings double row, deep groove type, insulated, ball bearings, selected for a minimum of L-10 life 100,000 hours under continuous loading in accordance with ABMA 9; each bearing capable of carrying the line loads and the outboard bearing also capable of carrying thrust loads with the thrust bearing securely held to the shaft by means of a bearing locknut and washer or retaining rings with adjustable alignment.

J. Pump inlet and outlet sizes as shown on the Drawings with a maximum inlet velocity of 10 fps.

K. Properly align pump and motor at the factory prior to shipment and again after grouting at the job site. (Refer to Part 3 of this Section of the Specifications).

2.6 SEPARATELY COUPLED, BASE-MOUNTED, DOUBLE-SUCTION CENTRIFUGAL PUMPS – TYPE HSC

A. Manufacturers:
1. Armstrong
2. Bell & Gossett Series VS
3. TACO
4. Approved equal

B. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts. Rate pump for a minimum working pressure of 175-psig continuous water temperature of 225 deg F.

C. Factory test each pump in accordance with the Hydraulic Institute "Centrifugal Pump Test" Standard. Furnish test reports with submittal data.

D. Pump Construction:
1. Casing:
   a. Radially or horizontally split, cast iron casing for system working pressures of up to 1200 kPa and ductile iron casing suitable for system working pressures up to 2760 kPa. Axially split design casing provided with suction and discharge flanges. Mounting feet cast integrally with the lower half casing. Suction and discharge connections provided on a common centerline in both the horizontal and vertical planes
   b. Replaceable bronze wear rings fabricated of ASTM B584 bronze, installed with an anti-rotation device and designed to prevent leakage across the ring fit by means of Buna-N rubber "O" rings.,
   c. Threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute,
   d. Upper casing and casing supports allow removal and replacement of impeller without disconnecting suction or discharge piping connections.
2. Impeller: One piece, ASTM B 584, cast bronze; enclosed, double suction type, non-overloading, statically and dynamically balanced, impeller keyed to shaft and fixed in an axial position. Hub provided with sufficient metal thickness to allow machining for the installation of impeller wear rings. Impeller maximum diameter of 90 percent of shaft to casing lip distance. Trim impeller to match specified performance.
3. Pump Shaft: 416 Stainless Steel sized for the transmitted loads with maximum deflection not exceeding 0.05 mm at the face of the seal flange at peak capacity.
4. Shaft Sleeves: ASTM B584 bronze shaft sleeves, threaded against rotation and extending beyond the mechanical seal flanges
5. Mechanical Seal:
   a. Pump cavity sealed by means of externally flushed, face type mechanical seals with Ni-resist ceramic stationary seat, carbon sealing washer, stainless steel metal parts and spring. Seals rated at 107 degrees C and 1034 kPa maximum; John Crane "type 21" or as approved. Pumps equipped with factory-mounted external flushing tubing and fittings.
   b. Pumps handling liquids in excess of 93 degrees C provided with a water-cooled heat exchanger in the flushing water loop, sized to maintain flushing water supply temperature at 82 degrees C .
   c. Pumps on condenser water service or other applications handling liquids with large concentrations of suspended solids, provided with a valved 5-micrometer filter or a centrifugal solids separator in the flushing water loop.

E. Bearings:

1. Grease-lubricated ball bearings contained in cast-iron housing with grease fittings
2. Bearing housings maintained in positive alignment by a 360-degree male-female fit. Housings to provide for a fit for the inboard bearing that allows freedom for thermal expansion and the outboard bearing clamped in place to take all thrust loads and keep the rotating element in its proper axial location. Housings provided with plugged openings for adding new grease and draining old grease.
3. Bearings of the heavy duty, self-aligning, insulated, deep groove, grease lubricated, ball type, single row inboard to carry radial thrust only and double row outboard, selected to carry radial and axial thrust loads. Bearings selected for a minimum L-10 life of 100,000 hours under continuous loading in accordance with ABMA 9.
4. Bearings protected from liquid entry by means of Buna-N rubber deflectors mounted on the shaft and Buna-N rubber lip seals in the bearing housings.
5. Outboard bearing cover provided with a plugged opening for a tachometer connection.

F. Shaft Coupling Pump and driver connected with a flexible type coupling with an EPDM center-drop-out spacer sized for the power of the driving motor and capable of absorbing the developed torsion vibration, with steel flanges connected by a rubber sleeve and fitted with an OSHA-approved coupling and shaft guard.

G. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

H. Mounting Frame: Welded-steel frame with drip rim and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor. Align pump, driver and bolt in place at the factory prior to shipment and realign after at the job site as specified.

I. Motor: Non-overloading performance characteristics, rated in keeping with the pump's possible peak horsepower requirements. Grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

J. Maximum suction connections velocity of 15 fps.

2.7 SEPARATELY COUPLED, VERTICAL-MOUNTED, DOUBLE-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers:
1. Armstrong Series 4300
2. Bell & Gossett Model 80SC
3. TACO Pumps
4. Approved equal

B. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for a minimum working pressure of 175-psig at a continuous water temperature of 225 deg F.

C. Pump Construction:
1. Casing: Radially split, cast iron, with replaceable bronze wear rings,]threaded gage tappings at inlet and outlet, drain plug at bottom of volute, mounting support, and ASME B16.1, Class 125 flanges.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket.
5. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

D. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration.

E. Motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to casing. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.8 AUTOMATIC CONDENSATE PUMP UNITS

A. Manufacturers:
1. Aurora Pump; Division of Pentair Pump Group.
2. Goulds Pumps.
3. Little Giant

B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory- or field-installed check valve and a 72-inch-minimum, electrical power cord with plug.

2.9 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175 psi pressure rating, cast iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.

PART 3 - EXECUTION

3.1 PUMPS - GENERAL REQUIREMENTS

A. Provide pumps with the capacities and characteristics indicated in the equipment schedule.

B. Provide motors of the type and characteristics as specified in Section 230513.

C. Furnish certified pump characteristic curves with each pump showing capacities, heads, efficiencies and brake horsepower throughout the entire range of the pump.

D. Select pumps to perform the specific duty for which they are intended.

E. Select pumps so that the ratio of the maximum pump impeller diameter to the selected pump impeller diameter is 1.15 or greater.

F. Select pumps that are non-overloading with the specified motor.

G. Request a factory representative to check base mounted pumps for lubrication, alignment and operating conditions after pump has been set, leveled, grouted, connected to piping, and system filled ready to operate.

H. Isolate base mounted pumps from piping by means of suitable flexible couplings specified under “Hydronic Piping Specialties” of Section 23.

I. Select pumps to operate at no less than 7 percentage points below the maximum efficiency point on the impeller curve selected.

3.2 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 CONCRETE BASES

A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 23 Section "Common Work Results for HVAC."
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on () centers around full perimeter of base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.4 PUMP INSTALLATION

A. Comply with HI 1.4 for centrifugal pumps and HI 2.4 for vertical mounted and turbine centrifugal pumps

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install hangers and rods and of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

E. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use hangers and hanger rods of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment." Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

F. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
   1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
   2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

G. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.5 ALIGNMENT

A. For close coupled end and double suction centrifugal pumps, align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation and HI 2.1-2.5, "Vertical Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill base plate with non-shrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.6 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check valve and throttling valve on discharge side of pumps.

F. Install non slam check valve and globe valve on discharge side of vertical in-line pumps. Triple duty valves can be used as a Contractor Option on constant flow pumping systems.

G. Install suction diffuser and shutoff valve on suction side of pumps.

H. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

I. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

J. Install check valve and gate or ball valve on each condensate pump unit discharge.

K. Install electrical connections for power, controls, and devices.

L. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems." And as follows:
   1. 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.

M. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.7 BASE MOUNTED CENTRIFUGAL PUMPS

A. Installation
1. Install pumps in accordance with the manufacturer's written instructions.
2. Install pumps in locations indicated and arranged to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
3. Support pumps and piping separately, so that piping is not supported by the pumps.
4. Set base-mounted pumps on their concrete foundation, either the floor mounted or inertia type. Leave top of foundation concrete rough (do not trowel) to enhance grout adhesion. Disconnect coupling halves before setting and do not reconnect couplings until alignment operations have been completed.
5. Set foundation bolts in a pipe or conduit three times the diameter of the bolts terminating flush with the top of the foundation concrete, leaving the bolts with a free length of 10 to 15 bolt diameters. Do not install nuts on the underside of the base plate.
6. Support pump base plate on rectangular metal blocks and shims, or on metal wedges with a small taper, at points near the foundation bolts to provide a gap of 19 to 38 mm between pump base and foundation for grouting.
7. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges to verify that they are level and plumb.

B. Alignment
1. Using a wedge gauge or block and feelers at for points between the coupling faces, check the angular misalignment, adjusting the wedges under the base plate to achieve an alignment not exceeding 0.075 mm.
2. Check vertical and horizontal alignment by placing a straight edge across both coupling rims, adjusting wedges as necessary so the straight edge rests evenly on both rims.
3. Recheck the alignment of the suction and discharge flanges and adjust the wedges as necessary.
4. Each time a wedge is adjusted to attain alignment in one direction, check the alignment in all other directions.

C. Grouting
1. After the unit has been aligned, pull down the foundation bolt nuts snugly; recheck the alignment at the coupling and for angular position of the flanges, and adjust as necessary.
2. Build a dam with wood boards around the concrete foundation to contain the grout and fill under the base plate completely with grout, stirring thoroughly to break up air pockets.
3. Remove the wood dam and recheck the alignment. If any misalignment is evident, correct by placing shims under the pump or driver feet.
4. Allow the grout to harden for 48 hours, then tighten the foundation bolts.

D. Making Piping Connections

1. Connect the suction and discharge piping flanges, and then recheck the alignment at the coupling. If the piping has caused misalignment, disconnect the piping, realign the unit, and make necessary changes in the piping to prevent its causing the misalignment.
2. Reconnect the piping suction and discharge flanges and check the alignment.

E. Unit Run-In and Final Check
1. Remove bearing covers, and clean thoroughly.
2. Check the rotation of the driver to see that it will rotate the pump in the direction indicated on the pump casing. Insert coupling bolts.
3. Check to see that pumps are free to rotate by hand. Do not operate pump if it is bound or if drags even slightly until cause of trouble is determined and corrected.
4. Start the unit and after it has thoroughly warmed up under actual operating conditions, shut the unit down and immediately check alignment at the coupling. Make any adjustments by adding or removing shims under the driver feet then secure bolts and check alignment.
5. Restart the unit, allow to run for a few more hours; shut down, and immediately recheck the alignment. There must not be more than 0.075 mm vertical difference between the coupling rims.

F. Connections
1. For horizontal split case pumps, provide an isolation valve and strainer on the pump suction and a check valve and isolation valve or triple duty valve where applicable on the pump discharge.
2. For end suction pumps, provide an isolation valve and a suction diffuser on the pump suction and a multi-purpose valve on the pump discharge.
3. Install flexible piping connectors on the suction and discharge side of base mounted pumps between the pump casing and valves.
4. Install a common pressure gauge piped across the pump casing through line cocks, connected to integral pressure gauge tappings in the pump casing at the suction and discharge connections.

G. Field Quality Control
1. Check pump suction connections for tightness to avoid drawing air into the pumps.
2. Clean strainers.
3. Set pump controls

3.8 IN-LINE CENTRIFUGAL PUMPS

A. Installation
1. Whenever possible, install pump in a vertical section of pipe, pumping upwards.
2. Provide isolation valves on either side of the pump with a strainer in the suction line and a check valve in the discharge line.
3. Adequately support pump from the bearing bracket assembly using continuous thread hanger rod and vibration-isolation hangers of sufficient size to support pump independent of piping system.

3.9 DRIVE GUARDS

A. Refer to Section 230500.

3.10 COMMISSINING

A. Verify that pumps are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.

C. Perform the following preventive maintenance operations and checks before starting:
   1. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
   2. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
   3. Check suction piping connections for tightness to avoid drawing air into pumps.
   4. Clean strainers.
   5. Verify that pump controls are correct for required application.

D. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:
   1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
   2. Open cooling water-supply valves in cooling water supply to bearings, where applicable.
   3. Open cooling water-supply valves if stuffing boxes are water cooled.
   4. Open sealing liquid-supply valves if pumps are so fitted.
   5. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
   6. Open circulating line valves if pumps should not be operated against dead shutoff.
   7. Start motors.
   8. Open discharge valves slowly.
   9. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.
   10. Check general mechanical operation of pumps and motors.
   11. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.
   12. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except open discharge valves before starting motors.
   13. Refer to Section 230500 for requirements for vibration testing of base-mounted pumps.
   14. Refer to Sections 230593 for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.11 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   6. Start motor.
   7. Open discharge valve slowly.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section "Demonstration and Training."

B. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.

C. Review data in maintenance manuals. Refer to Section 23 05 00.

D. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 232123

SECTION 232300 - REFRIGERANT 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. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-22:

1. Suction Lines for Air-Conditioning Applications: 185 psig.
2. Suction Lines for Heat-Pump Applications: 325 psig.
3. Hot-Gas and Liquid Lines: 325 psig.

B. Line Test Pressure for Refrigerant R-134a:

1. Suction Lines for Air-Conditioning Applications: 115 psig.
2. Suction Lines for Heat-Pump Applications: 225 psig.
3. Hot-Gas and Liquid Lines: 225 psig.

C. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig.
2. Suction Lines for Heat-Pump Applications: 380 psig.
3. Hot-Gas and Liquid Lines: 380 psig.

D. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

1.4 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.

5. Strainers.
6. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot.
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Field quality-control test reports.

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

1.5 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

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

1.7 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

G. Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket
2. End Connections:

   a. NPS 2 and Smaller: With threaded-end connections.
   b. NPS 2-1/2 and Larger: With flanged-end connections.

3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

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

B. Packed-Angle Valves:

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

C. Check Valves:

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

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.

9. Working Pressure Rating: 700 psig.

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.

1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Equalizer: Internal
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
8. End Connections: Socket.
9. Set Pressure: Refer to equipment manufactures recommendations
10. Throttling Range: Maximum 5 psig.
11. Working Pressure Rating: 500 psig.
12. Maximum Operating Temperature: 240 deg F.

I. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

J. Angle-Type Strainers:

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

K. Moisture/Liquid Indicators:

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

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

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

M. Permanent Filter Dryers: Comply with ARI 730.

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

N. Mufflers:

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

O. Receivers: Comply with ARI 495.

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

P. Liquid Accumulators: Comply with ARI 495.

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

2.3 REFRIGERANTS

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

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.
5. <Insert manufacturer's name.>

B. ASHRAE 34, R-22: Monochlorodifluoromethane.

C. ASHRAE 34, R-134a: Tetrafluoroethane.

D. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

E. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT

A. Suction Lines NPS 4for Conventional Air-Conditioning Applications: Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines: Copper, Type L, drawn-temper tubing and wrought-copper fittings with soldered joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type L, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

F. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

G. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

H. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

I. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

J. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

K. Install receivers sized to accommodate pump-down charge.

L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

A. 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 Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

R. Seal penetrations through fire and smoke barriers.

S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

U. Seal pipe penetrations through exterior walls.

V. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Spring hangers to support vertical runs.
3. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
2. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 232500 - HVAC WATER TREATMENT

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 HVAC water-treatment systems:

1. Bypass chemical-feed equipment and controls.
2. Biocide chemical-feed equipment and controls.
3. Chemical treatment test equipment.
4. HVAC water-treatment chemicals.
5. Water filtration units for HVAC makeup water.

1.3 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. TDS: Total dissolved solids.

1.4 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-water heating chilled water and geothermal heat pump loop,, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. Nitrite: Maintain a value within 500 to 1000 ppm.
3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.

D. Provide pre-cleaning chemicals for hot water systems.

E. Open hydronic systems, including condenser water, shall have the following water qualities:

1. pH: Maintain a value within 8.0 to 9.1.
2. "T" Alkalinity: Maintain a maximum value of 400 ppm.
3. Soluble Copper: Maintain a maximum value of 0.20 ppm.
4. Calcium Hardness: maintain a maximum value of 400 ppm.

F. Passivation for Galvanized Steel: For the first 60 days of operation.

1. Provide proper treatment chemicals for 24-hour circulation
2. pH: Maintain a value within 7 to 8.
3. Calcium Carbonate Hardness: Maintain a value within 100 to 300 ppm.
4. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm.

1.5 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Bypass feeders.
2. Water meters.
3. Inhibitor injection timers.
4. pH controllers.
5. TDS controllers.
6. Biocide feeder timers.
7. Chemical solution tanks.
8. Injection pumps.
9. Chemical test equipment.
10. Chemical material safety data sheets.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For sensors, injection pumps, water softeners, water filtration units, and controllers to include in emergency, operation, and maintenance manuals.

E. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

1.6 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping heating, hot-water piping, geothermal heat pump loop water piping, condenser-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Anderson Chemical Co, Inc.
2. Aqua-Chem, Inc.; Cleaver-Brooks Div.
3. Chemtreat.
4. GE Betz.
5. ONDEO Nalco Company.
6. Ecolabs.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 5 gal..

2. Minimum Working Pressure: 175 psig.

2.3 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter:

1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.
2. Body: Bronze.
3. Minimum Working-Pressure Rating: 150 psig.
4. Maximum Pressure Loss at Design Flow: 3 psig.
5. Registration: Gallons or cubic feet.
6. End Connections: Threaded.
7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.

B. Water Meter:

1. AWWA C701, turbine-type, totalization meter.
2. Body: Bronze.
3. Minimum Working-Pressure Rating: 150 psig.
4. Maximum Pressure Loss at Design Flow: 3 psig.
5. Registration: Gallons or cubic feet.
6. End Connections: Flanged.
7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.

C. Inhibitor Injection Timers:

1. Microprocessor-based controller with LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door.
2. Programmable timers with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.
3. Test switch.
4. Hand-off-auto switch for chemical pump.
5. Illuminated legend to indicate feed when pump is activated.
6. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
7. LCD makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.

D. TDS Controller / Conductivity:

1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 5000 micromhos. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door.
2. Digital display and touch pad for input.
3. Sensor probe adaptable to sample stream manifold.
4. High, low, and normal conductance indication.
5. High or low conductance alarm light, trip points field adjustable; with silence switch.

6. Hand-off-auto switch for solenoid bleed-off valve.
7. Bleed-off valve activated indication.
8. Internal adjustable hysteresis or deadband.
9. Bleed Valves:

    a. Cooling Systems: Forged-brass body, globe pattern, general-purpose solenoid with continuous-duty coil, or motorized valve.

E. Biocide Feeder Timer:

1. Microprocessor-based controller with digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door.
2. 24-hour timer with 14-day skip feature to permit activation any hour of day.
3. Precision, solid-state, bleed-off lockout timer and clock-controlled biocide pump timer. Prebleed and bleed lockout timers.
4. Solid-state alternator to enable use of two different formulations.
5. 24-hour display of time of day.
6. 14-day display of day of week.
7. Battery backup so clock is not disturbed by power outages.
8. Hand-off-auto switches for biocide pumps.
9. Biocide A and Biocide B pump running indication.

F. Chemical Solution Tanks:

1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 50 gal..
4. Chemical solution tanks are not required if premixed chemicals are used.

G. Chemical Solution Injection Pumps:

1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

H. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints.

I. Injection Assembly:

1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: Truunion pvc ball valve.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.

4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

2.4 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness, and oxidizing biocide test for open cooling systems.

B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.

1. Two-station rack for closed-loop systems.
2. Three-station rack for open systems.

2.5 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install water testing equipment on wall near water chemical application equipment.

C. Install interconnecting control wiring for chemical treatment controls and sensors.

D. Mount sensors and injectors in piping circuits.

E. Bypass Feeders: Install in closed hydronic systems, including hot-water heating, chilled water, geothermal heat pump closed loop and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
2. Install water meter in makeup water supply.
3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.

5. Install a swing check on inlet after the isolation valve.

F. Install automatic chemical-feed equipment for condenser water and include the following:

1. Install water meter in makeup water supply.
2. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.

    a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection.

3. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
4. Install TDS controller with sensor and bleed valves.

    a. Bleed valves shall cycle to maintain maximum TDS concentration.

5. Install Injector Pumps

6. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.

    a. Injection pumps shall operate to feed biocide on an alternating basis.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Common Work Results for HVAC."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."

E. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.

F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing or electronically.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. 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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. At eight-week intervals following Substantial Completion, and for a period of one year perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

F. Perform bacteria tests for the chilled water and water source heat pump systems every 3 months for a period of one year after substantial completion.

G. Pretreatment of cooling tower systems:

1. Add passivation chemicals at start-up and for a period of 24 hours.

H. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Steam System: ASTM D 1066.
3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Division 01 Section "Demonstration and Training."

B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION 232500

SECTION 232923 - VARIABLE-FREQUENCY CONTROLLERS

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 solid-state, PWM, VFCs for speed control of three-phase, squirrel-cage induction motors.

B. Related Sections include the following:

1. Division 26 Section "Electrical Power Monitoring and Control" for monitoring and control of motor circuits.
2. Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" for low-voltage power, control, and communication surge suppressors.

1.3 DEFINITIONS

A. BMS: Building management system.

B. IGBT: Integrated gate bipolar transistor.

C. LAN: Local area network.

D. PID: Control action, proportional plus integral plus derivative.

E. PWM: Pulse-width modulated.

F. VFC: Variable frequency controller.

1.4 SUBMITTALS

A. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

1. The VFC manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VFC manufacturer to ensure compliance with IEEE standard 519. All VFCs shall include a minimum of 5% impedance reactors, no exceptions.

B. Product Data: For each type of VFC. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

C. Shop Drawings: For each VFC.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

   a. Each installed unit's type and details.
   b. Nameplate legends.
   c. Short-circuit current rating of integrated unit.
   d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.
   e. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFCs. Provide schematic wiring diagram for each type of VFC.

D. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs where pipe and ducts are prohibited. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

E. Qualification Data

1. VFCs and options shall be UL listed as a complete assembly. VFCs that require the customer to supply external fuses for the VFC to be UL listed are not acceptable. The base VFC shall be UL listed for 100 KAIC without the need for input fuses.
2. CE Mark – The VFC shall conform to the European Union Electromagnetic Compatibility directive, a requirement for CE marking. The VFC shall meet product standard EN 61800-3 for the First Environment restricted level.
3. The VFC manufacturer shall have available a comprehensive, HVAC Drive Computer Based Training (CBT) product. The CBT product shall include detailed, interactive sections covering VFC unpacking, proper mechanical and electrical installation, and programming. The CBT product shall allow the user to provide just-in-time training to new personnel or refresher training for maintenance and repair personnel on the user’s site. The CBT product shall be repeatable, precise and shall include record keeping capability. The CBT product shall record answers to simulations and tests by student ID. The CBT product must be professionally produced and have interactive sections, student tests, and include video clips of proper wiring and installation.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for VFCs and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

H. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

I. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

G. Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE)

a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.

2. Underwriters laboratories

a. UL508C

3. National Electrical Manufacturer’s Association (NEMA)

a. ICS 7.0, AC Adjustable Speed Drives

4. IEC 16800 Parts 1 and 2

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver VFCs in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Store VFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subject to weather, cover VFCs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without de-rating, under the following conditions, unless otherwise indicated:

1. Ambient Temperature: 0 to 40 deg C.
2. Humidity: Less than 90 percent (non-condensing).
3. Altitude: Not exceeding 3300 feet.

B. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner, Architect, and Construction Manager no less than one week in advance of proposed interruption of electrical service.
2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electrical service without written permission.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.8 COORDINATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

D. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

E. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Furnish one spare for every five installed, but no less than one set of three of each type and rating.
2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. ABB, Inc.
2. Baldor Electric Company (Graham).
3. Danfoss Inc.; Danfoss Electronic Drives Div.
4. Eaton Corporation; Cutler-Hammer Products.
5. General Electric Company; GE Industrial Systems.
6. Square D.
7. Toshiba International Corporation.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.

1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.
2. Provide VFCs with 5% input impedance. All components shall be integrally mounted and wired in a single enclosure.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. The VFC package as specified herein shall be enclosed in a UL Listed Type 1enclosure when installed indoors and NEMA Type 3 enclosure when installed outdoors, completely assembled and tested by the manufacturer in an ISO9001 facility. The VFC tolerated voltage window shall

allow the VFC to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

D. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

E. Unit Operating Requirements:

1. Input ac voltage tolerance of 208 V, plus or minus 5, 380 to 500 V, plus or minus 10.
2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
3. Minimum Efficiency: 96 percent at 60 Hz, full load.
4. Minimum Displacement Primary-Side Power Factor: 96 percent.
5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
6. Starting Torque: 100 percent of rated torque or as indicated.
7. Speed Regulation: Plus or minus 1 percent.

F. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

1. Electrical Signal: 4 to 20 mA at 24 V.

G. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.
5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

H. Self-Protection and Reliability Features:

1. Input transient protection.

   a. The VFC shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOVs (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

2. Under- and overvoltage trips; inverter over temperature, overload, and overcurrent trips.
3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class 20 performance.
4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
5. Three (3) programmable critical frequency lockout ranges to prevent the VFC from operating the load continuously at an unstable speed.
6. Instantaneous line-to-line and line-to-ground overcurrent trips.
7. Loss-of-phase protection.
8. Reverse-phase protection.
9. Short-circuit protection.
10. Motor over temperature fault.

I. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.

J. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autopsied search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

K. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

L. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

M. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

N. Input Line Conditioning

1. The VFC shall have an integral 5% impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFCs with only one DC reactor shall add AC line reactors.

O. VFC Output Filtering

P. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

Q. Panel-Mounted Operator Station (Keypad): Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

R. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).

6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

S. Control Signal Interface:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

   a. 0 to 10-V dc.
   b. 0-20 or 4-20 mA.
   c. Potentiometer using up/down digital inputs.
   d. Fixed frequencies using digital inputs.
   e. RS485.
   f. Keypad display for local hand operation.

3. Output Signal Interface:

   a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:

      1) Output frequency (Hz).
      2) Output current (load).
      3) DC-link voltage (VDC).
      4) Motor torque (percent).
      5) Motor speed (rpm).
      6) Set-point frequency (Hz).

4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

   a. Motor running.
   b. Set-point speed reached.
   c. Fault and warning indication (over temperature or overcurrent).
   d. PID high- or low-speed limits reached.

T. Communications

1. The VFC shall have an RS-485 port as standard. The standard protocols shall be BACNet ASHRAE Standard 135 compliant. Each individual drive shall have the protocol in the base VFC. The use of third party gateways and multiplexers is not acceptable. All protocols shall be “certified” by the governing authority. Use of non-certified protocols is not allowed.
2. The BACnet connection shall be an RS485, MSTP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be

BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

a. Data Sharing – Read Property – B.
b. Data Sharing – Write Property – B.
c. Device Management – Dynamic Device Binding (Who-Is; I-AM).
d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
e. Device Management – Communication Control – B.
f. If additional hardware is required to obtain the BACnet interface, the VFC manufacturer shall supply one BACnet gateway per drive. Multiple VFCs sharing one gateway shall not be acceptable.

3. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFC relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFC fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The DDC system shall also be able to monitor if the motor is running in the VFC mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.
4. The VFC shall allow the DDC to control the drive’s digital and analog outputs via the serial interface. This control shall be independent of any VFC function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive’s digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive’s digital and analog inputs shall be capable of being monitored by the DDC system.
5. The VFC shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value control, etc. Both the VFC control PID loop and the independent PID loop shall continue functioning even if the serial communications connection is lost. The VFC shall keep the last good set-point command and last good DO & AO commands in memory in the event the serial communications connection is lost.

U. Manual Bypass and Control Features

1. All features to be furnished and mounted by the drive manufacturer. All features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.
2. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection and shall be provided in both drive and bypass modes.

3. Door interlocked, padlockable circuit breaker that will disconnect all input power from the drive and all internally mounted options.
4. Fused VFC only disconnect (service switch). Fast acting fuses exclusive to the VFC – fast acting fuses allow the VFC to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs, which have no such fuses, or that incorporate fuses common to both the VFC and the bypass will not be accepted. Three contactor bypass schemes are not acceptable.
5. The drive / bypass shall provide single-phase motor protection in both the VFC and bypass modes.
6. The following operators shall be provided:

    a. Bypass Hand-Off-Auto
    b. Drive mode selector
    c. Bypass mode selector
    d. Bypass fault reset

7. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.

    a. Power-on (Ready)
    b. Run enable (safeties) open
    c. Drive mode select damper opening
    d. Bypass mode selected
    e. Drive running
    f. Bypass running
    g. Drive fault
    h. Bypass fault
    i. Bypass H-O-A mode
    j. Automatic transfer to bypass selected
    k. Safety open
    l. Damper opening
    m. Damper end-switch made

8. The following relay (form C) outputs from the bypass shall be provided:

    a. System started
    b. System running
    c. Bypass override enabled
    d. Drive fault
    e. Bypass fault (motor overload or underload (broken belt))
    f. Bypass H-O-A position

9. The digital inputs for the system shall accept 24V or 115VAC (selectable). The bypass shall incorporate internally sourced power supply and not require an external control power source.
10. Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes (not

functional in Fireman's Override 2). The remote start/stop contact shall operate in VFC and bypass modes.

11. Dedicated digital input that will transfer motor from VFC mode to bypass mode upon dry contact closure for fireman's override. Two modes of operation are required.

    a. One mode forces the motor to bypass operation and overrides both the VFC and bypass H-O-A switches and forces the motor to operate across the line (test mode). The system will only respond to the digital inputs and motor protections.
    b. The second fireman's override mode remains as above, but will also defeat the overload and single-phase protection for bypass and ignore all keypad and digital inputs to the system (run until destruction).

12. The VFC shall include a "run permissive circuit" that will provide a normally open contact whenever a run command is provided (local or remote start command in VFC or bypass mode). The VFC system (VFC or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch. When the VFC system safety interlock (fire detector, freezestat, high static pressure switch, etc) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.
13. Class 20 or 30 (selectable) electronic motor overload protection shall be included.
14. There shall be an internal switch to select manual or automatic bypass.
15. There shall be an adjustable current sensing circuit for the bypass to provide loss of load indication (broken belt) when in the bypass mode.

2.3 ENCLOSURES

A. The VFC package as specified herein shall be enclosed in a UL listed Type 6 enclosure, completely assembled and tested by the manufacturer in an ISO9001 facility. The VFC tolerated voltage window shall allow the VFC to operate from a line of +30 percent nominal voltage as a minimum.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Standard Displays:

1. Output frequency (Hz).
2. Set-point frequency (Hz).
3. Motor current (amperes).
4. DC-link voltage (VDC).

5. Motor torque (percent).
6. Motor speed (rpm).
7. Motor output voltage (V).

F. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

G. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.5 FACTORY FINISHES

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Anchor each VFC assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.

B. Install VFCs on concrete bases.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Common Work Results for Electrical,".

3.5 IDENTIFICATION

A. Identify VFCs, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.6 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
3. Report results in writing.

C. Warranty

1. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll free phone number.

D. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 262923

SECTION 236416 – CENTRIFUGAL WATER CHILLERS

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. Packaged, water-cooled, electric-motor-driven centrifugal chillers.

B. Related Section:

1. Division 28 Section "Refrigerant Detection and Alarm" for refrigerant monitors, alarms, supplemental breathing apparatus, and ventilation equipment interlocks.
2. Section 230905 - Chilled Water Instrumentation and Controls

1.3 DEFINITIONS

A. BAS: Building automation system.

B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.

E. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

1.4 PERFORMANCE REQUIREMENTS

A. Condenser-Fluid Temperature Performance:

1. Startup Condenser-Fluid Temperature: Chiller shall be capable of starting with an entering condenser-fluid temperature of 40 deg F and providing stable operation until the system temperature is elevated to the minimum operating entering condenser-fluid temperature.
2. Minimum Operating Condenser-Fluid Temperature: Chiller shall be capable of continuous operation over the entire capacity range indicated with an entering condenser-fluid temperature of 65 deg F.

3. Make factory modifications to standard chiller design if necessary to comply with performance indicated.

B. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories. Provide summary of all auxiliary utility requirements such as electricity, water, etc. Summary shall indicate quality and quantity of each required utility.

1. Performance at AHRI standard conditions and at conditions indicated.
2. Performance at AHRI standard unloading conditions and at conditions indicated.
3. Minimum evaporator flow rate.
4. Minimum condenser flow rate.
5. Refrigerant capacity of chiller.
6. Oil capacity of chiller.
7. Fluid capacity of evaporator, condenser.
8. Characteristics of safety relief valves.
9. Minimum entering condenser-fluid temperature.
10. Manufacturer’s certified performance data at full load plus IPLV or NPLV.
11. Performance at varying capacities with constant design condenser-fluid temperature. Repeat performance at varying capacities for different condenser-fluid temperatures from design to minimum in 5 deg F increments.

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

1. Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Certificates: For certification required in "Quality Assurance" Article.

D. Source quality-control reports.

E. Startup service reports.

F. Operation and Maintenance Data: For each chiller to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. AHRI Certification: Certify chiller according to AHRI 550 certification program.

B. AHRI Rating: Rate chiller performance according to requirements in AHRI 550/590.

C. Comply with AHRI 575

D. ASHRAE Compliance:

1. ASHRAE 15 for safety code for mechanical refrigeration.
2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.

E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010.

F. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. For chillers charged with R-134a refrigerant, include an ASME U-stamp and nameplate certifying compliance.

G. Chiller manufacturer must be ISO Certified.

H. Comply with NFPA 70.

I. Comply with requirements of UL and UL Canada, and include label by a qualified testing agency showing compliance.

J. Comply with OSHA as adapted by the District of Columbia

K. Comply with ASME Section VIII

L. The chiller shall be tested to job conditions at the manufacturer's plant.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Ship each chiller with a full charge of refrigerant. Charge each chiller with nitrogen if refrigerant is shipped in containers separate from chiller.

B. Comply with the manufacturer's instructions for rigging and handling equipment. Leave protective covers in place until installation.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

1.9 WARRANTY

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

1. Extended warranties include, but are not limited to, the following:
   a. Complete compressor and drive assembly including refrigerant and oil charge.
   b. Parts and labor.
   c. Loss of refrigerant charge for any reason.

2. Warranty Period: One year (parts and labor) from date of Substantial Completion. Five years parts only on compressor.

1.10 MAINTENANCE

A. Extend a maintenance contract for a period of one year of the chillers in accordance with manufacturer’s recommendations as published in the installation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Subject to compliance with requirements, provide Daikin McQuay Magnitude Model WME including the standard product features and all special features as required per the plans and specifications; or a comparable product by one of the following

1. Trane; a division of American Standard.
2. YORK International Corporation.

B. Naming products from alternate manufacturers as equal does not imply that their standard construction or configuration is acceptable or meets the specifications. Equipment proposed "as equal", must meet the specifications including all architectural, mechanical, electrical, and structural details, all scheduled performance and the job design, plans and specifications.

2.2 MANUFACTURED UNIT

A. Description: Factory-assembled and -tested water cooled electric centrifugal chiller complete with compressor, compressor motor, compressor motor controller, evaporator, condenser, controls, interconnecting unit piping and wiring, and indicated accessories.

B. Provide chillers with two oil-free, magnetic bearing, semi-hermetic centrifugal compressors. Equip compressors with an integrated variable-frequency drive operating in concert with inlet guide vanes for optimized full and part load efficiency. If two-compressors are used, design the evaporator and condenser refrigerant sides and the expansion valve to be common and the chiller capable of running on one compressor with the other compressor or any of its auxiliaries inoperable or removed.

C. Perform factory run tests on each chiller under load conditions for a minimum of one hour on an AHRI certified test stand with evaporator and condenser water flow at job conditions (excluding glycol applications). Adjust and check operating controls. Adjust the refrigerant charge for optimum operation and recorded on the unit nameplate. Resolve and remedy any deviation in performance or operation prior to shipment and retest the unit to confirm repairs or adjustments. Provide a manufacturer issued certificate of completion of a successful run-test upon request. Unit must meet LEED EA4 refrigerant content per ton and qualify for LEED EA4 credits.

2.3 DESIGN REQUIREMENTS

A. General: Provide a complete water-cooled, semi-hermetic, oil-free centrifugal compressor water chiller as specified herein. The unit shall be provided according to standards indicated in Section 1.2. In general, unit shall consist of one or two magnetic bearing, oil-free centrifugal compressors, refrigerant, condenser and evaporator, and control systems including integrated variable frequency drive, operating controls and equipment protection controls. Chiller shall be charged with refrigerant HFC-134A. If manufacturer offers a chiller using any HCFC refrigerant, manufacturer shall provide written documentation signed by an officer of the company, assuring refrigerant availability and price schedule for a 20-year period.

B. The entire chiller system, including all pressure vessels, shall remain above atmospheric pressure during all operating conditions and during shut down to ensure that non-condensables and moisture do not contaminate the refrigerant and chiller system. If any portion of the chiller system is below atmospheric pressure during either operation or shut down, the manufacturer shall include, at no charge:

1. A 20-year purge maintenance agreement that provides parts, labor, and all preventative maintenance required by the manufacturer's operating and maintenance instructions.
2. A complete purge system capable of removing non-condensables and moisture during operation and shut-down.
3. The manufacturer shall also include at no charge for a period of 20 years an annual oil and refrigerant analysis report to identify chiller contamination due to vacuum leaks. If the analysis identifies water, acid, or other contaminant levels higher than specified by the manufacturer, the oil and/or refrigerant must be replaced or returned to the manufacturer's original specification at no cost to the owner.
4. The manufacturer shall include a factory-installed and wired system that will enable service personnel to readily elevate the vessel pressure during shutdown to facilitate leak testing.
5. A factory mounted, wired, and installed shell pressurization system shall be provided to keep air out of the chiller when the unit is not in service. Electric blanket or hot water circulation system are both acceptable.

C. Performance: Refer to chiller performance rating.

D. Acoustics: Sound pressure for the unit shall not exceed the following specified levels. Sound attenuation shall be provided on the compressor discharge at a minimum with additional acoustic treatment to chiller as required. Sound data shall be measured in dB according to AHRI Standard 575 and shall include overall dBA. Data shall be the highest levels recorded at all load points.

E. Sound Data:

Sound Data:								
63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	Overall
38.0	56.0	65.0	70.0	71.0	69.0	81.0	69.0	83.3
							75%	77.6
							50%	76.6
							25%	78.4
Sound Pressure (dB) measured in accordance with ANSI/AHRI Standard 575-2008 (A-weighted)								

2.4 REFRIGERATION

A. Refrigerant:

1. Type: R-134a; ASHRAE 34, Class A1 or Class B1.
2. Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.

B. Refrigerant Flow Control: Manufacturer's standard refrigerant flow-control device satisfying performance requirements indicated.

C. Pressure Relief Device:

1. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

2. For Chillers Using R-134a: ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger. Condenser shall have dual valves with one being redundant and configured to allow either valve to be replaced without loss of refrigerant.

D. Refrigeration Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from chiller to a remote refrigerant storage and recycling system. Comply with requirements in ASHRAE 15 and ASHRAE 147.

E. Refrigerant Isolation for Chillers Using R-134a: Factory install isolation valves in the compressor discharge line to the condenser and the refrigerant liquid line leaving the condenser to allow for isolation and storage of full refrigerant charge in the chiller condenser shell. In addition, provide isolation valve on suction side of compressor from evaporator to allow for isolation and storage of full refrigerant charge in the chiller evaporator shell.

F. Purge System:

1. System shall be a thermal purge design, refrigerant or air cooled, equipped with a carbon filter that includes an automatic regeneration cycle.
2. Factory wire to chiller's main power supply and system complete with controls, piping, and refrigerant valves to isolate the purge system from the chiller.
3. Construct components of non corrodible materials.
4. Controls shall interface with chiller control panel to indicate modes of operation, set points, data reports, diagnostics, and alarms.
5. Efficiency of not more than 0.02 lb of refrigerant per pound of air when rated according to ARI 580.
6. Operation independent of chiller per ASHRAE 147.

2.5 CHILLER COMPONENTS

A. Compressors: The unit shall utilize a magnetic bearing, oil-free, semi-hermetic centrifugal compressor. The levitated shaft position shall be digitally controlled and shall be monitored by X-axis position sensor, Y-axis position sensor, and Z-axis position sensor. The compressor drive train shall be capable of coming to a controlled, safe stop in the event of a power failure by diverting stored power to the magnetic bearing controls system.

1. The motor shall be of the semi-hermetic type, of sufficient size to efficiently fulfill compressor horsepower requirements. It shall be liquid refrigerant cooled with internal thermal sensing devices in the stator windings. The motor shall be compatible with variable frequency drive operation.
2. If unit contains an atmospheric shaft seal, the manufacturer shall provide the following at no additional charge:

   a. 20 year warranty and all preventive maintenance required to maintain the shaft seal including appropriate disposal of all oil lost through the shaft seal. Such disposal shall be done in a manner consistent with all Federal, state, and local laws pertaining to disposal and documentation of appropriate disposal shall be provided
   b. Replacement and re-charging on a semi-annual basis, or more often if required, all oil lost through the shaft seal
   c. 20 year refrigerant replacement warranty for any loss of refrigerant that can be directly attributable to the failure of the atmospheric shaft seal.

3. If the compressor drive motor is an open design the chiller manufacturer shall provide the following at no additional charge:

a. A self contained air conditioning system in the mechanical space sized to handle the maximum heat output the open drive motor. The energy required to operate this air conditioning system shall be added to the chiller power at all rating points for energy evaluation purposes.

4. If the compressor drive motor uses any form of antifriction bearings (roller, ball, etc) the chiller manufacturer shall provide the following at no additional charge:

   a. A 20 year motor bearing warranty and all preventative maintenance, including lubrication, required to maintain the bearings as specified in the manufacturer's operating and maintenance instructions
   b. At start up a three axis vibration analysis and written report which establishes a baseline of motor bearing condition.
   c. An annual three axis vibration analysis and written report to indicate the trend of bearing wear.

5. The chiller shall be equipped with an integrated Variable Frequency Drive (VFD) to automatically regulate compressor speed in response to cooling load and the compressor pressure lift requirement. Movable inlet guide vanes and variable compressor speed acting together, shall provide unloading. The chiller controls shall coordinate compressor speed and guide vane position to optimize chiller efficiency.
6. The compressor circuit shall be equipped with a 3% impedance line reactor to help protect against incoming power surges and help reduce harmonic distortion.
7. The compressor shall be vibration tested and not exceed a level of 0.14 IPS.

B. Evaporator and Condenser:

1. The evaporator and condenser shall be separate vessels of the shell-and-tube type, designed, constructed, tested and stamped according to the requirements of the ASME Code, Section VIII. Regardless of the operating pressure, the refrigerant side of each vessel will bear the ASME stamp indicating compliance with the code and indicating a test pressure of 1.1 times the working pressure, but not less than 100 psig. The tubes shall be individually replaceable and secured to the intermediate supports without rolling or expanding to facilitate replacement if required.
2. Chillers containing oil shall include at no additional charge a 20 year parts and labor warranty on all oil system components including:

   a. Pumps
   b. Starter
   c. Piping
   d. Tank
   e. Heater
   f. Cooler
   g. Controls
   h. Valves

3. The evaporator shall be flooded type with 0.025 in. wall copper internally and externally enhanced tubes rolled into carbon steel tubesheets. The water side shall be designed for a minimum of 150 psig. The refrigerant side shall be designed for a minimum of 200 psi. Provide intermediate tube supports at a maximum of 24 inch spacing. The heads shall be carbon steel and the tubes shall be carbon steel. Water connections shall be grooved

suitable for Victaulic couplings. The evaporator shall have dished heads with valved drain and vent connections. The evaporator shall have left-hand connections when looking at the unit control panel.

4. The condenser shall have 0.025 in. wall copper internally and externally enhanced tubes rolled into carbon steel. Water connections shall be grooved suitable for Victaulic couplings. The water side shall be designed for a minimum of 150 psig. The refrigerant side shall be designed for a minimum of 200 psi. Provide intermediate tube supports at a maximum of 24 inch spacing. The condenser shall have dished heads with valved drain and vent connections. The condenser shall have left-hand connections when looking at the unit control panel.
5. Provide sufficient isolation valves and condenser volume to hold the full unit refrigerant charge in the condenser during servicing or provide a separate pumpout system and storage tank sufficient to hold the charge of the largest unit being furnished.
6. An electronic expansion valve shall control refrigerant flow to the evaporator. Fixed orifice devices or float controls with hot gas bypass are not acceptable because of inefficient control at low load conditions. The liquid line shall have moisture indicating sight glass.
7. Re-seating type spring loaded pressure relief valves according to ASHRAE-15 safety code shall be furnished. The evaporator shall be provided with single or multiple valves. The condenser shall be provided with dual relief valves equipped with a transfer valve so one relief valve can be removed for testing or replacement without loss of refrigerant or removal of refrigerant from the condenser. Rupture disks are not acceptable. If rupture disks are required on negative pressure units to prevent air and moisture ingress, then factory mounted spring loaded pressure relief valves shall be provided in series with the rupture disks to contain the remaining refrigerant in the event of vessel over-pressurization. The space between the rupture disk and the relief valve shall include a suitable telltale indicator integrated into the chiller control system to alert the operator that a potential safety issue exists in the pressure relief system.
8. Provide factory-mounted and wired, thermal-dispersion water flow switches on each vessel to prevent unit operation with no or low water flow. Paddle and pressure differential type switches are not acceptable due to high rates of failure and false indications from these types of flow indicators.

C. INSULATION

1. Closed-cell, flexible elastomeric thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
2. Second option in subparagraph below may not be available from all manufacturers as a standard factory option. Consult manufacturer.
3. Thickness: 3/4 inch.
4. Adhesive: As recommended by insulation manufacturer.
5. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator shell and end tube sheets, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.
6. Apply adhesive to 100 percent of insulation contact surface.
7. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.

8. Seal seams and joints to provide a vapor barrier.
9. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.

D. Vibration Isolation: Refer to Specification Section 230548 - Vibration Isolation for HVAC Piping and Equipment. Provide neoprene waffle-type vibration isolators for each corner of the unit as recommended by manufacturer.

2.6 ELECTRICAL

A. Factory installed and wired, and functionally tested at factory before shipment.

B. Single-point, field-power connection to circuit breaker. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 65,000 A.

1. Branch power circuit to each motor, electric heater, dedicated electrical load, and controls with disconnect switch or circuit breaker.

a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
b. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit-trip set point.

2. NEMA ICS 2-rated motor controller for auxiliary motors, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller for each variable-speed motor furnished.
3. Control-circuit transformer with primary and secondary side fuses.

C. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.

D. Make terminal connections with not more than a 24-inch length of liquidtight or flexible metallic conduit.

E. Variable Frequency Drive Controller

1. Motor controller shall be factory mounted and wired on the chiller to provide a single-point, field-power termination to the chiller and its auxiliaries.
2. Description: UL-508 listed and labeled as a complete unit and arranged to provide variable speed by adjusting output voltage and frequency.
3. Enclosure: Unit mounted, NEMA 250, Type 1, with hinged full-front access door with lock and key.
4. Integral Disconnecting Means: Door-interlocked, NEMA AB 1, instantaneous-trip circuit breaker with lockable handle. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 65,000 A.
5. Technology: Pulse width modulated (PWM) output with insulated gate bipolar transistors (IGBT); suitable for variable torque loads.
6. Controller shall consist of a rectifier converter section, a digital/analog driver regulator section, and an inverter output section.

a. Rectifier section shall be a full-wave diode bridge that changes fixed-voltage, fixed-frequency, ac line power to a fixed dc voltage. Silicon controller rectifiers,

current source inverters, and paralleling of devices are unacceptable. Rectifier shall be insensitive to phase rotation of the ac line.

b. Regulator shall provide full digital control of frequency and voltage.

c. Inverter section shall change fixed dc voltage to variable-frequency, variable ac voltage, for application to a squirrel-cage motor. Inverter shall produce a sine-coded, pulse width modulated (PWM) output wave form and shall conduct no radio-frequency interference back to the input power supply.

7. Output Rating: Three phase; with voltage proportional to frequency throughout voltage range.

8. Operating Requirements:

a. Input AC Voltage Tolerance: 460-V ac, plus 10 percent or 506 V maximum.

b. Input frequency tolerance of 60 Hz, plus or minus 2 Hz.

c. Capable of driving full load, without derating, under the following conditions:

1) Ambient Temperature: 0 to 40 deg C.

2) Relative Humidity: Up to 95 percent (noncondensing).

3) Altitude: 3300 feet.

d. Minimum Efficiency: 96 percent at 60 Hz, full load.

e. Minimum Displacement Primary-Side Power Factor: 97 percent without harmonic filter, 98 percent with harmonic filter.

f. Overload Capability: 1.05 times the full-load current for 7 seconds.

g. Starting Torque: As required by compressor-drive assembly.

h. Speed Regulation: Plus or minus 1 percent.

i. Isolated control interface to allow controller to follow control signal over a 10:1 speed range.

j. To avoid equipment resonant vibrations, provide critical speed lockout circuitry to allow bands of operating frequency at which controller shall not operate continuously.

9. Internal Adjustability Capabilities:

a. Minimum Output Frequency: 6 Hz.

b. Maximum Output Frequency: 60 Hz.

c. Acceleration: 2 seconds to a minimum of 60 seconds.

d. Deceleration: 2 seconds to a minimum of 60 seconds.

e. Current Limit: 30 percent to a minimum of 100 percent of maximum rating.

10. Self-Protection and Reliability Features: Subjecting the controller to any of the following conditions shall not result in component failure or the need for replacement:

a. Overtemperature.

b. Short circuit at controller output.

c. Ground fault at controller output. Variable frequency controller shall be able to start a grounded motor.

d. Open circuit at controller output.

e. Input undervoltage.

f. Input overvoltage.

g. Loss of input phase.
h. Reverse phase.
i. AC line switching transients.
j. Instantaneous overload, line to line or line to ground.
k. Sustained overload exceeding 100 percent of controller rated current.

11. Motor Protection: Controller shall protect motor against overvoltage and undervoltage, phase loss, reverse phase, overcurrent, overtemperature, and ground fault.
12. Automatic Reset and Restart: Capable of three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Controller shall be capable of automatic restart on phase-loss and overvoltage and undervoltage trips.
13. Visual Indication: On face of controller enclosure or chiller control enclosure; indicating the following conditions:

    a. Power on.
    b. Run.
    c. Overvoltage.
    d. Line fault.
    e. Overcurrent.
    f. External fault.
    g. Motor speed (percent).
    h. Fault or alarm status (code).
    i. DC-link voltage.
    j. Motor output voltage.
    k. Total power factor.
    l. Kilowatts.
    m. Kilowatt-hours.
    n. Three-phase input voltage.
    o. Three-phase output current.
    p. Output frequency (Hertz).
    q. Elapsed operating time (hours).
    r. Diagnostic and service parameters.

14. Operator Interface: At controller or chiller control panel; with start-stop and auto-manual selector with manual-speed-control potentiometer.
15. Control Signal Interface:

    a. Electric Input Signal Interface: A minimum of two analog inputs (0 to 10 V or 0/4-20 mA) and six programmable digital inputs.

16. Active Harmonic Distortion Filter: Factory mounted and wired to limit total voltage and current distortion to 5 percent.
17. Cooling: Air- or refrigerant- cooled.
18. Accessories: Devices shall be factory installed in controller enclosure unless otherwise indicated.

    a. Control Relays: Auxiliary and adjustable time-delay relays.

19. Chiller Capacity Control Interface: Equip chiller with adaptive control logic to automatically adjust the compressor motor speed and the compressor pre-rotation inlet vane position independently to achieve maximum part-load efficiency in response to sensor inputs that are integral to the chiller controls.

2.7 CHILLER CONTROL PANEL

A. Control each chiller by means of a stand-alone Direct Digital Control (DDC) System . Provide a dedicated chiller control panel with each chiller. Design the panel to be microprocessor-based, with factory packaging and testing of all required control components with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.

B. Design the chiller control panel to provide control of chiller operation and to monitor chiller modules, sensors, actuators, relays and switches.

C. The unit shall have a microprocessor-based control system consisting of a 15-inch VGA touch-screen operator interface and a unit controller.

D. Design the chiller control panel to monitor motor starting and running time between compressor/motor starts, low chilled water temperature, low evaporator refrigerant temperature, high condenser refrigerant pressure, evaporator and condenser water refrigerant pressure, evaporator and condenser water flow status, low oil pressure, low oil temperature, high motor winding temperatures, sensor faults, and proper operation of unit controls.

E. Enclosure: Unit mounted, NEMA 250, Type 1, hinged or lockable; factory wired with a single-point, field-power connection and a separate control circuit.

F. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure. In either imperial or metric units selectable through the interface, display the following information:

1. Date and time.
2. Operating or alarm status.
3. Fault history with not less than last 10 faults displayed.
4. Set points of controllable parameters.
5. Trend data.
6. Operating hours.
7. Number of chiller starts.
8. Outdoor-air temperature or space temperature if required for chilled-water reset.
9. Entering- and leaving-fluid temperatures of evaporator and condenser.
10. Difference in fluid temperatures of evaporator and condenser.
11. Fluid pressure drop of evaporator and condenser.
12. Refrigerant pressures in evaporator and condenser.
13. Refrigerant saturation temperature in evaporator and condenser shell.
14. Compressor refrigerant suction and discharge temperature.
15. Compressor bearing temperature.
16. Motor winding temperature.
17. Oil temperature.
18. Oil discharge pressure.

19. Phase current.
20. Percent of motor rated load amperage.
21. Phase voltage.
22. Demand power (kilowatts).
23. Energy use (kilowatt-hours).
24. Power factor.
25. For chillers equipped with variable frequency controllers and harmonic filters, include the following:
    a. Output voltage and frequency.
    b. Voltage total harmonic distortion for each phase.
    c. Supply current total demand distortion for each phase.
    d. Inlet vane position.
    e. Controller internal ambient temperature.
    f. Heatsink temperature.
    g. Percent of 100% speed (per compressor)
26. Purge suction temperature if purge system is provided.
27. Purge elapsed time if purge system is provided.

G. In addition to the trended items above, all other important real-time operating parameters shall also be shown on the touch-screen. These items shall be displayed on a chiller graphic showing each component. At a minimum, the following critical areas must be monitored:

1. Compressor actual speed, maximum speed, percent speed
2. Evaporator water in and out temperatures, refrigerant pressure and temperature
3. Condenser water in and out temperatures, refrigerant pressure and temperature
4. Liquid line temperature
5. Chilled water setpoint
6. Compressor and unit state and input and output digital and analog values

H. A fault history shall be displayed using an easy to decipher, color coded set of messages that are date and time stamped. Time interval scale shall be user selectable as 20 mins, 2 hours, or 8 hours. The alarm history shall be downloadable from the unit's USB port. An operating and maintenance manual specific for the unit shall be viewable on the screen.

I. All setpoints shall be viewable and changeable (multi-level password protected) on the touch screen and include setpoint description and range of set values.

J. Automatic corrective action to reduce unnecessary cycling shall be accomplished through preemptive control of low evaporator or high discharge pressure conditions to keep the unit operating through abnormal transient conditions.

K. Chiller shall be capable of starting with entering condenser water temperatures as low as 40°F (4.4°C). For short periods of time during startup, the chiller shall be able to operate with an entering condenser water temperature lower than the leaving chilled water temperature.

L. Design the chiller control panel to provide evaporator freeze protection and low limit control. Design this control to be used to avoid low evaporator refrigerant temperature trip-outs during critical periods of chiller operation.

M. Chiller shall be capable of stable operation with varying evaporator flow rate up to 50% per minute.

N. Chiller plant optimization software for multiple chillers shall be provided including automatic control of: at least eight (8) chillers, evaporator and condenser pumps (primary and standby), up to 3 stages of cooling tower fan cycling control and a tower modulating bypass valve or cooling tower fan variable frequency drives. Provide a system control panel as specified below if specified requirements cannot be achievedthrough the unit control panel.

1. The factory mounted controller(s) shall support operation on a ASHRAE 135 BACnet® communication interface network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.
2. BACnet MS/TP master (Clause 9)
3. BACnet IP, (Annex J)
4. BACnet ISO 8802-3, (Ethernet)

O. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.

P. The factory supplied VFD and controls shall include the following:

1. High short circuit panel rating of 35kA at 460v with a matching circuit breaker.
2. Electronic overload
3. Phase loss protection
4. Under/over voltage protection
5. Ground Fault Protection to reduce the arcing ground fault damage from line-to-ground fault currents less than those required for conductor protection.
6. High short circuit panel rating of 35kA at 460v with a matching circuit breaker.
7. EMI filters to reduce radio frequency interference.

Q. Energy saving software logic shall at a minimum offer the following:

1. User programmable compressor soft loading
2. Chilled water reset
3. Demand limit control
4. Staging options lead lag between multiple compressors on a single chiller or on multiple chillers
5. Plotting of historic trends for optimizing efficiencyDescription: Single-stage or multistage, variable-displacement, centrifugal-type compressor driven by an electric motor.

2.8 CHILLER PLANT CONTROL

A. Provide a separate chiller plant (system) control panel if the unit control panel is unable to provide the specified control features.

B. Provide the system control panel with the following capabilities:

1. ASHRAE 135 (BACnet) compliant control system.
2. Capability to optimize the sequencing and control of 2 to 6 centrifugal chillers and their associated pumps, based on motor amperage draw.
3. Control strategies for the following functions pre-programmed by the manufacturer:

   a. Automatic lead/lag of chillers based on return water temperature.
   b. Optimum start/stop.
   c. Cooling tower control.
   d. Condenser water temperature valve control.
   e. Chilled and condenser water pump start/stop control.
   f. Collect and report all operating conditions of the chillers including communication of alarms.
   g. Run time and maintenance reports.
   h. Chilled water reset based on load.
   i. Seven day plus holiday scheduling.
   j. Outside air temperature.

C. Capability of providing system soft loading/cool down to gradually reduce the chilled water temperature within a time frame specified by the Operator.

D. Provide 330-mm (13-inch) CRT, printer, and telephone modem.

E. All chiller plant control, as described herein, is to be the responsibility of the chiller manufacturer and includes engineering, programming, check, test, start-up 1 year parts and labor warranty and system wiring diagrams.

F. In addition to the sequence of operation, provide for the chiller plant controller to trend log the mechanical room refrigerant levels along with purge run time on a daily basis and if the purge run time exceeds a user specified limit, automatically dial out the alarm.

G. Providing a daily log of the list of points recommended in ASHRAE Guideline 3.

H. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display chiller status and alarms.

1. Communication interface with the existing pneumatic based BAS shall enable the BAS operator to remotely monitor the chiller plant from an operator workstation. Control features and monitoring points displayed locally at chiller control panel shall be available through the BAS.
2. Provide the BACNet Standard 135 compliant chilled water system instrumentation and control ready for full interface with a future BACNet Standard 135 compliant DDC based Building Automation System (BAS).

I. For additional requirements, refer to Section 230905 Chilled Water System Instrumentation and Controls.

2.9 FINISH

A. Paint chiller, using manufacturer's standard procedures, except comply with the following minimum requirements:

1. Provide at least one coat of primer with a total dry film thickness of at least 2 mils.
2. Provide at least two coats of alkyd-modified, vinyl enamel finish with a total dry film thickness of at least 4 mils.
3. Paint surfaces that are to be insulated before applying the insulation.
4. Paint installed insulation to match adjacent uninsulated surfaces.
5. Color of finish coat to be manufacturer's standard.

B. Provide Owner with quart container of paint used in application of topcoat to use in touchup applications after Project Closeout.

2.10 ACCESSORIES

A. Flow Switches For Chilled and Condenser Water:

1. Pressure Differential Switches:

a. Construction: Wetted parts of body and trim constructed of Type 316 stainless steel.
b. Performance: Switch shall withstand, without damage, the full-pressure rating of the heat exchanger applied to either port and exhibit zero set-point shift due to variation in working pressure.
c. Set Point: Screw type, field adjustable.
d. Electrical Connections: Internally mounted screw-type terminal blocks.
e. Switch Enclosure: NEMA 250, Type 4.
f. Switch Action: Double-pole, double-throw switch with one pole field wired to the chiller control panel and the other pole field wired to the BAS.

B. Sound Barrier:

1. Furnish removable and reusable sound-barrier covers over the compressor housing, hermetic motor, compressor suction and discharge piping, and condenser shell as necessary to meet the specified acoustical performance requirements.
2. Provide for repeated installation and removal without use of tape or calk.
3. Inner and outer cover shall consist of a PTFE-impregnated fiberglass cloth enclosing heavy-density, needled fiberglass insulation material with a mass-loaded vinyl acoustic barrier.
4. Covers shall be double sewn and lock stitched with edges folded and sewn so no raw cut edges are exposed.
5. Form covers around control devices, gages, conduit, piping, and supports without degrading sound-barrier performance.
6. Continuously lap all exposed seams at least 2 inches for better sound containment.
7. Permanently label each section of cover to indicate its location, description, size, and number sequence.
8. Randomly place stainless-steel quilting pins to prevent covers from shifting and sagging.

2.11 SOURCE QUALITY CONTROL

A. Perform functional run tests of chillers before shipping.

B. Factory performance test chillers, before shipping, according to AHRI 550/590.

1. Test the following conditions:

a. Design conditions indicated.
b. Reduction in capacity from design to minimum load in 3 steps with condenser relief per AHRI 550/590.

2. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.
3. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

C. For chillers using R-134a refrigerant, factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. For chillers located indoors, rate sound power level according to AHRI 575.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine chillers before installation.

B. Examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting chiller performance, maintenance, and operations before equipment installation.

1. Final chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CHILLER INSTALLATION

A. Equipment Mounting: Install chiller on concrete bases using non-skid, waffle-style, neoprene isolation pads. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 0.75 inches.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Maintain manufacturer's recommended clearances for service and maintenance.

C. Charge chiller with refrigerant and fill with oil if not factory installed.

D. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 23 Section "Hydronic Piping" and Division 23 Section "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to chiller to allow service and maintenance.

C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and pressure gage. Connect to evaporator outlet with shutoff/balancing valve (butterfly valve with memory stop), flexible connector, flow switch, thermometer, with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a flange.

D. Condenser-Fluid Connections: Connect to condenser inlet with shutoff valve, strainer, flexible connector, thermometer, and pressure gage. Connect to condenser outlet with shutoff/balancing valve (butterfly valve with memory stop), flexible connector, flow switch, thermometer, with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a flange.

E. Refrigerant Pressure Relief Device Connections: For chillers installed indoors, extend vent piping to the outdoors without valves or restrictions. Comply with ASHRAE 15. Connect to chiller pressure relief device with flexible connector and dirt leg with drain valve.

F. For chillers equipped with a purge system, extend purge vent piping to the outdoors. Comply with ASHRAE 15 and ASHRAE 147.

G. Connect each chiller drain connection with a union and drain pipe, and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection.

3.4 EDDY CURRENT TESTING

A. Employ the services of an independent refrigeration service company to perform an Eddy Current test on the condenser and evaporator tubes of the chillers.

B. Notify the Owner and the Architect two weeks prior to the scheduled date of the Eddy Current test.

C. After the chillers have been set in place, remove the condenser and evaporator water boxes to permit access to the tubes for the Eddy Current test.

D. Require the chiller manufacturer to furnish replacement tubes for any tubes determined to be defective by the Eddy Current test. Replace all defective tubes.

E. Upon completion of the tube replacement, reinstall the condenser and evaporation water boxes, cap the piping connections and hydrostatically test the condenser and evaporator water sides at 1-1/2 times the design working pressure but not less than 1550 kPa (225 psi).

3.5 CLEANING

A. After completing the installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
3. Verify that pumps are installed and functional.
4. Verify that thermometers and gages are installed.
5. Operate chiller for run-in period.
6. Check bearing lubrication and oil levels.
7. Verify that refrigerant pressure relief device is vented outside.
8. Verify proper motor rotation.
9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
11. Verify and record performance of chiller protection devices.
12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.

C. Prepare test and inspection startup reports.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chillers. Video record the training sessions.

END OF SECTION 236416

SECTION 236423 - SCROLL WATER CHILLERS

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. Packaged, water-cooled, electric-motor-driven, scroll water chillers.
2. Packaged refrigerant recovery units.

B. Related Sections:

1. Division 28 Section "Refrigerant Detection and Alarm" for refrigerant monitors, alarms, supplemental breathing apparatus, and ventilation equipment interlocks.

1.3 DEFINITIONS

A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

B. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

C. IPLV: Integrated part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.

D. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

E. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

1.4 ACTION SUBMITTALS

A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at ARI standard conditions and at conditions indicated.
2. Performance at ARI standard unloading conditions.
3. Minimum evaporator flow rate.
4. Refrigerant capacity of water chiller.
5. Oil capacity of water chiller.
6. Fluid capacity of evaporator.
7. Fluid capacity of condenser.
8. Characteristics of safety relief valves.
9. Minimum entering condenser-water temperature.
10. Performance at varying capacity with constant design condenser-water temperature. Repeat performance at varying capacity for different condenser-water temperatures from design to minimum in **5 deg F (3 deg C)** increments.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.

C. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Source quality-control test reports.

D. Startup service reports.

E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. ARI Certification: Certify chiller according to ARI 590 certification program.

B. ARI Rating: Rate water chiller performance according to requirements in ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

C. ASHRAE Compliance: ASHRAE 15 for safety code for mechanical refrigeration.

D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

F. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.10 WARRANTY

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

1. Compressor Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PACKAGED WATER-COOLED WATER CHILLERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. McQuay International.
2. Trane.
3. York.

B. Description: Factory-assembled and run-tested water chiller complete with compressor(s), compressor motors and motor controllers, evaporator, condenser where indicated, electrical power, controls, and indicated accessories.

C. Compressors:

1. Description: Positive-displacement direct drive with hermetically sealed casing.
2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
4. Capacity Control: On-off compressor cycling.
5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
6. Sound-reduction package shall consist of acoustic enclosures around the compressors that are designed to reduce sound level without affecting performance.

D. Compressor Motors:

1. Hermetically sealed and cooled by refrigerant suction gas.
2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

E. Compressor Motor Controllers:

1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

F. Refrigeration:

1. Refrigerant: R-22 . Classified as Safety Group A1 according to ASHRAE 34 or R-407C.
2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

G. Evaporator:
1. Shell and Tube:

a. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.

b. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
c. Shell Material: Carbon steel.
d. Shell Heads: Removable carbon-steel heads with multipass baffles designed to ensure positive oil return and located at each end of the tube bundle.
e. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping.
f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.

2. Brazed Plate:

a. Direct-expansion, single-pass, brazed-plate design.
b. Type 316 stainless-steel construction.
c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.

H. Condenser:
1. Shell and Tube:

a. Description: Shell-and-tube design with refrigerant flowing through the shell and fluid flowing through the tubes within the shell.
b. Provides positive subcooling of liquid refrigerant.
c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
d. Shell Material: Carbon steel.
e. Water Boxes: Removable, of carbon-steel construction, located at each end of the tube bundle with fluid nozzles terminated with mechanical-coupling end connections for connection to field piping.
f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
g. Provide each condenser with a pressure relief device, purge cock, and liquid-line shutoff valve.

I. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.
2. House in a unit-mounted, NEMA 250, [**Type 1**] enclosure with hinged access door with lock and key or padlock and key.
3. Wiring shall be numbered and color-coded to match wiring diagram.
4. Install factory wiring outside of an enclosure in a raceway.
5. Field power interface shall be to [**wire lugs**] [**NEMA KS 1, heavy-duty, nonfused disconnect switch**].
6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:

a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
b. NEMA KS 1, heavy-duty, nonfusible switch.
c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

7. Provide each motor with overcurrent protection.
8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
9. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
10. Controls Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
11. Control Relays: Auxiliary and adjustable time-delay relays.
12. Indicate the following for water chiller electrical power supply:

a. Current, phase to phase, for all three phases.
b. Voltage, phase to phase and phase to neutral for all three phases.
c. Three-phase real power (kilowatts).
d. Three-phase reactive power (kilovolt amperes reactive).
e. Power factor.
f. Running log of total power versus time (kilowatt hours).
g. Fault log, with time and date of each.

J. Unit Control Center:

1. Stand-alone, microprocessor based.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:

a. Date and time.
b. Operating or alarm status.
c. Operating hours.
d. Outside-air temperature if required for chilled-water reset.
e. Temperature and pressure of operating set points.
f. Entering and leaving temperatures of chilled water.
g. Entering and leaving temperatures of condenser water.
h. Refrigerant pressures in evaporator and condenser.
i. Saturation temperature in evaporator and condenser.
j. No cooling load condition.
k. Elapsed time meter (compressor run status).
l. Pump status.
m. Antirecycling timer status.
n. Percent of maximum motor amperage.
o. Current-limit set point.
p. Number of compressor starts.

4. Control Functions:

   a. Manual or automatic startup and shutdown time schedule.
   b. Entering and leaving chilled-water temperatures, control set points, and motor load limit. Chilled-water leaving temperature shall be reset based on **return-water** temperature.
   c. Current limit and demand limit.
   d. Condenser-water temperature.
   e. External water chiller emergency stop.
   f. Antirecycling timer.
   g. Automatic lead-lag switching.

5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:

   a. Low evaporator pressure or high condenser pressure.
   b. Low chilled-water temperature.
   c. Refrigerant high pressure.
   d. High or low oil pressure.
   e. High oil temperature.
   f. Loss of chilled-water flow.
   g. Loss of condenser-water flow.
   h. Control device failure.

6. Building Automation System Interface: Factory-installed hardware and software to enable building automation system to monitor, control, and display water chiller status and alarms.

   a. Hardwired Points:

      1) Monitoring: On/off status, common trouble alarm .
      2) Control: On/off operation,

   1. ASHRAE 135 (BACnet) communication interface with the chilled water plant system control panel shall enable building automation system operator to remotely control and monitor the water chiller from an operator workstation. Design the control center to be able to interface with a chilled water plant system control panel to provide remote chiller start/stop; reset of chilled water temperature; reset of current limit; and status signal indicating chiller is ready to start, chiller is operating, or chiller is shutdown on a safety requiring reset. Refer to Section 230905 for additional requirements

K. Insulation:

1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
2. Thickness: **3/4 inch (19 mm)** .
3. Factory-applied insulation over cold surfaces of water chiller components.

   a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.

4. Apply protective coating to exposed surfaces of insulation.

L. Accessories:

1. Factory-furnished, chilled- and condenser water flow switches for field installation.
2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.

M. Capacities and Characteristics: as indicated on the drawings

2.2 PACKAGED REFRIGERANT RECOVERY UNITS

A. Packaged portable unit shall consist of compressor, air-cooled condenser, recovery system, tank pressure gages, filter-dryer, and valving that allows for switching between liquid and vapor recovery mode. Refrigerant recovery unit shall be factory mounted on an ASME-constructed and -stamped refrigerant storage vessel that is sized to hold the full refrigerant charge of the largest water chiller.

2.3 SOURCE QUALITY CONTROL

A. Perform functional test of water chillers before shipping.

B. Factory performance test water chillers, before shipping, according to ARI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

C. Factory test and inspect evaporator [**and water-cooled condenser**]according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.

D. For water chillers located indoors, rate sound power level according to ARI 575 procedure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

A. Install water chillers on support structure indicated.

B. Equipment Mounting: Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration for HVAC Piping and Equipment."

C. Equipment Mounting: Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

D. Equipment Mounting: Install water chiller on vibration isolation inertia bases. Comply with requirements specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.

G. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

A. Comply with requirements in Division 23 Section "Hydronic Piping" Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to chiller to allow service and maintenance.

C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, **strainer, flexible connector,** thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, **flexible connector,** flow switch, thermometer, plugged tee with pressure gage, **flow meter,** and drain connection with valve. Make connections to water chiller with a **union, flange, or mechanical coupling**.

D. Condenser Fluid Connections: Connect to condenser inlet with shutoff valve, **strainer, flexible connector,** thermometer, and plugged tee with pressure gage. Connect to condenser outlet with shutoff valve, balancing valve, **flexible connector,** flow switch, thermometer, plugged tee with pressure gage, **flow meter,** and drain connection with valve. Make connections to water chiller with a **union, flange, or mechanical coupling**.

E. Refrigerant Pressure Relief Valve Connections: For water chillers installed indoors, extend vent piping to the outside without valves or restrictions. Comply with ASHRAE 15.

F. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

3.4 STARTUP SERVICE

A. Perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
2. Verify that pumps are installed and functional.
3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.
6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
7. Verify proper motor rotation.
8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
9. Verify and record performance of chilled and condenser water flow and low-temperature interlocks.
10. Verify and record performance of water chiller protection devices.
11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions.

END OF SECTION 236423

SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provision of Contract, including General and Supplementary Conditions and Division 1 specifications, apply to this section. Where Paragraphs of this Section conflict with similar paragraphs of Division 1, requirements of this Section shall prevail.

1.2 SUMMARY

A. Perform work and provide material and equipment as shown on Drawings and/or as specified and/or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

B. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. Give notices, file plans, obtain permits and licenses, pay fees and backcharges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda, and Revisions, all of which are part of the Contract Documents.

D. Examine Drawings and other Sections of Specifications for requirements that affect work of this Section.

1.3 DEFINITIONS

A. As used in these Sections, "provide" means "furnish and install." "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.

1.4 CONTRACT DOCUMENTS

A. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, and all other Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of this Section must be coordinated.

B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both,

carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, pullbox, junction box fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.

E. Information and components shown on riser diagrams, but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.

1.5 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are unclear, notify Architect in writing before Award of Contract. Otherwise, Architect’s interpretation of Contract Documents shall be final, and no additional compensation shall be permitted.

B. Where Drawings or Specifications are not congruent with manufacturers' recommendations, notify Architect in writing before installation.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specs, this contractor shall provide that material, installation, or work which is of the higher standard.

D. It is the requirement of these contract documents to have the contractor provide systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. The contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

E. Where discrepancies exist between the mechanical, plumbing, fire protection, and electrical drawings in regards to what trade owns equipment such as disconnects, starters, etc., the discrepancy shall be brought to the Architect’s attention in accordance with paragraph (A) above.

1.6 MODIFICATIONS IN LAYOUT

A. Electrical Drawings are diagrammatic. They indicate general arrangements of electrical systems and other work. They do not show all offsets required for coordination nor do

they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.

B. In order to obtain the intended desired aesthetics in spaces used by building occupants, in all such spaces, prior to installation of visible material and equipment (including access panels), review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.

C. Check Contract Drawings, as well as Shop Drawings, of all subcontractors to verify and coordinate spaces in which work of this section will be installed.

D. Maintain maximum headroom at all locations. All raceways, pull boxes, junction boxes, and associated components to be as tight to underside of structure as possible, unless indicated otherwise.

E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to paragraphs above.

1.7 SITE VISIT

A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer.

1.8 EXISTING CONDITIONS AND PREPARATORY WORK

A. Before starting work, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or other Contracts or by the Owner Institution. Report conditions that might affect work adversely in writing through Contractor to Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory.

1.9 CODES, STANDARDS, AUTHORITIES AND PERMITS

A. Perform work strictly as required by rules, regulations, standards, codes, ordinances, and laws of local, state, and federal governments and other authorities that have legal jurisdiction over the site.

B. When requirements cited in this Specification conflict with each other or with Contract Documents, most stringent shall govern work.

1.10 PROTECTION OF WORK

A. Each contractor shall be responsible for his work and equipment until finally inspected, tested, and accepted. Carefully store materials and equipment which are not immediately installed after delivery to site, or existing equipment to be relocated. Close open ends of work with temporary covers or plug during construction to prevent entry of obstructing material.

B. Provide all materials, equipment and labor to provide adequate protection of all electrical equipment during the course of construction. This includes protection from moisture and foreign material.

C. Each separate contractor shall protect the work and material of other trades that might be damaged by his work or workmen and make good all damage thus caused.

PART 2 - PRODUCTS

A. Refer to specific sections for product specifications.

PART 3 - EXECUTION

3.1 SPECIAL RESPONSIBILITIES

A. Cooperate and coordinate with work of other Sections in executing work of this Section.

1. Perform work such that progress of entire project including work of other Sections shall not be interfered with or delayed.
2. Provide information as requested on items furnished under this Section which shall be installed under other Sections.
3. Obtain detailed installation information from manufacturers of equipment provided under this Section.
4. Obtain final roughing dimensions or other information as needed for complete installation of items furnished under other Sections or by Owner.
5. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under this and other Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance. In case of failure to provide sufficient information in proper time, provide cutting and patching or have same done, at own expense and to full satisfaction of Architect.
6. Notify Architect of location and extent of existing piping, conduit, ductwork and equipment that interferes with new construction. In coordination with and with approval of Architect, relocate piping, ductwork and equipment to permit new work to be provided as required by Contract Documents. Remove non-functioning and abandoned raceway, wiring, and equipment.

B. Installation Only Items

1. Where this contractor is required to install items which it does not purchase, it shall coordinate their delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to the time of installation. This trade shall be responsible for:

a. Any necessary field assembly and internal connections, as well as mounting in place of the items.

b. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.

2. This contractor shall carefully examine such items upon delivery. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of work of this contractor will be considered only if presented in writing within one week of their date of delivery. Unless such claims have been submitted this contractor shall be fully responsible for the complete reconditioning or replacement of the damaged items.

C. Maintenance of equipment and systems: Maintain equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions.

3.2 CONTINUITY OF SERVICES

A. Do not interrupt existing services without Owner's approval.

B. Schedule interruptions in advance, according to Owner's instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

C. Interruptions shall be scheduled at such times of day and work so that they have minimal impact on operations.

D. Subcontractor shall coordinate any shutdowns of existing systems as follows:

1. Give proper notice to facility when making shutdowns; a minimum of two full days is required.
2. Minimize shutdowns of any system.
3. Provide temporary services where required and perform shutdowns and tie-ins at a time convenient to Owner.
4. Perform required survey and inspection work required by the notice for shutdown.

E. Include premium time work associated with interruptions of services and/or shutdowns as necessary to avoid disruption to Owner's operations.

END OF SECTION 260100

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

1.3 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways and cables will be clear of obstructions and of the working and access space of other equipment.

PART 2 - PRODUCTS

2.1 N/A

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

END OF SECTION 260500

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. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

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

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THW and THHN-THWN.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire. Limit lengths of multiconductor cable per part 3.

2.2 CONNECTORS AND SPLICES

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

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings for recessed light fixtures: Type THHN-THWN, single conductors in raceway and Metal-clad cable, Type MC. Use maximum of 72 inches for recessed light fixtures.

E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

F. Class 1 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification 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 and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test 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 Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 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.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. 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 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. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 CONNECTORS

A. Listed and labeled by an NRTL 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. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

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. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Three-phase motor and appliance branch circuits.
3. Flexible raceway runs.
4. Metal-clad cable runs.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. 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.

C. Grounding and Bonding for Metal ducts.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. 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.

C. Report measured ground resistances that exceed 10 ohms.

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.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. 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 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07.

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. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.

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.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel 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. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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

1) Hilti Inc.
2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
3) MKT Fastening, LLC.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

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 in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other 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 using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

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

SECTION 260533 - RACEWAY 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. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Alflex Inc.

3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. O-Z Gedney; a unit of General Signal.
8. Wheatland Tube Company.

B. EMT: ANSI C80.3.

C. LFMC: Flexible steel conduit with PVC jacket.

D. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel, set-screw type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

E. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 METAL WIREWAYS

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

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 or 3R, as indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type or Flanged-and-gasketed type As indicated.

E. Finish: Manufacturer's standard enamel finish.

2.3 BOXES, ENCLOSURES, AND CABINETS

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

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Scott Fetzer Co.; Adalet Division.
9. Spring City Electrical Manufacturing Company.
10. Thomas & Betts Corporation.
11. Walker Systems, Inc.; Wiremold Company (The).
12. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

E. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:
3. Concealed in Ceilings and Interior Walls and Partitions: EMT.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: Rigid steel conduit.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.

B. Minimum Raceway Size: 3/4-inch trade size.

C. 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.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Install no more than the equivalent of three 90-degree bends in any conduit run, for which fewer bends are allowed.

F. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

G. 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.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

I. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

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 conductors.
2. Equipment identification labels.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

1.4 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 ARMORED AND METAL-CLAD CABLE 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 and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.3 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.4 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background for equipment on the Normal power system. Adhesive backed, with white letters on a red background for equipment on the Essential (Life Safety, Critical, or Equipment branch) power system. Minimum letter height shall be 3/8 inch.

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.

3.2 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.

a. Color shall be factory applied.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 460/265-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

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.

B. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Adhesive film label with clear protective overlay. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. A new panelboard directory shall be provided for each new panelboard and for each existing panelboard affected by the project by demolition or addition of new circuits.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
e. Emergency system boxes and enclosures.
f. Enclosed switches.
g. Enclosed circuit breakers.

h. Enclosed controllers.

END OF SECTION 260553

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. Provide all labor, materials and equipment to furnish and install all of the items specified herein, indicated on the drawings and as necessary for the proper and complete performance of work.

B. Section Includes:

1. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. 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. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panelboards.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.

1.7 COORDINATION

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.

PART 2 - PRODUCTS

2.1 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: As indicated on panel schedule.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads.
   d. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

2.3 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboard components and accessories according to NECA 407 and NEMA PB 1.1.

B. Install overcurrent protective devices and controllers not already factory installed.

C. Install filler plates in unused spaces.

D. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components.

B. Create a directory to indicate installed circuit loads upon completion of work; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 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 stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262416

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, and enclosed controllers.

1.3 REFERENCES

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form part of this specification to the extent referenced. Publications are referenced in the text by the basic designations only.

1. National Electrical Code (NEC)
2. Underwriter’s Laboratories (UL)
   a. UL 50 Enclosures for Electrical Equipment
   b. UL 508 Standard for Safety Industrial Control Equipment
   c. UL 977 Fused Power Circuit Devices
3. American National Standard Institute (ANSI)

1.4 SUBMITTALS

A. Product Data: For each type and rating of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.7 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Feeders: Class RK1, time delay.
2. Motor Branch Circuits: Class RK1, time delay.
3. Other Branch Circuits: Class RK5, time delay.
4. Control Circuits: Class CC.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Manufacturer's field service report.

F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Install fuses in fusible devices.

C. Comply with NECA 1.

3.3 IDENTIFICATION

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

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

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 the following enclosed controllers rated 600 V and less:

1. Full-voltage manual and magnetic.
2. Combination of magnetic controller and switch rated at HP of load.

B. Related Section:

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.
b. Factory-installed devices.
c. Nameplate legends.
d. Short-circuit current rating of integrated unit.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For enclosed controllers 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. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for setting field-adjustable overload relays.

E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.5 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

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 NFPA 70.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions or clearances.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.8 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

C. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle action; marked to show whether unit is off, on, or tripped.

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

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type; melting alloy type.
4. Surface mounting.
5. Red pilot light.

C. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

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

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. MCP Disconnecting Means:

a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
d. N.C. alarm contact that operates only when MCP has tripped.

2.2 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: NEMA 250, Type 1.

2.3 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.

a. Push Buttons: Shrouded.
b. Pilot Lights: LED types; colors as indicated; push to test.
c. Selector Switches: Rotary type.

B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

C. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. Connect hand-off-automatic selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 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. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages.
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust the trip settings of MCPs with adjustable instantaneous trip elements.

END OF SECTION 262913

SECTION 283500 – REFRIGERANT DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. This Section provides for the installation of a completely integrated refrigerant leak detection and alarming system, complete with all sensors, alarms, analyzers, controls, etc. necessary for a complete and functional monitoring system.

B. Related Sections

1. Section 230000 - Common Mechanical and Electrical Requirements
2. Section 230500 – Common Work Results for HVAC.
3. Section 230513 - Common Motor Requirements for HVAC Equipment.
4. Section 23553 – Identification for HVAC Piping And Equipment.
5. Section 236416 – Centrifugal Water Chillers.
6. Section 236423 - Scroll Water Chillers
7. Section 230905 – Instrumentation and Controls for Chiller Plants.

1.2 REFERENCES

A. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

1. 15 - Safety Code for Mechanical Refrigeration.

B. Code of Federal Regulations

1. 42 CFR 84 – Approval of Respiratory Protective Devices

a. Subpart H – Self-Contained Breathing Apparatus.

C. National Electrical Manufacturers Association (NEMA)

1. 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 DEFINITIONS AND ABBREVIATIONS

A. AEL – Acceptable Environmental Level

B. AHJ – Authority Having Jurisdiction

C. AOA – Annual Operational Audit

D. ASHRAE –American Society of Heating, Refrigerating and Air Conditioning Engineers

E. BMS – Building Management System

F. CFC – Chlorofluorocarbon

G. CFR – Code of Federal Regulations

H. DOL – Department of Labor

I. EPA – Environmental Protection Agency

J. FACP – Fire Alarm Control Panel

K. HCFC – Hydrochlorofluoarbon

L. HFC – Hydrofluocarbon

M. IBC – International Building Code

N. IDLH – Immediately Dangerous to Life or Health

O. IFC – International Fire Code

P. IIAR – International Institute of Ammonia Refrigeration

Q. IMC – International Mechanical Code

R. LEL – Lower Exposure Level

S. LFL – Lower Flammability Level

T. MSHA – Mine Safety and Health Association

U. NEMA – National Electrical Manufacturers Association

V. NFPA – National Fire Protection Association

W. NGDA – National Gas Detection Association

X. NH3 – Ammonia

Y. NIOSH – National Institute for Occupational Safety and Health

Z. PPM – Parts Per Million

AA. RMS – Refrigerant Monitoring System

BB. SCBA – Self-Contained Breathing Apparatus

CC. TLV – Threshold Limit Value

DD. TWA – Time Weighted Average

1.4 SUBMITTALS

A. General:

1. Submit each item in this Article according to requirements of International Fire Code, the Conditions of the Contract and Division 1 Specification Sections.
2. Submit construction documents that are in accordance with the local building code.

B. Information contained within the Construction Documents and submittal/approval package:

1. Draw construction documents to scale upon suitable material. Electronic media documents are allowed to be submitted when approved by the code official.
2. Submit construction documents that are of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of the building code and relevant laws, ordinances, rules and regulations as determined by the code official.
3. Provide a scope of work and details on the work to be completed.
4. Identify and submit, as required by code, applicable code references for each refrigerant monitoring system designed component, alarm and control function.
5. Provide Hazardous Area Alarm Evaluation information for Fire Marshall review. Identify the use group of the hazard area, hazard classification and the processes. Submit information that is detailed and site specific per each zone and in compliance

with the International Fire Code. Hazard Evaluation provided for each monitored zone to include the following.

a. Sequence of Alarm Matrix with notification devices and resulting action to interlocks, field devices and alarm appliances per code requirements.
b. Drawing of each zone containing hazardous material with locations indicated for all sources of leak; each zone hazard shall be listed, identified and described with hazard physical properties in relation to ambient atmosphere and explanation describing hazardous effect.
c. Exhaust and supply air intakes and registers for each zone with airflow data in cfm, also for each associated gas cabinet, exhaust-fume hood, exhaust canopy, etc. Include preliminary ventilation airflow diagrams supporting basis for design.

6. Provide details on the sequence of alarm and where the signal will be transmitted. For signals transmitted to the building fire alarm systems, provide details on what type of signal will be sent and details of interlock in the supervisory panel. Information to be provided for fire alarm contractor use.
7. Provide emergency power or secondary power to the continuous gas detection / emergency alarm system. If power is supplied from a generator, then it must be noted. If batteries are used, provide detailed battery calculations for standby and alarm conditions.

C. Applicant Responsibility:

1. It is the responsibility of the supplier to ensure that the construction documents include all fire protection requirements and the shop drawings are complete and in compliance with the applicable codes and standards.
2. Three (3) sets of approval package / drawings are to be retained by the Code Official. One (1) each for mechanical, electrical and fire inspection groups. Submit additional sets as required above and beyond code official sets for client approval process.

D. Approved Documents:

1. Construction documents approved by the code official are approved with the intent that such construction documents comply in all respects with the building code. Review and approval by the code official does not relieve the supplier of the responsibility of compliance with the building code.

E. Corrected Documents:

1. Where field conditions necessitate any substantial change from the approved construction documents, the code official has the authority to require the corrected construction documents to be submitted for approval.

F. Retention of Construction Documents:

1. One set of construction documents is to be retained by the code official until final approval of the work covered therein.
2. One set of approved construction documents is to be returned to the supplier, and said set shall be kept on the site of the building or work at all times during which the work authorized thereby is in progress.

G. Product Data:

1. Submit manufacturer's product data for system components; highlighted specific data is required.

H. Wiring Diagrams:

1. Submit system wiring diagrams differentiating between factory and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Indicate components for both field and factory wiring.
2. Submit wiring diagrams that include all interconnections between components, control panels, and other system interfaces and devices. Include control panel wiring details.

I. Piping Diagrams:

1. Submit system piping diagrams differentiating between factory and field installed piping. Include diagrams for equipment and for system with all interconnections identified. Indicate components for both field and factory piping.
2. Piping diagrams including all interconnections between components, control panels, and other system interfaces and include piping riser details.

J. Operation and Maintenance Data:

1. Submit system operation description covering this specific Project including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
2. Submit operating instructions for mounting at each control panel.
3. Submit operation and maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1. Include data for each type product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.

K. Product Certification:

1. Submit product certification signed by the manufacturer of the system components certifying that their products comply with indicated requirements and meet approvals.

L. Code Compliance Safety Certification Documentation:

1. Submit Code Compliance documentation; itemizing all building code references for design justification. Include Code Compliant Hazard Evaluation forms filled in for each zone monitored.
2. At a minimum include the following: Air Flow Profile Report for each sample point location, Calibration Report with before and after results of each analyzer, Alarm / Interface Report stating all field devices interlocked to system; manufacturer and model number, threshold levels, alarm and interface action at each level of alarm with field verification report, Safety Training Checklist with action procedures in alarm situation, SCBA Training Checklist (where applicable) and List of all owner attendees for each training session. Utilize this information in “Permanent Site Records” manual provided in this specification.

1.5 QUALITY ASSURANCE

A. Codes and Standards:

1. Applicable Codes. Provide system that meets or exceeds the latest applicable, International Building Code, International Fire Code, International Mechanical Code, NFPA, NGDA, ASHRAE Standard 2001, and EPA standard CFR. Provide a system that incorporates all latest revisions to bring it up to current standards.

B. Manufacturing / System Supplier Qualifications:

1. Code Compliant Supplier. Employ a refrigerant gas detection system supplier that is a firm regularly engaged in supplying Code Compliant refrigerant gas detection systems. Provide a system that has been approved by the AHJ. Provide a system that has been in similar service for not less than five (5) years. Employ a supplier that is familiar with current International Building and Fire Code requirements and installation of Code Compliant refrigerant gas vapor detection systems.
2. Liability. The specification provided for this system is a performance specification. Gas Detection Safety System Turnkey Supplier / Installer is to take full liability and responsibility for proper detail design and supply of a current Building Code Compliant as detection and emergency alarm / shutdown system. This is a Life Safety system. System may not be shown in full detail on drawings, supplier is to take full responsibility to provide detailed design to current Building Codes. Supply the system as "Package Equipment".
3. Provide system design, fabrication, installation, supervision, service, and training for gas detection system specified.
4. Permits. Provide proper building and electrical installation permits with local Fire Marshall for Gas Detection System and work through necessary building code inspectors to supply an approved code compliant system. Provide a system that complies with current applicable codes as indicated.

1.6 WARRANTY

A. Refer to Section 230000.

PART 2 - PRODUCTS

2.1 SAFETY SYSTEM SUPPLIER

A. Provide turnkey refrigerant monitoring system including design, fabrication and installation from one of the following:

1. Ino-Tek,
2. Hall & Associates,
3. P.I.D. Engineering, Inc.,

B. Subject to compliance with requirements, provide refrigerant gas detection analyzer components from one of the following:

1. Mine Safety Appliance
2. O.I. Analytical
3. Genesis
4. Safe-Aire Equipment

C. Deviations from Specification

1. Deviation from specified products or qualifications must be clearly spelled out and itemized by specification, section and number, clearly described in detail as to specific deviation, reason for deviation, benefit derived to Owner from deviation, and must be approved prior to contractors bid proposal.

2.2 GENERAL

A. Design and provide a refrigerant monitoring system related to the chiller mechanical room, in accordance with applicable code sections referring to mechanical refrigeration, emergency and standby power systems, emergency alarm systems, hazardous materials – general provisions governed by the International Fire Code (IFC). Incorporate related system design criteria established by DOL 29 CFR; 1910.1000 – 74 and 1910.1200 – 74.

B. Provide a series of detection points located in areas where refrigerant from a leak is likely to accumulate and / or be sensed. Include infrared sensor(s), analyzer, sequencer and interface control panels(s), filters, sensors, alarm signaling devices, self contained breathing apparatus', piping and all components necessary for a complete operational system.

C. Provide various stages of alarming and control chiller room mechanical ventilation in accordance with sequence of operation at values not to exceed specified TLV. Provide the system capable of detecting the presence of the refrigerants(s) actually used on this project and capable of detecting, indicating, alarming, shutting down equipment, interfacing to building automation, fire and security systems, as specified below, on contract documents, and per applicable codes, standards, and regulations.

D. Under circumstances directed by regulations for mechanical equipment room design, for refrigerants requiring LEL monitoring below 4% by volume, employ the appropriate sensing technology and conform to Class 1, Division 2, NFPA 70 requirements. When refrigerant groups A2, A3, B2 other than NH3, and B3 are used, follow appropriate guidelines indicated in regulations concerning area classification and equipment requirements.

E. Employ multi-point monitoring to provide minimum two (2) points of area sampling per chiller for base bid with line item price to add additional sensors as required by NGDA approved smoke testing methods. Additionally, provide monitoring for any pit or grated floor basement areas located in chiller mechanical room. For diluted samples due to ventilation airflow currents, employ multi-point monitoring techniques strategically located according to regulation guidelines and applicable airflow profiling. Incorporate leak detection monitoring sensing locations for early warning indication to prevent a major loss of refrigerant and to minimize owners risk to EPA mandated accidental refrigerant release fines and penalties. Where multiple refrigerant types are used, it is system supplier’s responsibility to properly select quantity and type of refrigerant detectors and / or multi-point sequential sampling systems required to safely monitor equipment room. Provide components and system safety and interface logic as outlined following without exception. Provide number of sampling points as indicated on plans with 20% spare sample point capability on analyzer and expansion module.

F. Provide a refrigerant monitoring system that complies with requirements of the IFC and, except as modified by IFC, ASHRAE 15.

G. Classify refrigerants in accordance with ASHRAE 34 and International Mechanical Code. For refrigerant blends assigned dual classifications, as formulated and for the worst case of fractionation, use the classification for the worst case of fractionation.

H. Classify refrigeration systems according to degree of probability that refrigerant leaked from failed connection, seal or component could enter an occupied area. Distinction is based on basic design or location of components.

1. Low-probability systems: Classify double-indirect open-spray systems, indirect closed systems and indirect-vented closed systems as low-probability systems, provided all refrigerant-containing piping and fittings are isolated when quantities in code are exceeded.
2. High-probability systems. Classify direct systems and indirect open-spray systems as high-probability systems.

I. Maintain a written record of required testing on premises. Persons trained and qualified in refrigeration systems shall conduct tests of emergency devices or systems required by code. Emergency devices or systems which shall be periodically tested in accordance with manufacture's instructions and as required by code official include fans and associated equipment intended to operate emergency pure ventilation systems and detection and alarm systems.

J. Provide for the chiller mechanical room a refrigerant detector with an audible and visual alarm inside the room and outside each entrance to the room. Locate the detector, or sampling tube that draws air to detector in area where refrigerant from leak will concentrate. Provide for the alarm to be actuated at a value not greater than corresponding TLV-TWA values shown in International Mechanical Code for refrigerant classification. Provide alarms with manual reset. Place detectors and alarms in approved locations. Clearly mark meaning of each alarm by signage near annunciators. Locate visual display of refrigerant concentration outside of area being monitored. Detectors are not required for ammonia systems when machinery room complies with International Mechanical Code.

K. Where any device having an open flame or surface temperature greater than 800 degrees F, is used in a room containing more than 6.6 pounds of refrigerant in an independent circuit, provide a refrigerant detector to automatically shut off the combustion process in the event of a refrigerant leak.

L. Upon actuation of refrigerant detector, provide for the mechanical ventilation system to exhaust air from the chiller mechanical room at ventilation rate as defined in code.

M. Machinery room special requirements. Group A2, B2, A3 and B3 refrigerants must also comply with following.

1. Where quantity of any Group A2, B2, A3 or B3 refrigerant in a single independent circuit would exceed 25 percent of LFL upon release to space, provide all electrical equipment and appliances in conformance with Class 1, Division 2, hazardous location classification requirements of NFPA 70.
2. Provide remote control of mechanical equipment and appliances located in the chiller mechanical room at an approved location immediately outside the room and adjacent to its principal entrance.

a. Refrigeration system. A clearly identified switch of break-glass type to provide off-only control of all electrically energized equipment and appliances in machinery room, other than refrigerant leak detectors and machinery room ventilation.
b. Ventilation system. A clearly identified switch of break-glass type to provide on-only control of machinery room ventilation fans.
c. Emergency control box. Provide emergency control boxes for refrigeration systems required to be equipped with a treatment system, flaring system or ammonia diffusion system. See code for location, construction, operational and identification procedures.

N. Provide emergency shutdown interlocks, monitoring system interlocks and control interlocks shall be provided as defined in the code.

O. Where alarm and detection systems are required, connect such systems to an emergency electrical system or provided with a standby power system in accordance with code.

P. Supervise alarm and detection systems required by an approved central, proprietary or remote station service or initiate an audible and visual signal at a constantly attended on-site location as defined by the AHJ. Provide the necessary fire alarm panel hardware for interlocks, fire system programming, landing of interlock wires, commissioning assistance, etc. as required making a complete operating system under Division 16 / 26.

2.3 CONTROL PANEL AND CONTROL PANEL EQUIPMENT

A. Provide NEMA 3R infrared sensor / transmitter in wall mount enclosure. Mount sensor on uni-strut bracket at each chiller as noted above and on the Drawings. Sensor to provide 90% response in 120 seconds or less and employ infrared sensor gas cell technology, to provide sensing down to one (1) part per million (ppm) and be compound specific and calibrated for refrigerant as specified below or required per chiller manufacturer's requirement. Provide the analyzer with the capability to be switched to monitor, at a future date, another refrigerant type by changing one part and recalibration. (i.e. CFC-11 to HCFC-123, etc.) Provide controller with menu driven microprocessor based electronics and user-friendly programming allowing operator to select alarm set points and latched or unlatched alarms. Provide the first level warning alarm to comply with recommended AEL of 10 ppm +/- 1 ppm. Panel display to show concentration levels from all sample points simultaneously. Controller outputs available: Common Alarm Level 1, 2, and 3 contacts with indication provided by zone, malfunction, and 4-20 madc analog signals of refrigerant level available. Provide required input contacts for interface to Fire Alarm Control Panel and BMS as specified. Contact rating: 240 vac, 5-amp resistive or 2 amp inductive. Unit to be insensitive to vibration. Malfunction relay to be de-energized on sensor failure or malfunction alarm. Provide all sample points with individual alarm setpoint adjustment capability. Include display with text description of area / point in alarm, alarm level, concentration and resulting interlock action. Provide system alarm and interface logic to be microprocessor based and programmable with re-wiring not required to make system logic changes. Provide system interlocks with interface relays where required, alarm reset with remote capability, alarm test, trouble relay, etc. as outlined below and on the Drawings. Provide all control system interlocks and logic in local control panel. Provide Safe-Aire SafeGARD, Drager, MSA.

B. Photoacoustic and electrochemical sensing technology employing short-term life sensors, which deplete as a normal part of their operation or storage shelf life, shall not be acceptable.

C. Configure system to provide additional dry contact alarm contacts and output signals for control or for interface as follows, noted on the Drawings and specified in the code:

1. Interface to 24 hour supervised area through FACP as required by code. Include contacts for interface as supervisory alarms, trouble alarms and fire alarms as directed by local AHJ.
2. BMS maintenance dry alarm contact, AEL level; low leak warning dry alarm (first level) contact, TLV - TWA level; high level danger dry alarm (second level) contact.
3. (1) 4-20 madc process concentration signal for each channel.
4. Direct interlock to purge air supply and exhaust fan starter control circuit. Purge Mode.
5. Direct interlock to Purge Mode damper controls.
6. Direct interlock to shut down combustion equipment located in chiller room.

D. Provide alarms at the AEL and TLV-TWA level, and for malfunction. At the AEL level, the system is to actuate the warning amber beacon and the audible horn. At the TLV-TWA level, the system is to activate the purge ventilation system, energize the red beacon, sound the refrigerant leak audible alarm, and shut down area combustion equipment. If a system malfunction occurs, energize a blue beacon and audible alarm at locations in zone in alarm and at interface panel. Provide dry alarm contacts for each alarm level for interface to BMS. Provide all control system interlocks and logic in control panel. Where indicated, use third level contacts to initiate area ventilation prior to TLV level to prevent shutdown of combustion equipment. Analyzer display is to indicate which channel is in alarm.

1. First level RMS alarm; (adjustable) PPM.

   a. Amber beacon and horn at main panel, floor panel and in zone.
   b. Dry contact for Fire Alarm Supervisory Input.
   c. Dry contact for indication to building energy management system.

2. Danger level RMS alarm; (adjustable) PPM.

   a. Red beacon and horn at main panel, floor panel and in zone.
   b. Dry contact for Fire Alarm – Supervisory Input.
   c. Dry contact for indication to building energy management system.

3. Common Malfunction RMS alarm.

   a. Blue beacon and horn at main panel, floor panel and in zone.
   b. Dry contact for Fire Alarm – Trouble Input.
   c. Dry contact for indication to building energy management system.

E. Upon system reset, deactivate alarm beacons only if area monitored has returned to safe condition. Maintain purge ventilation system activated for 30 minutes after alarm condition has cleared. Panel-mounted indicator is to denote that purge ventilation system

is still activated. Provide a manual selector switch for "Auto - Manual On" purge fan control

F. Provide push button reset switch on front of interface control panel to acknowledge and silence or reset self-latching alarm circuit. Alarm beacons and horns are to remain on until system is reset from panel face or from remote reset pushbutton. Alarms are to stay latched to prevent them from automatically resetting when toxic condition goes away.

G. Provide push button switch inside interface control panel to test alarm circuitry and panel indicators. During test function, output signals to BMS, FACP, and combustion shutdown shall be disabled.

H. Provide malfunction relay outputs as required for system interface to FACP and BMS. Relay(s) are to be energized in normal operation, de-energized due to malfunction at any channel.

I. Provide panel indication for power on, zone alarm status, alarm status for relief vent alarms (where applicable) and purge fan status.

J. Provide terminals for dedicated 115 vac, 60 Hz. input power supply. Power all alarm warning devices and system components from this panel circuit. Provide all remote field devices associated with this system to be 120 vac or as indicated.

K. Provide battery back up system to meet Michigan / International Building Code requirements for emergency alarm systems back up power supply system; including sizing for load with duration of back up per code. Provide load calculation information in submittal data and for permanent site records. Interface status contacts to fire alarm system per building code requirements.

L. Provide "Lamacoid" tag, red background with 1/2" high white letters at each remote visual and audible device. Anchor tag to wall adjacent to wall mounted devices, suspend with brass security chain adjacent to ceiling mounted devices.

M. Inscribe tags located inside and outside mechanical room as follows:

N. DANGER - REFRIGERANT R-_____

O. BLUE - MALFUNCTION.

P. AMBER - WARNING ALARM

Q. RED - DANGER ALARM.

R. UNSAFE TO ENTER ROOM WITHOUT PROPER BREATHING APPARATUS.

S. BREATHING APPARATUS'S FOR THIS AREA ARE LOCATED _____.

T. REMOTE RESET PUSHBUTTON FOR THIS AREA IS LOCATED _____.

U. NOTIFY BUILDING ENGINEER OR SECURITY IMMEDIATELY UPON INDICATION OF ANY ALARM.

V. Tags located near horn inside mechanical room shall be inscribed as follows:

1. DANGER - REFRIGERANT R-_____
2. LEAVE ROOM IMMEDIATELY IF HORN SOUNDS.

3. NOTIFY BUILDING ENGINEER OR SECURITY IMMEDIATELY UPON INDICATION OF ANY ALARM.

W. Balance of tag information to comply with code requirements and provide emergency action required upon entering or leaving the premises. Indicate on tag location of SCBA and remote reset pushbuttons. Provide all tag information.

X. Provide alarm horns and beacons equal to Edwards Triliptical inside of each area being monitored and at each entrance into each area being monitored and where indicated on drawings. Beacons are to be strobe, three colors; blue, amber, and red in mechanical room; amber and red at all entrances into mechanical room and outdoors or as indicated on the Drawings. Locate alarm beacons inside each mechanical room in clear view in event of alarm. Provide quantity of devices inside each mechanical room as required so that there is no area without warning indication. Provide devices located outdoors NEMA 4 rated. Where pilot lights are used for annunciation purposes use Allen - Bradley; push-to-test or equal. Provide beacons and horns located in public areas that are decorative, flush wall mount type and match room décor of area as much as possible.

Y. Provide minimum (1) remote reset pushbutton assembly at or near main entrance to mechanical room and additional where indicated on the drawings to allow reset / silence from safe location. Signs at remote reset assembly to denote "safe and unsafe" response action relating to local beacons and entrance to monitored area upon depressing remote reset pushbutton. Upon reset, if the area monitored has been purged to a safe level the beacons are to be deactivated and safe entry shall be permitted.

Z. Provide an emergency ventilation switch as noted per code requirements.

AA. Provide (2) self contained breathing apparatus with wall mount case and manufacturer training, minimum of eight (8) hours of instruction to Owner's personnel in proper use, maintenance, and re-charging. Schedule training in advance with Owner. Provide SCBA approved for use in an IDLH environment by MSHA and NIOSH. Components to include air cylinder, harness frame assembly, face piece, positive pressure regulator, PRV, pressure gauge. Provide SCBA with a minimum 30 minute rating and be suitable for gases present. Include manufacturers 5-year full warranty and 15 year regulator warranty. Provide a wall mounted unit near sampled area with identification tags showing SCBA location if other than adjacent area entrances. Provide Scott Air Pak, Drager, or owner approved equal.

BB. Provide "Lamacoid" tag above carrying case, yellow background with 3" high black letters inscribed: SELF CONTAINED BREATHING APPARATUS.

CC. Provide quantity and location of sensors based on the supplied Airflow Profile Test Report. Provide accurate airflow profile testing and report with ventilation system operating under normal and operating under alarm conditions. Document recommended locations and quantities of sensors for code inspector approval (see installation, testing and acceptance procedures below). Sensor locations and quantities shown on drawings or indicated in specifications are for reference purposes only and represent at best a minimum quantity of sensors required for this project. After approved review of simulated airflow test by Fire Marshall and project engineer, provide quantity of sensors deemed necessary by AHJ. Provide base bid with (2) sensors per chiller and as noted above. Provide price per additional sensor(s) based on requirements of airflow profile testing and Fire Marshall approved quantities.

DD. Employ sequential sampling and multi point monitoring to provide minimum two (2) points of area sampling for each chiller. Provide monitoring for any pit, basement or stairwell areas below main floor area levels located in the chiller mechanical room. Where multiple refrigerant types are used, properly select quantity and type of refrigerant detectors and multi-point sequential sampling systems required to safely monitor equipment and / or cold rooms. Sample locations indicated on drawings are approximate and are to be field verified with airflow profile tests. Turn airflow profile tests over to owner as part of safety certification documentation. Determine final location of sample points when HVAC or Mechanical Contractor can simulate actual occupied ventilation conditions and be installed after all chiller mechanical room ventilation systems and equipment have been installed, and properly balanced. Insure that enough sample points exist to properly monitor air samples both under normal ventilation conditions and under purge ventilation conditions. Air profile test is to indicate airflow pattern prior to alarm and after alarm to insure that safe monitoring exists under both conditions.

2.4 CALIBRATION GAS AND HARDWARE

A. Provide all necessary calibration gas and hardware for two years operation in a portable case. Turn over to owner after successful system start up.

2.5 CONTROL CABLE

A. Provide control wiring as specified in Division 26.

2.6 SOURCE QUALITY CONTROL

A. SCBA: Tested and certified by NIOSH and MSHA, according to 42 CFR 84, Subpart H.

B. Refrigerant Monitor: Factory tested and certified.

PART 3 -EXECUTION

3.1 INSTALLATION

A. Provide for necessary installation permits. Install control panels and electrical field devices in accordance with applicable codes and manufacturer's printed instructions. Install conduit and wire for all interlocks to each remote system. Make final electrical terminations. Install in accordance with division 16 / 26 installation practices and applicable code requirements.

B. Make final determination of sensor quantity and location after ventilation system is operating. Provide Gas Leak Simulation Test method that emulates actual properties of gases present to prove that gaseous vapor will come into contact with proposed sensor locations under normal ventilation conditions. I.e. heavier than air, lighter than air, etc. Local Fire Marshall and owner’s representative are to witness and sign off on these tests. After approved review of simulated airflow test by Fire Marshall and project engineer, provide quantity of sensors necessary to properly monitor proposed areas.

C. Install equipment in accordance with applicable codes and manufacturer's printed instructions.

D. Route conduits as required making neat and operating system.

3.2 TESTING AND ACCEPTANCE

A. General:

1. Prior to project completion and when directed by Owner's Representative, provide a manufacturer factory trained representative to program, start up, thoroughly test and calibrate, set alarm threshold levels, and verify that system is in compliance with operational sequence and code requirements. Should corrections be required to any system, and after corrections have been completed, re-test the system.
2. Fire Marshall and owner representative are to witness system operation performance test, subject to final on-site field inspection and full alarm system test witnessed by the Municipality. Provide a minimum of two alarm system personnel, a pair of two-way radios and all necessary equipment to provide complete testing of each alarm system device.
3. Provide Gas Leak Simulation Test that emulates actual properties of hazards present to prove gas will come into contact with proposed sensor locations under actual ventilation conditions. Local AHJ, Fire Marshall and owner representative to witness test and sign off.
4. Provide certification to Municipality that system is installed per manufacturers requirements, Michigan Building Code and International Fire Code.
5. Provide training of Owner personnel on both system operation and routine maintenance procedures. Provide training for all devices in the system outlined above. Provide three (3) complete operations and maintenance manuals in 3-ring binders, including parts list and as-built drawings.
6. Provide training for persons responsible for the operation of areas in which hazardous materials are stored, dispensed, handled or used. Train the responsible person specifically to relate pertinent data from system, as liaison to the fire department. Training to include site system specific written emergency response procedures.
7. After system acceptance, provide building safety manager with “Permanent Site Records Manual” for this system to be maintained on site for Fire Department/Marshall accessibility. Include “As Built” system drawings, calibration reports, AOA reports, service records, emergency power system load calculation data, airflow profile testing data, code compliant system design data and justification information, code references, sequence of operation matrix, etc. and any additional information as required by the AHJ.
8. Tests to be witnessed by Owner or his designated representative and a letter submitted certifying system performance and code compliance conformance.
9. Provide training of plant personnel on both system operation and routine maintenance procedures. Provide a minimum of eight (8) hours training. Include all devices in the system outlined above. Provide (3) complete operations and maintenance manuals in 3 - ring binders.

B. Code Compliance Certification:

1. Provide Owner and Municipality with a certified document stating that alarm systems are installed in compliance with all MBC/IFC and NFPA codes and standards and that all required acceptance tests have been completed. Mount approved inspection certificate at main control panel location.

C. As Built Drawings:

1. Correct deviations from original shop and installation submittal drawings and submit in operations and maintenance manuals as "As Built" drawings.

2. Submit as-built alarm shop drawings for final review of AHJ / Fire Marshall. Show all field changes on the as-built drawings.

3.3 INSPECTION AND SERVICING

A. On Site Service:

1. Each three (3) months, per code requirements, after final acceptance until warranty expires, systematically inspect, examine, clean and adjust, detector, panels, relays, self-contained breathing apparatus, and accessories pertaining to system. Provide updated reports for AHJ on site records.
2. During the warranty period, provide code required annual certification inspection and operation testing. Mount updated approved certificate at main control panel location. Include, but not limited to, emergency power supply testing, ventilation interlock operation, interlocks to 24 hour supervised station, alarm signaling device operation, etc. and all interface operation as required per governing code. Provide updated certification reports to owner and municipal AHJ.

B. Permanent Site Records:

1. After each inspection furnish Owner with written report certifying that work has been accomplished with results. Provide updated Permanent Site Record documentation to owner including following: Inspection Report, Calibration Report with before and after results of each analyzer, Alarm / Interface Report stating all threshold levels, alarm and interface action at each level of alarm with field verification report, any additional Safety Training with Checklist and List of all owner attendees.
2. Near end of warranty period of operation, provide similar service as described above complete with written report. Should a control or device be suspect in its operation or function, report this deficiency to operating personnel, document in report and replace.

END OF SECTION 283500

General Decision Number: DC100004 07/08/2011 DC4

Superseded General Decision Number: DC20080004

State: District of Columbia

Construction Type: Building

County: District of Columbia Statewide.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Modification Number	Publication Date
0	03/12/2010
1	03/19/2010
2	06/11/2010
3	07/09/2010
4	07/23/2010
5	08/20/2010
6	09/24/2010
7	11/05/2010
8	11/26/2010
9	12/10/2010
10	12/24/2010
11	01/07/2011
12	01/21/2011
13	04/15/2011
14	05/06/2011
15	05/27/2011
16	06/03/2011
17	07/01/2011
18	07/08/2011

ASBE0024-007 10/01/2009

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 30.43	14.43

Includes the application of all insulating materials, protective coverings, coatings and finishes to all types of mechanical systems

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ASBE0024-008 10/01/2009

	Rates	Fringes
ASBESTOS WORKER: HAZARDOUS MATERIAL HANDLER (REMOVAL FROM MECHANICAL SYSTEMS, WHICH WILL NOT BE REPLACED OR SCRAPPED)	$ 18.85	7.10

BRDC0001-002 05/03/2010

	Rates	Fringes
BRICKLAYER	$ 27.21	7.21

CARP0132-008 05/01/2010

	Rates	Fringes

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CARPENTER, Includes Drywall
Hanging, Formsetting, and
Soft Floor (Carpet)
Installation.....................$ 26.38             7.00
PILEDRIVERMAN....................$ 24.48             7.80
-----------------------------------------------------------------
 CARP1831-002 04/01/2010

                                  Rates          Fringes

MILLWRIGHT.......................$ 27.91            10.90
-----------------------------------------------------------------
* ELEC0026-016 06/01/2011

                                  Rates          Fringes

ELECTRICIAN, Including HVAC
Temperature Control
Installation.....................$ 39.75            11.09
-----------------------------------------------------------------
 ELEC0026-017 09/01/2008

                                  Rates          Fringes

ELECTRICIAN: COMMUNICATION
TECHNICIAN.......................$ 24.25          3%+6.87

  SCOPE OF WORK: Includes low voltage construction,
  installation, maintenance and removal of teledata
  facilities (voice, data and video) including outside plant,
  telephone and data inside wire, interconnect, terminal
  equipment, central offices, PABX, fiber optic cable and
  equipment, railroad communications, micro waves, VSAT,
  bypass, CATV, WAN (Wide area networks), LAN (Local area
  networks) and ISDN (Integrated systems digital network).

  WORK EXCLUDED: The installation of computer systems in
  industrial applications such as assembly lines, robotics
  and computer controller manufacturing systems.  The
  installation of conduit and/or raceways shall be installed
  by Inside Wiremen. On sites where there is no Inside
  Wireman employed, the Teledata Technician may install
  raceway or conduit not greater than 10 feet. Fire alarm
  work is excluded on all new construction sites or wherever
  the fire alarm system is installed in conduit.  All HVAC
  control work.
-----------------------------------------------------------------
 ELEV0010-001 01/01/2011

                                  Rates          Fringes

ELEVATOR MECHANIC................$ 38.55       21.785+a+b

  a. PAID HOLIDAYS: New Year's Day, Memorial Day, Independence
  Day, Labor Day, Veterans' Day, Thanksgiving Day, Christmas
  Day and the Friday after Thanksgiving.

  b. VACATIONS: Employer contributes 8% of basic hourly rate
  for 5 years or more of service; 6% of basic hourly rate for
  6 months to 5 years of service as vacation pay credit.
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 IRON0005-005 06/01/2009

                                  Rates          Fringes

IRONWORKER, STRUCTURAL AND
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ORNAMENTAL.....$ 28.83 13.295

IRON0201-006 05/01/2009

	Rates	Fringes
IRONWORKER, REINFORCING.....	$ 25.20	14.33

LABO0657-015 06/01/2010

	Rates	Fringes
LABORER: Skilled.....	$ 20.71	5.97

FOOTNOTE: Potmen, power tool operator, small machine operator, signalmen, laser beam operator, waterproofer, open caisson, test pit, underpinnig, pier hole and ditches, laggers and all work associated with lagging that is not expressly stated, strippers, operator of hand derricks, vibrator operators, pipe layers, or tile layers, operators of jackhammers, paving breakers, spaders or any machine that does the same general type of work, carpenter tenders, scaffold builders, operators of towmasters, scootcretes, buggymobiles and other machines of similar character, operators of tampers and rammers and other machines that do the same general type of work, whether powered by air, electric or gasoline, builders of trestle scaffolds over one tier high and sand blasters, power and chain saw operators used in clearing, installers of well points, wagon drill operators, acetylene burners and licensed powdermen, stake jumper, structural demolition.

MARB0002-004 05/01/2011

	Rates	Fringes
MARBLE/STONE MASON.....	$ 32.88	13.99

INCLUDING pointing, caulking and cleaning of All types of masonry, brick, stone and cement EXCEPT pointing, caulking, cleaning of existing masonry, brick, stone and cement (restoration work)

MARB0003-006 05/01/2010

	Rates	Fringes
TERRAZZO WORKER/SETTER.....	$ 26.04	9.59

MARB0003-007 05/01/2010

	Rates	Fringes
TERRAZZO FINISHER.....	$ 20.48	8.44

MARB0003-008 05/01/2010

	Rates	Fringes
TILE SETTER.....	$ 25.29	9.59

MARB0003-009 05/01/2010

	Rates	Fringes
TILE FINISHER.....	$ 20.48	8.44

PAIN0051-014 06/01/2010

	Rates	Fringes
GLAZIER		
Glazing Contracts $2 million and under	$ 24.57	8.31
Glazing Contracts over $2 million	$ 27.29	8.31

PAIN0051-015 06/01/2010

	Rates	Fringes
PAINTER		
Brush, Roller, Spray and Drywall Finisher	$ 24.64	7.86

PLAS0891-005 07/01/2009

	Rates	Fringes
PLASTERER	$ 27.00	5.82

PLAS0891-006 05/01/2010

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 27.15	9.58

PLAS0891-007 07/01/2009

	Rates	Fringes
FIREPROOFER		
Handler	$ 11.50	3.89
Mixer/Pump	$ 14.00	3.89
Sprayer	$ 19.00	3.89

Spraying of all Fireproofing materials. Hand application of Fireproofing materials. This includes wet or dry, hard or soft. Intumescent fireproofing and refraction work, including, but not limited to, all steel beams, columns, metal decks, vessels, floors, roofs, where ever fireproofing is required. Plus any installation of thermal and acoustical insulation. All that encompasses setting up for Fireproofing, and taken down. Removal of fireproofing materials and protection. Mixing of all materials either by hand or machine following manufactures standards.

PLUM0005-008 08/01/2010

	Rates	Fringes
PLUMBER		
Apartment Buildings over 4 stories (except hotels)	$ 22.66	9.36+a
ALL Other Work	$ 37.67	14.69+a

a. PAID HOLIDAYS: Labor Day, Veterans' Day, Thanksgiving Day and the day after Thanksgiving, Christmas Day, New Year's Day, Martin Luther King's Birthday, Memorial Day and the Fourth of July.

PLUM0602-008 11/01/2010

	Rates	Fringes
PIPEFITTER, Including HVAC Pipe Installation	$ 36.87	16.72+a

a. PAID HOLIDAYS: New Year's Day, Martin Luther King's Birthday, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day and the day after Thanksgiving and Christmas Day.

ROOF0030-016 05/01/2009

	Rates	Fringes
ROOFER	$ 25.80	8.26

SFDC0669-002 04/01/2011

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers)	$ 29.95	17.00

SHEE0100-015 07/01/2011

	Rates	Fringes
SHEET METAL WORKER (Including HVAC Duct Installation)	$ 37.09	13.61

SUDC2009-003 05/19/2009

	Rates	Fringes
LABORER: Common or General	$ 13.04	2.80
LABORER: Mason Tender - Cement/Concrete	$ 15.40	2.85
LABORER: Mason Tender for pointing, caulking, cleaning of existing masonry, brick, stone and cement structures (restoration work); excludes pointing, caulking and cleaning of new or replacement masonry, brick, stone and cement	$ 11.67	
POINTER, CAULKER, CLEANER, Includes pointing, caulking, cleaning of existing masonry, brick, stone and cement structures (restoration work); excludes pointing, caulking, cleaning of new or replacement masonry, brick, stone or cement	$ 18.88	

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(ii)).

In the listing above, the "SU" designation means that rates listed under the identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

Government of the District of Columbia

STANDARD CONTRACT PROVISIONS

For Use With
Specifications for
District of Columbia Government
Construction Projects
(Revised March 2011)

PLEASE RETAIN FOR YOUR REFERENCE

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ARTICLE 1. QUALIFICATIONS OF BIDDERS—Bidders shall have the capability to perform classes of work contemplated, have the necessary plant and sufficient capital to execute the work properly within specified time.

Any Bidder who has not performed comparable work for the District within the last 5 years shall submit, at the Contracting Officer's discretion, a certified statement of his organization, plant, manpower, financial resources, and construction experience that he considers will qualify him for proposed contract. This information shall be certified by a Certified Public Accountant for contracts over $25,000 and submitted on the AGC Form "Standard Questionnaires and Financial Statement for Bidders", obtainable from the Associated General Contractors of America, Inc.., at 1957 "B" Street, N. W., Washington, D. C., 20008, or on an approved equivalent form. This requirement is not needed if the bidder has submitted such a statement to the District within a year prior to bid opening date, but will be required if bidder has previously submitted such a statement under-one company name or organization or joint venture and is now bidding under another company name or organization or joint venture. A certified statement of prequalification approval by another jurisdiction may be considered as an alternative to foregoing procedure. A bidder shall submit a supplemental statement if requested by the District.

ARTICLE 2. BID DOCUMENTS—The Specifications (including all documents referenced therein and all documents attached thereto), drawings and addenda which form the basis of any bid shall be considered as part thereof and will form part of the bid. Copies of these documents will be furnished to or made available for the inspection of prospective bidders by that office indicated in the advertisement or invitation.

ARTICLE 3. EXAMINATION OF BID DOCUMENTS AND SITE OF WORK—Each Bidder shall carefully examine the site of the proposed work and the bid documents and fully acquaint himself with conditions relating to construction and labor so that he may fully understand the facilities, difficulties and restrictions attending the execution of the work under the bid documents, and he shall judge for and satisfy himself as to conditions to be encountered affecting the character, quality and quantity of the work to be performed and materials to be furnished arid to the requirements of the bid documents. Failure to do so will be at the Bidder's own risk and shall not relieve him from any obligation under his bid or contract.

ARTICLE 4. PREPARATION FOR BIDS—The bid form furnished in the bid proposal and specifications shall be used in strict compliance with the requirements of the Invitation and Supplemental Instructions to Bidders in the specifications. Special care shall be exercised in the preparation of bids. Bidders must make their own estimates of the facilities and difficulties to be anticipated upon execution of the contract, including local conditions, uncertainty of weather and all other contingencies. All designations and prices shall be fully and clearly set forth in the bid submission. ALL PRICES SHALL BE INSERTED IN FIGURES TYPED OR PRINTED LEGIBLY ON THE BID FORM. All corrections on the bid documents must be initialed by the person signing the bid form.

ARTICLE 5. ERROR IN BIDS—Bidders or their authorized agents are expected to examine all bid documents and any addenda thereto, and all other instructions pertaining to the work which will be open to their inspection. Failure to do so will be at the bidder's own risk, and will not constitute reason for relief on plea of error in the bid. IN CASE OF ERROR IN THE EXTENSION OF PRICES IN THE BID, UNIT PRICES WILL GOVERN.

The bidder must submit his plea of error in writing to the Contracting Officer and must be prepared to document and prove his error.

ARTICLE 6. LABOR AND MATERIAL NOT FURNISHED BY DISTRICT—The District will not furnish any labor, material or supplies unless a provision to do so is included in the contract documents.

ARTICLE 7. ADDENDA AND INTERPRETATIONS—No oral interpretations of the meaning of the drawings, specifications or other bid documents will be made to any bidder. Verbal clarification will not be binding on the District. All requests must be in writing and addressed to the Contracting Officer responsible for administering the contract. Requests for interpretations of bid documents must be received by the Contracting Officer not later than 10 days prior to bid opening date. All changes to the bid documents will be made by addenda mailed to all prospective bidders, who have obtained copies of the bid documents, not later than 7 days before bid opening date. In case of discrepancy among addenda, a later dated addendum has priority over earlier dated addenda. It shall be the bidder's responsibility to make inquiry as to any or all addenda issued, and failure of any prospective bidder to receive any such addenda issued by the Contracting Officer shall not relieve the bidder from any obligation under his bid as submitted. Bidders must acknowledge receipt of all addenda on the Bid Form; failure to do so may result in rejection of bid.. All addenda issued shall become part of the bid and contract documents. -

ARTICLE 8. ALTERNATE BIDS—Alternate bids will not be considered unless called for in the Bid Form.

ARTICLE 9. BIDS FOR ALL OR PART—Where bids are not qualified by specific limitations, the District reserves the right to award all or any of the items according to its best interests.

ARTICLE 10. PRICE SCHEDULE INTERPRETATION—Quantities appearing in the Price Schedule are approximate only and are prepared for the comparison of bids. Payment will be made only for actual material requirements accepted and for work performed and accepted. Schedule quantities may be increased., decreased or omitted and there shall be no adjustment in contract unit prices except as provided, and except for such materials actually purchased or work actually performed prior to notification of the change in items affected.

The price for any item, unless otherwise specified, shall include full compensation for all materials, tests, samples, manufacturers' guaranties, tools, equipment, labor and incidental work needed to complete specified items. Prices without exception shall be net, not subject to discount, and shall include all royalties and costs arising from patents, proprietary items, trademarks and copyrights.

ARTICLE 11. CORRECTIONS—Erasures and other changes in bids must be explained or noted over the signature of the bidder.

ARTICLE 12. BOND REQUIREMENTS

A. BID GUARANTY—On all bids of $100,000.00 or more, security is required to insure the execution of the contract. No bid will be considered unless it is so guaranteed. Each bidder must furnish with his bid either a Bid Bond (Form No. DC 2640-5), with good and sufficient sureties, a certified check payable to the order of the Treasurer of the District of Columbia (uncertified check will not be accepted), negotiable United States bonds (at par value), or an irrevocable letter of credit in an amount not less than five percent (5%) of the amount of his bid, as a guaranty that he Will not withdraw said bid within the period specified therein after the opening of the same; or, if no period be specified, within ninety (90) days after said opening, and will, within the period specified therefore, or, if no period be specified, within ten (10) days, after the prescribed forms are forwarded to him for execution (or within any extension of time which may be granted by the officer to whom the bid was addressed) execute and deliver a written contract on the standard District form in accordance with bid as accepted and give bond with good and sufficient sureties, as specified below for the faithful performance and proper fulfillment of such contract and payment of laborers and material men as required by law or, in the event of the withdrawal of said bid within the period above stated, or the failure to enter into such contract and give such bond within the time above stated, that he will pay to the District the difference between the amount specified in said bid and the amount for which the District may procure the required work, if the latter amount be in excess of the former.

In case security is in the form of a certified check or United States bonds, the District may make such disposition of the same as will accomplish the purpose for which

submitted. Certified checks may be held uncollected at the bidder's risk. Certified checks and United States bonds will be returned to the unsuccessful bidders after award of contract and to successful bidders after the signing of prescribed forms of contract and bonds. Guaranty bonds will be returned only upon written application.

B. PERFORMANCE BOND—For any construction contract exceeding $100,000.00, a Performance Bond (Form No. DC 2640-7) shall be required in a penal amount equal to one hundred percent (100%) of the contract price at time of award. Additional performance bond protection shall be required in connection with any modification effecting an increase in price under any contract for which a bond is required pursuant to the above if:

1. The modification is for new or additional work which is beyond the scope of the existing contract; or,

2. The modification is pursuant to an existing provision of the contract and is expected to increase the contract price by $50,000 or twenty-five percent (25%) of the original total contract price, whichever is less.

The penal amount of the bond protection shall be increased so that the total performance bond protection is one hundred percent (100%) of the contract price as revised by both the modification requiring such additional protection and the aggregate of any previous modification. The increased penal amount may be secured either by increasing the bond protection provided by existing surety or sureties or by obtaining an additional performance bond from a new surety.

C. PAYMENT BOND— In accordance with the provisions of Section 504(b) of the District of Columbia Procurement Practices Act of 1985, payment bonds shall be required in an amount not less than fifty percent (50%) of the total amount payable by the terms of the contract.

Additional payment protection shall be required in connection with any notification effecting an increase in price under any contract for which a bond is required pursuant to the above if —

1. The modification is for new or additional work which is beyond the scope of the existing contract; or

2. The modification is pursuant to an existing provision of the contract and is expected to increase the contract price by $50,000 or twenty-five percent (25%) of the original total contract price, whichever is less.

The penal amount of the additional bond protection shall generally be such that the total payment bond protection is fifty percent (50%) of the contract price as revised by both the modification requiring such additional protection, and the aggregate of any previous modifications. The additional protection may be secured either by increasing the bond protection provided by the existing surety or sureties or by obtaining an additional payment bond from a new surety.

D. BOND SOURCE—The bonds may be obtained from any surety company authorized by the U.S. Treasury Department as acceptable sureties on Federal Bonds and authorized to transact business in the District of Columbia by the Director, Department of Insurance, Securities and Banking.

ARTICLE 13. SIGNATURE TO BIDS—Each bid must show the full business address of the bidder and be signed by him with his usual signature. Bids by partnerships must be signed with the partnership name by one of the members of the partnership or by an authorized representative, followed by the signature and designation of the person signing. Bids by corporations must be signed with the name of the corporation, followed by the signature and

designation of the President or Vice President and attested by the Secretary of the corporation or other persons authorized to bind the corporation and the corporate seal affixed thereto. If bid is signed by other than the President or Vice President, evidence of authority to so sign must be furnished in the form of an extract of minutes. of a meeting of the Board of Directors or extract of bylaws certified by the Corporate Secretary and corporate seal affixed thereto. The names of all persons signing shall be typed or printed below the signatures. A bid by a person who affixes to his signature the word “President”, “Vice President”, “Secretary”, “Agent”, or other designation, without disclosing his principal, may be held personally to the bid. Bids submitted by a joint venture must be signed by all authorized parties to the joint venture.

ARTICLE 14. MARKING AND MAILING BIDS—Bids, addenda acknowledgment, and bid guaranty must be securely sealed in suitable envelopes, addressed and marked on the outside with the name of the bidder, invitation number and date of opening.

ARTICLE 15. RECEIVING BIDS, MODIFICATIONS OR WITHDRAWALS—Bids received prior to the time set for opening will be securely kept unopened. The officer whose duty it is to open them will decide when the specified time has arrived and no bid received thereafter will be considered unless: (1) they are sent by registered mail or by certified mail for which an official dated post office stamp (postmark) on the original Receipt for Certified Mail has been obtained and it is determined by the District that the late receipt was due solely to delay in the mails for which the bidder was not responsible; or (2) if submitted by mail (or by telegram if authorized by the Contracting Officer), it is determined by the District that the late receipt was due solely to mishandling by the District after receipt at the District agency: Provided, that timely receipt. at such agency is established upon examination of an appropriate date or time stamp or other documentary evidence of receipt within the control of such agency.

Bidders using certified mail are cautioned to obtain a receipt for certified mail showing legible, dated postmark and to retain such receipt against the chance that it will be required as evidence that a late bid was timely mailed. The only evidence acceptable in this matter is as follows: (1) where the Receipt of Certified Mail identifies the post office station of mailing, evidence furnished by the bidder which establishes, that the business day of the station ended at an earlier time, in which case the time of mailing shall be deemed to be last minute of the business day; or (2) an entry in ink on the Receipt for Certified Mail showing the time of mailing and the initials of postal employee receiving the item and making the entry, with appropriate written verification of such entry from the post office station of mailing, in which case the time of mailing, shall be the time shown in the entry. If the postmark on the original Receipt for Certified Mail does not show a date, the bid shall not be considered.

The time of mailing of late bids submitted by registered or certified mail shall be deemed to be the last minute of the date shown in the postmark on the registered mail receipt or registered mail wrapper or on the Receipt for Certified Mail unless the bidder furnishes evidence from the post office station of mailing which establishes an earlier time.

No responsibility will attach to the District or any of its officers or employees for the premature opening of a bid not properly addressed and identified. Unless specifically authorized, telegraphic bids will not be considered, but modifications, by telegram, of bids already submitted will be considered if received prior to the hour set for opening, but should not reveal the amount of the original or revised bid.

ARTICLE 16. WITHDRAWAL OF BIDS—Bids may be withdrawn on written or telegraphic request received from bidders prior to the time fixed for opening, provided the name of the bidder appears on the outside of the envelope containing the bid. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

ARTICLE 17. OPENING OF BIDS—At the time fixed for the opening of bids, their contents will be made public by the Office of Contracting and Procurement for the information of bidders and other properly interested persons.

ARTICLE 18. AWARD OR REJECTION—The Contract will be awarded to the lowest responsible Bidder complying with conditions of the bid documents, provided his bid is reasonable and it is in the best interest of the District to accept it. The Bidder, to whom award is made, will be notified by

the Contracting Officer at the earliest possible date. The District, however, reserves the right to reject any and all bids and to waive any informality in bids received whenever such rejection or waiver is in the best interest of the District.

If more than one bid be offered by any one party, by or in the name of his or their clerk, partner, or other person, all such bids may be rejected. This shall not prevent a Bidder from proceeding under Article 8 hereof, nor from quoting different prices on different qualities of material or different conditions of delivery. A supplier or material man who has quoted prices on materials to a Bidder is not thereby disqualified from quoting to other bidders or from submitting a bid directly for the materials or work.

Each Bidder shall submit a bid on all items in the Price Schedule; failure to bid on all items may result in bid rejection.

In addition to requirements for qualification of bidders as set forth in Article 1 hereof, and as determined by the District, proposals will be considered irregular and may be rejected by the Contracting Officer for any of, but not limited to, the following reasons:

A. Incompetency, inadequate plant or insufficient capital as revealed by Bidder's statement on AGC or equivalent form.

B. Evidence of collusion.

C. Uncompleted work which might hinder or prevent proper and prompt execution and completion of work contemplated.

D. Evidence that Bidder has not adequately considered all aspects of contemplated work.

E. Failure to settle bills satisfactorily, claims and judgments due for labor and material on Bidder's contracts in force on bid opening date.

F. Default under previous contracts.

G. Unacceptable rating as listed on published government lists.

H. Proposal submission on form other than that form furnished by District, or altered or partially detached form.

I. Unauthorized additions, deletions, omissions, conditional bids, or irregularities which may make proposal incomplete or ambiguous in meaning.

J. Failure to acknowledge all addenda issued.

K. Failure to submit bid in the properly labeled receptacle at that location designated as the Office of Contracting and Procurement, Bid Room, Suite 700, 441 4th St., N.W., Washington, D.C. 20001 and prior to the time set for opening as governed by the Official Clock designated as such in that Bid Room.

ARTICLE 19. CANCELLATION OF AWARDS—The right is reserved to the District, without any liability upon the District, to cancel the award of any contract at any time prior to approval of a formal written contract signed by the Contractor and the Contracting Officer.

ARTICLE 20. CONTRACT AND BOND—The Bidder to whom award is made must, when required, enter into a written contract on the standard District form, with satisfactory security in the amount required (see Article 12) within the period specified, or no period be specified, within 10 days alter the prescribed forms are presented to him for signature.

GENERAL PROVISIONS
(Construction Contract)

ARTICLE 1. DEFINITIONS

A. "District" as used herein means the District of Columbia, a municipal corporation.

B. "Mayor" as used herein means the elected head of the District as set forth in Public Law 93-198 dated December 24, 1973, Title 4, Part B, Section 422(1).

C. "Contracting Officer" as used herein means the District official authorized to execute and administrate the Contract on behalf of the District.

D. "Contract Documents" or "Contract" as. used herein means Addenda, Contract Form, Instructions to Bidders, General Provisions, Labor Provisions, Performance and Payment Bonds, Specifications, Special Provisions, Contract Drawings, approved written Change Orders and Agreements required to acceptably complete the Contract, including authorized extensions thereof.

ARTICLE 2. SPECIFICATIONS AND DRAWINGS—The Contractor shall keep on the work site a copy of Contract drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the Contract drawings, or shown on the Contract drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both.

All Contract requirements are equally binding. Each Contract requirement, whether or not omitted elsewhere in the Contract, is binding as though occurring in any or all parts of the Contract. In case of discrepancy:

1. The Contracting Officer shall be promptly notified in writing of any error, discrepancy or omission, apparent or otherwise.

2. Applicable Federal and D. C. Code requirements have priority over: the Contract form, General Provisions, Change Orders, Addenda, Contract drawings, Special Provisions and Specifications.

3. The Contract form, General Provisions and Labor Provisions have priority over: Change Orders, Addenda, Contract drawings, Special Provisions and Specifications.

4. Change Orders have priority over: Addenda, Contract drawings and Specifications.

5. Addenda have priority over: Contract drawings, Special Provisions and Specifications. A later dated Addendum has priority over earlier dated Addenda.

6. Special Provisions have priority over: Contract drawings and other specifications.

7. Shown and indicated dimensions have priority over scaled dimensions.

8. Original scale drawings and details have priority over any other different scale drawings and details.

9. Large scale drawings and details have priority over small scale drawings and details.

10. Any adjustment by the Contractor without a prior determination by the Contracting Officer shall be at his own risk and expense. The Contracting Officer will furnish from time to time such detail drawings and other information as he may consider necessary, unless otherwise provided.

ARTICLE 3. CHANGES

A. DESIGNATED CHANGE ORDERS—The Contracting Officer may, at any time, without notice to the sureties, by written order designated or indicated to be a change order, make any change in the work within the general scope of the Contract, including but not limited to changes

1. In the Contract drawings and specifications;
2. In the method or manner of performance of the work;
3. In the District furnished facilities, equipment, materials or services; or
4. Directing acceleration in the performance of the work.

Nothing provided in this Article shall excuse the Contractor from proceeding with the prosecution of the work so changed.

B. OTHER CHANGE ORDERS—Any other written order or an oral order (which term as used in this Section (B) shall include direction, instruction, interpretation, or determination) from the Contracting Officer which causes any such change, shall be treated as a Change Order under this Article, provided that the Contractor gives the Contracting Officer written notice stating the date, circumstances and sources of the order and that the Contractor regards the order as a Change Order.

C. GENERAL REQUIREMENTS—Except as herein provided, no order, statement or conduct of the Contracting Officer shall be treated as a change under this Article or entitle the Contractor to an equitable adjustment hereunder. If any change under this Article causes an increase or decrease in the Contract's cost of, or the time required for, the performance of any part of the work under this Contract whether or not changed by any order, an equitable adjustment shall be made and the Contract modified in writing accordingly; provided, however, that except for claims based on defective specifications, no claim for any change under (B) above shall be allowed for any cost incurred more than 20 days before the Contractor gives written notice as therein required unless this 20 days is extended by the Contracting Officer and provided further, that in case of defective drawings and specifications, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with such defective drawings and specifications.

If the Contractor intends to assert a claim for an equitable adjustment under this Article, he must, within 30 days after receipt of a written Change Order under (A) above or the furnishing of a written notice under (B) above, submit to the Contracting Officer a written statement setting forth the general nature and monetary extent of such claim, unless this period is extended by the Contracting Officer. The statement of claim hereunder may be included in the notice under (B) above.

No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under the Contract.

D. CHANGE ORDER BREAKDOWN—Contract prices shall be used for Change Order work where work is of similar nature; no other costs, overhead or profit will be allowed.

Where Contract prices are not appropriate and the nature of the change is known in advance of construction, the parties shall attempt to agree on a fully justifiable price adjustment and/or adjustment of completion time.

When Contract prices are not appropriate, or the parties fail to agree on equitable adjustment, or in processing claims, equitable adjustment for Change Order work shall be per this Article and Article 4 and shall be based upon the breakdown shown in following

subsections 1. through 7. The Contractor shall assemble a complete cost breakdown that lists and substantiates each item of work and each item of cost.

1. **Labor—**Payment will be made for direct labor cost plus indirect labor cost such as insurance, taxes, fringe benefits and welfare provided such costs are considered reasonable. Indirect costs shall be itemized and verified by receipted invoices. If verification is not possible, up to 18 percent of direct labor costs may be allowed. In addition, up to 20 percent of direct plus indirect labor costs may be allowed for overhead and profit.

2. **Bond—**Payment for additional bond cost will be made per bond rate schedule submitted to the Office of Contracting and Procurement with the executed Contract.

3. **Materials—**Payment for cost of required materials will be F.O.B. destination (the job site) with an allowance for overhead and profit.

4. **Rented Equipment—**Payment for required equipment rented from an outside company that is neither an affiliate of, nor a subsidiary of, the Contractor will be based on receipted invoices which shall not exceed rates given in the current edition of the Rental Rate Blue Book for Construction Equipment published by Data Quest. If actual rental rates exceed manual rates, written justification shall be furnished to the Contracting Officer for consideration. No additional allowance will be made for overhead and profit. The Contractor shall submit written certification to the Contracting Officer that any required rented equipment is neither owned by nor rented from the Contractor or an affiliate of or subsidiary of the Contractor.

5. **Contractor's Equipment—** Payment for required equipment owned by the Contractor or an affiliate of the Contractor will be based solely on an hourly rate derived by dividing the current appropriate monthly rate by 176 hours. No payment will be made under any circumstances for repair costs, freight and transportation charges, fuel, lubricants, insurance, any other costs and expenses, or overhead and profit. Payment for such equipment made idle by delays attributable to the District will be based on one-half the derived hourly rate under this subsection.

6. **Miscellaneous—**No additional allowance will be made for general superintendence, use of small tools and other costs for which no specific allowance is herein provided.

7. **Subcontract Work—**Payment for additional necessary subcontract work will be based on applicable procedures in 1. through 6., to which total additional subcontract work up to an additional 10 percent may be allowed for the Contractor's overhead and profit.

ARTICLE 4. EQUITABLE ADJUSTMENT OF CONTRACT TERMS

The Contractor is entitled to an equitable adjustment of the contract terms whenever the following situations develop:

Differing Site Conditions:

(1) During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the contract or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract, are encountered at the site, the Contractor, upon discovering such conditions, shall promptly notify the Contracting Officer in writing of the specific differing conditions before they are disturbed and before the affected work is performed.

(2) Upon written notification, the Contracting Officer will investigate the conditions, and if he/she determines that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the contract, an adjustment, excluding loss of anticipated profits, will be made and the contract modified in writing accordingly. The Contracting Officer will notify the Contractor of his/her determination whether or not an adjustment of the contract is warranted.

(3) No contract adjustment which results in a benefit to the Contract will be allowed unless the Contractor has provided the required written notice.

(4) No contract adjustment will be allowed under this clause for any effects caused on unchanged work.

Suspension of Work Ordered by the Contracting Officer:

(1) If the performance of all or any portion of the work is suspended or delayed by the Contracting Officer in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation and/or contract time is due as a result of such suspension or delay, the Contractor shall submit to the Contracting Officer in writing a request for equitable adjustment within seven (7) calendar days of receipt of the notice to resume work. The request shall set forth the reasons and support for such adjustment.

(2) Upon receipt, the Contracting Officer will evaluate the Contractor's request. If the Contracting Officer agrees that the cost and/or time required for the performance of the contract has increased as a result of such suspension and the suspension was caused by conditions beyond the control or and not the fault of the contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the Contracting Officer will make an adjustment (excluding profit) and modify the contract in writing accordingly. The Contracting Officer will notify the Contract of his/her determination whether or not an adjustment of the contract is warranted.

(3) No contract adjustment will be allowed unless the Contractor has submitted the request for adjustment within the time prescribed.

(4) No contract adjustment will be allowed under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term of condition of this contract.

Significant Changes in the Character of Work:

(1) The Contracting Officer reserves the right to make, in writing, at any time during the work, such changes in quantities and such alterations in the work as are necessary to satisfactorily complete the project. Such changes in quantities and alterations shall not invalidate the contract nor release the surety, and the Contractor agrees to perform the work as altered.

(2) If the alterations or changes in quantities significantly change the character of the work under the contract, whether or not changed by any such different quantities or alterations, an adjustment, excluding loss of anticipated profits, will be made to the contract. The basis for the adjustment shall be agreed upon prior to the performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Contracting Officer may determine to be fair and reasonable.

(3) If the alterations or changes in quantities significantly change the character of the work to be performed under the contract, the altered work will be paid for as provided elsewhere in the contract.

(4) The term “significant change” shall be construed to apply only to the following circumstances:

(a) When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction; or

(b) When an item of work is increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of original contract item quantity, or in the case of a decrease below 75 percent, to the actual amount of work performed.

ARTICLE 5. TERMINATION-DELAYS—If the Contractor refuses or fails to prosecute the work, or any separable part thereof, with such diligence as will insure its completion within the time specified in the Contract, or any extension thereof, or fails to complete said work within specified time, the District may, by written notice to the Contractor, terminate his right to proceed with the work or such part of the work involving the delay. In such event the District may take over the work and prosecute the same to completion, by contract or otherwise, and may take possession of and utilize in completing the work such materials, appliances, and plant as may have been paid for by the District or may be on the site of the work and necessary therefore. Whether or not the Contractor’s right to proceed with the work is terminated, he and his sureties shall be liable for any liability to the District resulting from his refusal or failure to complete the work within the specified time.

If fixed and agreed liquidated damages are provided in the Contract and if the District does not so terminate the Contractor’s right to proceed, the resulting damage will consist of such liquidated damages until the work is completed or accepted.

The Contractor’s right to proceed shall not be so terminated nor the Contractor charged with resulting damage if:

1. The delay in the completion the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to acts of God, acts of the public enemy, acts of the District in either its sovereign or contractual capacity, acts of another contractor in the performance of a contract with the District, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, climatic conditions beyond the normal which could be anticipated, or delays of subcontractors or suppliers arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and such subcontractors or suppliers (the term subcontractors or suppliers shall mean subcontractors or suppliers at any tier); and

2. The Contractor, within 10 days from the beginning of any such delay, (unless the Contracting Officer grants a further period of time before the date of final payment under the Contract) notifies the Contracting Officer in writing of the causes of delay.

The Contracting Officer shall ascertain the facts and the extent of the delay and extend the time far completing the work when, in his judgment, the findings of fact justify such an extension, and his findings of fact shall be final and conclusive on the parties, subject only to appeal as provided in Article 7 herein.

If, after notice of termination of the Contractor’s right to proceed under the provisions of this Article, it is determined for any reason that the Contractor was not in default under the provisions of this Article, or that the delay was excusable under the provisions of this Article, the rights and

obligations of the parties shall be in accordance with Article 6 herein. Failure to agree to any such adjustment shall be a dispute concerning a question of fact within the meaning of Article 7 herein.

The rights and remedies of the District provided in this Article are in addition to any other rights and remedies provided by law or under the Contract.

The District may, by written notice, terminate the Contract or a portion thereof as a result of an Executive Order of the President of the United States with respect to the prosecution of war or in the interest of national defense. When the Contract is so terminated, no claim for loss of anticipated profits will be permitted.

ARTICLE 6. TERMINATION FOR CONVENIENCE OF THE DISTRICT

A. The performance of work under the Contract may be terminated by the District in accordance with this Article in whole, or in part, whenever the Contracting Officer shall determine that such termination is in the best interest of the District. Any such termination shall be effected by delivery to the Contractor of a Notice of Termination specifying the extent to which performance of work under the Contract is terminated, and the date upon which such termination becomes effective.

B. After receipt of a Notice of Termination, and except as otherwise directed by the Contracting Officer, the Contractor shall:

1. Stop work under the Contract on the date and to the extent specified in the Notice of Termination.

2. Place no further orders or subcontracts for materials, services, or facilities except as may be necessary for completion of such portion of the work under the Contract as is not terminated.

3. Terminate all orders and subcontracts to the extent that they relate to the performance of work terminated by the Notice of Termination.

4. Assign to the District, in the manner, at the times, and to the extent directed by the Contracting Officer, all of the right, title and interest of the Contractor under the orders and subcontracts so terminated, in which case the District shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts.

5. Settle all outstanding liabilities and all claims arising out of such termination of orders or subcontracts, with the approval or ratification of the Contracting Officer to the extent he may require, which approval or ratification shall be final for all purposes of this Article.

6. Transfer title to the District and deliver in the manner, at the times, and to the extent, if any, directed by the Contracting Officer

:

a. The fabricated or unfabricated parts, work in progress, completed work, supplies, and other material procured as a part of, or acquired in connection with, the performance of the work terminated by the Notice of Termination, and

b. The completed, or partially completed plans, drawings information and other property which, if the Contract bad been completed, would have been required to be furnished to the District.

7. Use his best efforts to sell, in the manner, at the terms, to the extent, and at the price or prices directed or authorized by the Contracting Officer, any property of the types referred to in 6 above provided, however, that the Contractor:

a. Shall not be required to extend credit to any purchaser, and

b. May acquire any property under the conditions prescribed and at a price or prices approved by the Contracting Officer, and

c. Provided further, that the proceeds of any such transfer or disposition shall be applied in reduction of any payments to be made by the District to the Contractor under the Contract or shall otherwise be credited to the price or cost of the work covered by the Contract or paid in such other manner as the Contracting Officer may direct.

8. Complete performance of such part of the work as shall not have been terminated by the Notice of Termination.

9. Take such action as may be necessary, or as the Contracting Officer may direct, for the protection and preservation of the property related to the Contract which is in the possession of the Contractor and in which the District has or may acquire an interest.

10. The Contractor shall proceed immediately with the performance of the above obligations notwithstanding any delay in determining or adjusting the cost, or any item of reimbursable cost, under this Article.

11. "Plant clearance period" means, for each particular property classification (such as raw materials, purchased parts and work in progress) at any one plant or location, a period beginning with the effective date of the termination for convenience and ending 90 days after receipt by the Contracting Officer of acceptable inventory schedules covering all items of that particular property classification in the termination inventory at that plant or location, or ending on such later date as may be agreed to by the Contracting Officer and the Contractor. Final phase of a plant clearance period means that part of a plant clearance period which occurs alter the receipt of acceptable inventory schedules covering all items of the particular property classification at the plant or location.

At any time after expiration of the plant clearance period, as defined above, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of any or all items of termination inventory not previously disposed of, exclusive of items the disposition of which has been directed or authorized by the Contracting Officer, and may request the District to remove such items or enter into a storage agreement covering them. Not later than 15 days thereafter, the District will accept title to such items and remove them or enter into a storage agreement covering the same; provided, that the list submitted shall be subject to verification by the Contracting Officer upon removal of the items or, if the items are stored, within 45 days from the date of submission of the list, and any necessary adjustments to correct the list as submitted, shall be made prior to final settlement.

C. After receipt of a Notice of Termination, the Contractor shall submit to the Contracting Officer his termination claim, in the form with the certification prescribed by the Contracting Officer. Such claim shall be submitted promptly but in no event later than one year from the effective date of termination, unless one or more extensions in writing are granted by the Contracting Officer upon request of the Contractor made in writing within such one year period or authorized extension thereof. However, if the Contracting Officer determines that the facts justify such action, he may receive and act upon any such termination claim at any time after such one year period or extension thereof. Upon failure of the Contractor to submit his termination claim within the time allowed, the Contracting Officer may, subject to any review required by the District's procedures in effect as of the date of execution of the Contract, determine, on the basis of information available to him, the amount, if any, due to the Contractor by reason of the termination and shall thereupon pay to the Contractor the amount so determined.

D. Subject to the provisions of C above, and subject to any review required by the District's procedures in effect as of the date of execution of the Contract, the Contractor and Contracting Officer may agree upon the whole or any part of the amount or amounts to be paid to the Contractor by reason of the total or partial termination of work pursuant to this Article, which amount or amounts may include a reasonable allowance for profit on work done; provided, that such agreed amount or amounts, exclusive of settlement costs, shall not exceed the total Contract price as reduced by the amount of payments otherwise made and as further reduced by the Contract price of work not terminated. The Contract shall be amended accordingly, and the Contractor shall be paid the agreed amount. Nothing in E below prescribing the amount to be paid to the Contractor in the event of failure of the Contractor and the Contracting Officer to agree upon the whole amount to be paid to the Contractor by reason of the termination of work pursuant to this Article, shall be deemed to limit, restrict or otherwise determine or effect the amount or amounts which may be agreed upon to be paid to the Contractor pursuant to this paragraph.

E. In the event of the failure of the Contractor and the Contracting Officer to agree as provided in D above upon the whole amount to be paid to the Contractor by reason of the termination of work pursuant to this Article, the Contracting Officer shall, subject to any review required by the District's procedures in effect as of the date of execution of the Contract, determine, on the basis of information available to him, the amount, if any, due the Contractor by reason of the termination and shall pay to the Contractor the amounts determined by the Contracting Officer, as follows, but without duplication of any amounts agreed upon in accordance with D above:

1. With respect to all Contract work performed prior to the effective date of the Notice of Termination, the total (without duplication of any items) of:

a. The cost of such work;

b. The cost of settling and paying claims arising out of the termination of work under subcontracts or orders as provided in B 5. above, exclusive of the amounts paid or payable on account of supplies or materials delivered or services furnished by the subcontractor prior to the effective date of the Notice of Termination of work under the Contract, which amounts shall be included in the cost on account of which payment is made under E1.a. above; and

c. A sum, as profit on E.1.a. above, determined by the Contracting Officer to be fair and reasonable; provided however, that if it appears that the Contractor would have sustained a loss on the entire Contract had it been completed, no profit shall be included or allowed under this subparagraph and an appropriate adjustment shall be made reducing the amount of the settlement to reflect the indicated rate of loss; and provided further that profit shall be allowed only on preparations made and work done by the Contractor for the terminated portion of the Contract but may not be allowed on the Contractor's settlement expenses. Anticipatory profits and consequential damages will not be allowed. Any reasonable method may be used to arrive at a fair profit, separately or as part of the whole settlement.

2. The reasonable cost of the preservation and protection of property incurred pursuant to B.9; and any other reasonable cost incidental to termination of work under the Contract including expense incidental to the determination of the amount due to the Contractor as the result of the termination of work under the Contract.

F. The total sum to be paid to me Contractor under E.1. above shall not exceed the total Contract price as reduced by the amount of payments otherwise made and as further reduced by the Contract price of work not terminated. Except for normal spoilage, and except to the extent that the District shall have otherwise expressly assumed the risk of loss, there shall be excluded from the amounts payable to the Contractor under E.1. above, the fair value, as determined by the Contracting Officer, of property which is destroyed, lost, stolen or damaged so as to become undeliverable to the District, or to a buyer pursuant to B.7 above.

G. The Contractor shall have the right of appeal, under Article 7 herein, from any determination made by the Contracting Officer under C. or E. above, except that, if the Contractor has failed to submit his claim within the time provided in C above and has failed to request extension of such time, he shall have no such right of appeal. In any case where the Contracting Officer has made a determination of the amount due under C. or E. above, the District shall pay to the Contractor the following:

1. If there is no right of appeal hereunder or if no timely appeal has been taken, the amount so determined by the Contracting Officer, or

2. If an appeal had been taken, the amount finally determined on such appeal.

H. In arriving at the amount due the Contractor under this Article there shall be deducted:

1. all unliquidated advance or other payments on account theretofore made to the Contractor, applicable to the terminated portion of the Contract;

2. any claim which the District may have against the Contractor in connection with the Contract; and

3. the agreed price for, or the proceeds of sale of, any materials, supplies or other things kept by the Contractor or sold, pursuant to the provisions of this Article and not otherwise recovered by or credited to the District.

I. If the termination hereunder be partial, prior to the settlement of the terminated portion of the Contract, the Contractor may file with the Contracting Officer a request in writing for an equitable adjustment of the price or prices specified in the Contract relating to the continued portion of the Contract (the portion not terminated by the Notice of Termination), and such equitable adjustment as may be agreed upon shall be made at such price or prices; however, nothing contained herein shall limit the right of the District and the Contractor to agree upon the amount or amounts to be paid to the Contractor for the completion of the continued portion of the Contract when said Contract does not contain an established Contract price for such continued portion.

J. The District may from time to time, under such terms and conditions as it may prescribe, make partial payments against costs incurred by the Contractor in connection with the terminated portion of the Contract whenever in the opinion of the Contracting Officer the aggregate of such payments shall be within the amount to which the Contractor will be entitled hereunder. If the total of such payments is in excess of the amount finally agreed or determined to be due under this Article, such excess Shall be payable by the Contractor to the District upon demand, together with interest computed at the rate of 6 percent per annum for the period from the date such excess is received by the Contractor to the date on which such excess is repaid to the District; provided however, that no interest shall be charged with respect to any such excess payment attributable to a reduction in the Contractor's claim by reason of retention or other disposition of termination inventory until ten days after the date of such retention or disposition, or such later date as determined by the Contracting Officer by reason of the circumstances.

K. Unless otherwise provided in the Contract or by applicable statute, the Contractor, from the effective date of termination and for a period of three years after final settlement under the Contract, shall preserve and make available to the District at all reasonable times at the office of the Contractor, but without direct charge to the District, all his books, records, documents and other evidence bearing on the costs and expenses of the Contractor under the Contract and relating to the work terminated hereunder, or, to the extent approved by the Contracting Officer, photographs and other authentic reproductions thereof.

ARTICLE 7. DISPUTES

A. All disputes arising under or relating to this contract shall be resolved as provided herein.

B. Claims by a Contractor against the District.

"Claim", as used in Section B of this clause, means a written assertion by the Contractor seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant.

(a) All claims by a Contractor against the District arising under or relating to a contract shall be in writing and shall be submitted to the Contracting Officer for a decision. The contractor's claim shall contain at least the following:

(1) A description of the claim and the amount in dispute;
(2) Any data or other information in support of the claim;
(3) A brief description of the Contractor's efforts to resolve the dispute prior to filing the claim; and
(4) The Contractor's request for relief or other action by the Contracting Officer.
(b) The Contracting Officer may meet with the Contractor in a further attempt to resolve the claim by agreement.
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(c) For any claim of $50,000 or less, the Contracting Officer shall issue a decision within sixty (60) days from receipt of a written request from a Contractor that a decision be rendered within that period.
(d) For any claim over $50,000, the Contracting Officer shall issue a decision within ninety (90) days of receipt of the claim. Whenever possible, the Contracting Officer shall take into account factors such as the size and complexity of the claim and the adequacy of the information in support of the claim provided by the Contractor.
(e) The Contracting Officer's written decision shall do the following:
(1) Provide a description of the claim or dispute;
(2) Refer to the pertinent contract terms;
(3) State the factual areas of agreement and disagreement;
(4) State the reasons for the decision, including any specific findings of fact, although specific findings of fact are not required and, if made, shall not be binding in any subsequent proceeding;
(5) If all or any part of the claim is determined to be valid, determine the amount of monetary settlement, the contract adjustment to be made, or other relief to be granted;
(6) Indicate that the written document is the contracting officer's final decision; and
(7) Inform the Contractor of the right to seek further redress by appealing the decision to the Contract Appeals Board.
(f) Any failure by the Contracting Officer to issue a decision on a contract claim within the required time period will be deemed to be a denial of the claim, and

will authorize the commencement of an appeal to the Contract Appeals Board as authorized by D.C. Official Code § 2-309.04.
(g) (1) If a Contractor is unable to support any part of his or her claim and it is determined that the inability is attributable to a material misrepresentation of fact or fraud on the part of the Contractor, the Contractor shall be liable to the District for an amount equal to the unsupported part of the claim in addition to all costs to the District attributable to the cost of reviewing that part of the Contractor's claim.
(2) Liability under paragraph (g)(1) shall be determined within six (6) years of the commission of the misrepresentation of fact or fraud.
(h) The decision of the Contracting Officer shall be final and not subject to review unless an administrative appeal or action for judicial review is timely commenced by the Contractor as authorized by D. C. Official Code § 2-309.04.
(i) Pending final decision of an appeal, action, or fina l settlement, a Contractor shall proceed diligently with performance of the contract in accordance with the decision of the Contracting Officer.
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C. Claims by the District against a Contractor
(a) Claim as used in Section C of this clause, means a written demand or written assertion by the District seeking, as a matter of right, the payment of money in a sum certain, the adjustment of contract terms, or other relief arising under or relating to this contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant.
(b) (1) All claims by the District against a Contractor arising under or relating to a contract shall be decided by the Contracting Officer.
(2) The Contracting Officer shall send written notice of the claim to the Contractor. The Contracting Officer's written decision shall do the following:
(a) Provide a description of the claim or dispute;
(b) Refer to the pertinent contract terms;
(c) State the factual areas of agreement and disagreement;
(d) State the reasons for the decision, including any specific findings of fact, although specific findings of fact are not required and, if made, shall not be binding in any subsequent proceeding;
(e) If all or any part of the claim is determined to be valid, determine the amount of monetary settlement, the contract adjustment to be made, or other relief to be granted;
(f) Indicate that the written document is the Contracting Officer's final decision; and
(g) Inform the Contractor of the right to seek further redress by appealing the decision to the Contract Appeals Board.
(3) The decision shall be supported by reasons and shall inform the Contractor of its rights as provided herein.
(4) The authority contained in this clause shall not apply to a claim or dispute for penalties or forfeitures prescribed by statute or regulation which another District agency is specifically authorized to administer, settle, or determine.
(5) This clause shall not authorize the Contracting Officer to settle, compromise, pay, or otherwise adjust any claim involving fraud.
(c) The decision of the Contracting Officer shall be final and not subject to review unless an administrative appeal or action for judicial review is timely commenced by the Contractor as authorized by D.C. Official Code §2-309.04.
(d) Pending final decision of an appeal, action, or final settlement, the Contractor shall proceed diligently with performance of the contract in accordance with the decision of the Contracting Officer.

ARTICLE 8. PAYMENTS TO CONTRACTOR—The District will pay the contract price or prices as hereinafter provided in accordance with District and Federal regulations.

The District will make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates approved by the Contracting Officer. The Contractor shall furnish a breakdown of the total Contract price showing the amount included therein for each principal category of the work, in such detail as requested, to provide a basis for determining progress payments. In the preparation of estimates the Contracting Officer, at his discretion, may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site may also be taken into consideration:

1. If such consideration is specifically authorized by the Contract;

2. If the Contractor furnishes satisfactory evidence that he has acquired title to such material, that it meets Contract requirements and that it will be utilized on the work covered by the Contract; and

3. If the Contractor furnishes to the Contracting Officer an itemized list.

The Contracting Officer at his/her discretion shall cause to be with held retention in an amount sufficient to protect the interest of the District of Columbia. The amount shall not exceed ten percent (10%) of the partial payment. However, if the Contracting Officer, at any time after 50 percent of the work has been completed, finds that satisfactory progress is being made, he may authorize any of the remaining progress payments to be made in full or may retain from such remaining partial payments less than 10 percent thereof. Also, whenever work is substantially complete, the Contracting Officer, if he considers the amount retained to be in excess of the amount adequate for the protection of the District, at his discretion, may release to the Contractor all or a portion of such excess amount. Furthermore, on completion and acceptance of each separate building, public work, or other division of the Contract, on which the price is stated separately in the Contract, payment may be made therefore without retention of a percentage, less authorized deductions.

All material and work covered by progress payments made shall thereupon become the sole property of the District, but this provision shall not be construed as relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work, or as waiving the right of the District to require the fulfillment of all of the terms of the Contract.

Upon completion and acceptance of all work, the amount due the Contractor under the Contract shall be paid upon presentation at a properly executed voucher and after the Contractor shall have furnished the District with a release, if required, of all claims against the District arising by virtue of the Contract, other than claims in stated amounts as may be specifically excepted by the Contractor from the operation of the release.

ARTICLE 9. TRANSFER OR ASSIGNMENT—Unless otherwise provided by law, neither the Contract nor any interest therein may be transferred or assigned by the Contractor to any other party without the written consent of the Contracting Officer nor without the written acceptance by the surety on the performance and payment bond securing the Contract of the assignee as the Contractor and the principal on such bond; and any attempted transfer or assignment not authorized by this Article shall constitute a breach of the Contract and the District may for such cause terminate the right of the Contractor to proceed in the same manner as provided in Article 5 herein, and the Contractor and his sureties shall be liable to the District for any excess cost occasioned the District thereby.

ARTICLE 10. MATERIAL AND WORKMANSHIP

A. **GENERAL**—Unless otherwise specifically provided in the Contract, all equipment, material and articles incorporated in the work covered by the Contract shall be new and of the most suitable grade for the purpose intended. Unless otherwise specifically provided in the Contract, reference to any equipment, material, article or patented

process, by trade name, make or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition., and the Contractor may use any equipment, material, article or process which, in the judgment of the Contracting Officer, is equivalent to that named unless otherwise specified. The Contractor shall furnish to the Contracting Officer for his approval the name of the manufacturer, the model number, and other identifying data and information respecting the performance, capacity, nature and rating of the mechanical and other equipment which the Contractor contemplates incorporating in the work. Machinery and equipment shall be in proper condition. When required by the Contract or when called for by the Contracting Officer, the Contractor shall furnish to the Contracting Officer for approval full information concerning the material or articles which he contemplates incorporating in the work. When so directed, samples shall be submitted for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles installed or used without required approval shall be at the risk of subsequent rejection and subject to satisfactory replacement at Contractor's expense.

B. SURPLUS MATERIALS USE—Whenever specified in the Contract or authorized by the Contracting Officer that materials become the property of the Contractor, which by reference or otherwise shall include disposal of materials, it is understood that the Contractor accepts such materials "as is" with no further expense or liability to the District. If such material specified in the Contract will have a potential or real interest of value, the Contractor shall make allowance in the Contract to show such value.

C. DISTRICT MATERIAL—No materials furnished by the District shall be applied to any other use, public or private, than that for which they are issued to the Contractor. The full amount of the cost to the District of all materials furnished by the District to the Contractor and for which no charge is made, which are not accounted for by the Contractor to the satisfaction of the Contracting Officer, will be charged against the Contractor and his sureties and may be deducted from any monies due the Contractor, and this charge shall be in addition to and not in lieu of any other liabilities of the Contractor whether civil or criminal. Materials furnished by the District for which a charge is made at a rate mentioned in the specifications will be delivered to the Contractor upon proper requisitions therefore and will be charged to his account.

D. Plant —The Contractor shall at all times employ sufficient tools and equipment for prosecuting the various classes of work to full completion in the manner and time required. The Contractor shall at all times perform work in sufficient light and shall provide proper illumination, including lighting required for night work as directed, as a Contract requirement. All equipment, tools, formwork and staging used on the project shall be of sufficient size and in proper mechanical and safe condition to meet work requirements, to produce satisfactory work quality and to prevent injury to persons, the project or adjacent property. When methods and equipment are not prescribed in the Contract, the Contractor is free to use tools, methods and equipment that he satisfactorily demonstrates will accomplish the work in conformity with Contract requirements.

If the Contractor desires to use a method or type of tool or equipment other than specified in the Contract, he shall request approval to do so; the request shall be in writing and shall include a full description of proposed methods, tools and equipment and reason for the change or substitution. Approval of substitutions and changed methods will be on condition that the Contractor will be fully responsible for producing work meeting Contract requirements. If after trial use of the substituted methods, tools and equipment, the Contracting Officer determines that work produced does not meet Contract requirements, the Contractor shall complete remaining work with specified methods, tools and equipment.

E. CAPABILITY OF WORKERS- All work under the Contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may require the Contractor to remove from the work any such employees as the Contracting Officer deems incompetent, careless, insubordinate, or otherwise objectionable, or whose continued employment on the work is deemed by the Contracting Officer to be contrary to the public interest. Such request will be in writing:

F. CONFORMITY OF WORK AND MATERIALS—All work performed and materials and products furnished shall be in conformity, within indicated tolerances, with lines, grades, cross sections, details, dimensions, material and construction requirements shown or intended by the drawings arid specifications.

When materials, products or work cannot be corrected, written notice of rejection will be issued. Rejected materials, products and work shall be eliminated form the project and acceptably replaced at Contractor's expense. The Contracting Officer's failure to reject any portion of the project shall not constitute implied acceptance nor in any way release the Contractor from Contract requirements.

G. UNAUTHORIZED WORK AND MATERIALS—Work performed or materials ordered or furnished for the project deviating from requirements without written authority, will be considered unauthorized and at Contractor's expense. The District is not obligated to pay for unauthorized work. Unauthorized work and materials may be ordered removed and replaced at Contractor's expense.

ARTICLE 11. INSPECTION AND ACCEPTANCE—Except as otherwise provided in the Contract, inspection and test by the District of material and workmanship required by the Contract shall be made at reasonable times and at the site of the work, unless the Contracting Officer determines that such inspection or test of material which is to be incorporated in the work shall be made at the place of production, manufacture or shipment of such material. To the extent specified by the Contracting Officer at the time of determining to make off-site inspection or test, such inspection or test shall be conclusive as to whether the material involved conforms to Contract requirements. Such off-site inspection or test shall not relieve the Contractor of responsibility for damage to or loss of the material prior to acceptance, nor in any way affect the continuing rights of the District after acceptance of the completed work under the terms of the last paragraph of this Article, except as herein above provided.

The Contractor shall, without charge, replace any material and correct any workmanship found by the District not to conform to Contract requirements, unless in the public interest the District consents to accept such material or workmanship with an appropriate adjustment in Contract price. The Contractor shall promptly segregate and remove rejected material from the premises at Contractor's expense.

If the Contractor does not promptly replace rejected material or correct rejected workmanship, the District:

1. May, by contract or otherwise, replace such material and correct such workmanship and charge the cost thereof to the Contractor, or

2. May terminate the Contractor's right to proceed in accordance with Article 5 herein.

The Contractor shall furnish promptly, without additional cost to the District, all facilities, labor and material reasonably needed for performing such safe and convenient inspection and test as may be required by the Contracting Officer. All inspections and tests by the District shall be performed in such manner as not unnecessarily to delay the work. Special, full size, and performance tests shall be performed as described in the Contract. The Contractor shall be charged with any additional cost of inspection when material and workmanship are not ready for inspection at the time specified by the Contractor.

Should it be considered necessary or advisable by the Contracting Officer at any time before acceptance of the work, either in part or in its entirety, to make an examination of work completed, by removing or tearing out same, the Contractor shall, on request, promptly furnish all necessary facilities, labor and material to do same. If such work is found to be defective or nonconforming in any material respect, due to the fault of the Contractor or his subcontractors, he shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, an equitable adjustment shall be made in the Contract price

to compensate the Contractor for the additional services involved in such examination and reconstruction and, if completion of the work has been delayed thereby, he shall, in addition, be granted an equitable extension of time.

Unless otherwise provided in the Contract, acceptance by the District will be made as promptly as practicable after completion and inspection of all work required by the Contract. Acceptance shall be final and conclusive except as regards to latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the District's rights under any warranty or guaranty.

ARTICLE 12. SUPERINTENDENCE BY CONTRACTOR—The Contractor shall give his personal superintendence to the performance of the work or have a competent foreman or superintendent, satisfactory to the Contracting Officer, on the work site at all times during progress, with authority to act for him.

ARTICLE 13. PERMITS AND RESPONSIBILITIES—The Contractor shall, without expense to the District, be responsible for obtaining any necessary licenses, certificates and permits, and for complying with any applicable Federal, State, and Municipal laws, codes and regulations, in connection with the prosecution of the work. He shall be similarly responsible for all damages to persons or property that occurs as a result of his fault or negligence. He shall take proper safety, health and environmental precautions to protect the work, the workers, the public, and the property of others. He shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire construction work, except for any completed unit of construction thereof which theretofore may have been accepted.

ARTICLE 14. INDEMNIFICATION—The Contractor shall indemnify and save harmless the District and all of its officers, agents and servants against any and all claims or liability arising from or based on, or as a consequence or result of, any act, omission or default of the Contractor, his employees, or his subcontractors, in the performance of, or in connection with, any work required, contemplated or performed under the Contract.

ARTICLE l5. PROTECTION AGAINST TRESPASS—Except as otherwise expressly provided in the Contract, the Contractor is authorized to refuse admission either to the premises or to the working space covered by the Contract to any person whose admission is not specifically authorized in writing by the Contracting Officer.

ARTICLE 16. CONDITIONS AFFECTING THE WORK

A. GENERAL—The Contractor shall be responsible for having taken steps reasonably necessary to ascertain the nature and location of the work, and the general and local conditions which can affect the work and the cost thereof. Any failure by the Contractor to do so will not relieve him from responsibility for successfully performing the work as specified without additional expense to the District. The District assumes no responsibility for any understanding or representation concerning conditions made by any of its officers or agents prior to the execution of the Contract, unless such understanding or representation by the District is expressly stated in the Contract.

B. WORK AND STORAGE SPACE—Available work and storage space designated by the District shall be developed as required by the Contract or restored at completion of the project by the Contractor to a condition equivalent to that existing prior to construction. No payment will be made for furnishing or restoration of any work and storage space. If no area is designated or the area designated is not sufficient for the Contractor's operations, he shall obtain necessary space elsewhere at no expense or liability to the District.

C. WORK ON SUNDAYS, LEGAL HOLIDAYS AND AT NIGHT—No work shall be done at any time on Sundays or legal holidays or on any other day before 7 a.m. or after 7 p.m., except with the written permission of the Contracting Officer and pursuant to the requirements of the Police Requirements of the District.

D. EXISTING FEATURES—Subsurface and topographic information including borings data, utilities data and other physical data contained in the Contract or otherwise available, are

not intended as representations or warranties but are furnished as available information. The District assumes no expense or liability for the accuracy of, or interpretations made from, existing features. The Contractor shall be responsible for reasonable consideration of existing features above and below ground which may affect the project.

E. UTILITIES AND VAULTS—The Contractor shall take necessary measures to prevent interruption of service or damage to existing utilities within or adjacent to the project. It shall be the Contractor's responsibility to determine exact locations of all utilities in the field.

For any underground utility or vault encountered, the Contractor shall immediately notify the Contracting Officer and take necessary measures to protect the utility or vault and maintain the service until relocation by owner is accomplished. No additional payment will be made for the encountering of these obstructions.

In case of damage to utilities by the Contractor, either above or below ground, the Contractor shall restore such utilities to a condition equivalent to that which existed prior to the damage by repairing, rebuilding or otherwise restoring as may be directed, at the Contractor's sole expense. Damaged utilities shall be repaired by the Contractor or, when directed by the Contracting Officer, the utility owner will make needed repairs at the Contractor's expense.

No compensation, other than authorized time extensions, will be allowed the Contractor for protective measures, work interruptions, changes in construction sequence, changes in methods of handling excavation and drainage or changes in types of equipment used, made necessary by existing utilities, imprecise utility or vault information or by others performing work within or adjacent to the project.

F. SITE MAINTENANCE—The Contractor shall maintain the project site in a neat and presentable manner throughout the course of all operations, and shall be responsible for such maintenance until final acceptance by the District Trash containers shall be furnished, maintained and emptied by the Contractor to the satisfaction of the Contracting Officer. Excavated earthwork, stripped forms and all other materials and debris not scheduled for reuse in the project shall be promptly removed from the site.

The Contracting Officer may order the Contractor to clean up the project site at any stage of work at no added expense to the District If the Contractor fails to comply with this order, the Contracting Officer may require the work to be done by others and the costs will be charged to the Contractor.

Upon completion of all work and prior to final inspection, the Contractor shall clean up and remove from the project area and adjacent areas all excess materials, equipment, temporary structures, and refuse, and restore said areas to an acceptable condition.

G. PRIVATE WORK—Except as specifically authorized by the Contracting Officer, the Contractor shall not perform any private work abutting District projects with any labor, materials, tools, equipment, supplies or supervision scheduled for the Contract until all work under the Contract has been completed. Contract materials used for any unauthorized purpose shall be subtracted from Contract amount.

H. DISTRICT OF COLUMBIA NOISE CONTROL ACT OF 1977—The contractor shall be in strict compliance with D.C. Law 2-53, District of Columbia Noise Control Act of 1977 and all provisions thereof. Effective March 16, 1978. 24 D.C.Register 5293.

ARTICLE 17. OTHER CONTRACTS—The District may undertake or award other contracts for additional work and the Contractor shall fully cooperate with such other contractors and District employees and carefully coordinate his own work with such additional work as may be directed by the Contracting Officer. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor or by District employees. The District assumes no liability, other than authorized time extensions, for Contract delays and damages resulting from delays and lack of progress by others.

ARTICLE 18. PATENT INDEMNITY—Except as otherwise provided, the Contractor agrees to indemnify the District and its officers, agents, and employees against liability, including costs and expenses, for infringement upon any Letters Patent of the United States (except Letters Patent issued upon an application which is now or may hereafter be, for reasons of national security, ordered by the Federal Government to be kept classified or otherwise withheld from issue) arising out of the performance of the Contract or out of the use or disposal, by or for the account of the District, of supplies furnished or construction work performed hereunder.

ARTICLE 19. ADDITIONAL BOND SECURITY—If any surety upon any bond furnished in connection with the Contract becomes unacceptable to the District, or if any such surety fails to furnish reports as to his financial condition from time to time as requested by the District, the Contractor shall promptly furnish such additional security as may be required from time to time to protect the interests of the District and of persons supplying labor or materials in the prosecution of the work contemplated by the Contract. Provided that upon the failure of the Contractor to furnish such additional security within ten (10) days after written notice so to do, all payments under the Contract will be withheld until such additional security is furnished.

ARTICLE 20. COVENANT AGAINST CONTINGENT FEES—The Contractor warrants that no person or selling agency has been employed or retained to solicit or secure the Contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Contractor for the purpose of securing business. For breach or violation of this warranty, the District shall have the right to terminate the Contract without liability or in its discretion to deduct from the Contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage or contingent fee.

ARTICLE 21. APPOINTMENT OF ATTORNEY—The Contractor does hereby irrevocably designate and appoint the Clerk of the Superior Court of the District of Columbia and his successors in office as the true and lawful attorney of the Contractor for the purpose of receiving service of all notices and processes issued by any court in the District, as well as service of all pleadings and other papers, in relation to any action or legal proceeding arising out of or pertaining to the Contract or the work required or performed hereunder.

The Contractor expressly agrees that the validity of any service upon the said Clerk as herein authorized shall not be affected either by the fact that the Contractor was personally within the District and otherwise subject to personal service at the time of such service upon the said Clerk or by the fact that the Contractor failed to receive a copy of such process, notice, pleading or other paper so served upon the said Clerk, provided that said Clerk shall have deposited in the United States mail, certified and postage prepaid, a copy of such process, notice, pleading or other papers addressed to the Contractor at the address stated in the Contract.

ARTICLE 22. DISTRICT EMPLOYEES NOT TO BENEFIT — Unless a determination is made as provided herein, no officer or employee of the District will be admitted to any share or part of this contract or to any benefit that may arise therefrom, and any contract made by the Contracting Officer or any District employee authorized to execute contracts in which they or an employee of the District will be personally interested shall be void, and no payment shall be made thereon by the District or any officer thereof, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit. A District employee shall not be a party to a contract with the District and will not knowingly cause or allow a business concern or other organization owned or substantially owned or controlled by the employee to be a party to such a contract, unless a written determination has been made by the head of the procuring agency that there is a compelling reason for contracting with the employee, such as when the District's needs cannot reasonably otherwise be met. (DC Procurement Practices Act of l985, D.C. Law 6-85, D.C. Official Code, section 2-310.01, and Chapter 18 of the DC Personnel Regulations) The Contractor represents and covenants that it presently has no interest and shall not acquire any interest, direct or indirect, which would conflict in any manner or degree with the performance of its services hereunder. The Contractor further covenants not to employ any person having such known interests in the performance of the contract.

ARTICLE 23. WAIVER—No waiver of any breach of any provision of the Contract shall operate as a waiver of such provision or of the Contract or as a waiver of subsequent or other breaches of the same or any other provision of the Contract; nor shall any action or non-action by the Contracting Officer or by the Mayor be construed as a waiver of any provision of the Contract or of any breach thereof unless the same has been expressly declared or recognized as a waiver by the Contracting Officer or the Mayor in writing.

ARTICLE 24. BUY AMERICAN

A. AGREEMENT—In accordance with the Buy American Act (41 USC l0a-l0d), and Executive Order 10582. December 17, 1954 (3 CFR, 1954-58 Comp., p. 230), as amended by Executive Order 11051, September 27,1962 (3 CFR, l059—63 Comp., p. 635), the Contractor agrees that only domestic construction material will be used by the Contractor, subcontractors, material men and suppliers in the performance of the Contract, except for non-domestic material listed in the Contract.

B. DOMESTIC CONSTRUCTION MATERIAL—"Construction material" means any article, material or supply brought to the construction site for incorporation in the building or work. An unmanufactured construction material is a "domestic construction material" if it has been mined or produced in the United States. A manufactured construction material is a "domestic construction material" if it has been manufactured in the United States and if the cost of its components which have been mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. "Component" means any article, material, or supply directly incorporated in a construction material. -

C. DOMESTIC COMPONENT—A component shall be considered to have been "mined, produced, or manufactured in the United States" regardless of its source, in fact, if the article, material or supply in which it is incorporated was manufactured in the United States and the component is of a class or kind determined by the District to be not mined, produced or manufactured in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality.

D. FOREIGN MATERIAL – When steel materials are used in a project a minimal use of foreign steel is permitted. The cost of such materials can not exceed on-tenth of one percent of the total project cost, or $2,500,000, whichever is greater.

ARTICLE 25. TAXES

A. FEDERAL EXCISE—Materials, supplies and equipment are not subject to the Federal Manufacturer's Excise Tax, if they are furnished or used in connection with the Contract provided that title to such materials, supplies and equipment passes to the District under the Contract. The Contractor shall in such cases furnish his subcontractors and suppliers with a purchaser's certificate in the form prescribed by the U.S. Internal Revenue Service.

B. SALES AND USE TAXES—Materials which are physically incorporated as a permanent part of real property are not subject to District of Columbia Sales and Use Tax. The Contractor shall, when purchasing such materials, furnish his suppliers with a Contractor's Exempt Purchase Certificate in the form prescribed in the Sales and Use Tax Regulations of the District of Columbia. Where the Contractor, subcontractor or material man has already paid the Sales and Use Tax on material, as prescribed above, the Sales and Use Tax Regulations of the District of Columbia permit the Contractor, subcontractor or material man to deduct the sales or use tax on the purchase price of the same on his next monthly return as an adjustment. However, the Contractor, subcontractor or material man must satisfy the Chief Financial Officer for the District of Columbia that no sum in reimbursement of such tax was included in the Contract or else that the District has received a credit under the Contract in an amount equal to such tax.

District of Columbia Sales and Use Tax shall be paid on any material and supplies, including equipment rentals, which do not become a physical part of the finished project. (See District of Columbia Sales and Use Tax Administration Ruling No. 6).

The Contractor, subcontractor,or material supplier shall provide proof of compliance with the provisions of D.C. Law 9-260, as amended, codified in D.C. Code46-103, Employer Contributions, prior to award.

Material and supplies required under contracts relating to Glenn Dale Hospital, Glenn Dale, Maryland, and Children's Center, Laurel, Maryland, are subject to the Maryland State Sales and Use Tax, effective July 1, 1968. BIDDERS SHALL INCLUDE SUCH TAX IN THEIR BIDS. Contracts relating to Department of Corrections, Lorton, Virginia, are subject to the Virginia Retail Sales and Use Tax, effective September 1, 1966, when incorporated in public works contracts 'f the District. BIDDERS SHALL INCLUDE SUCH TAX IN THEIR BIDS.

The Contractor, subcontractor, or material supplier shall provide proof of compliance with the applicable tax filing and licensing requirements set forth in D.C. Code, Title 47, Taxation and Fiscal Affairs, prior to contract award.

ARTICLE 26. SUSPENSION OF WORK—The Contracting Officer may order the Contractor in writing to suspend, delay or interrupt all or any part of the work for such period of time as he may determine to be appropriate for the convenience of the District.

If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed or interrupted by an act of the Contracting Officer in the administration of the Contract, or by his failure to act within the time specified in the Contract (or if no time is specified, within a reasonable time), an adjustment will be made for an increase in the cost of performance of the Contract (excluding profit) necessarily caused by such unreasonable suspension, delay or interruption and the Contract modified in writing accordingly. However, no adjustment will be made under this Article for any suspension, delay or interruption to the extent:

1. That performance would have been so suspended, delayed or interrupted by any other cause, including the fault or negligence of the contractor, or

2. For which an equitable adjustment is provided or excluded under any other provision of the Contract.

No claim under this Article shall be allowed:

1. For any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall no apply as to a claim resulting from a suspension order), and

2. Unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of such suspension, delay, or interruption, but not later than the date of final payment under the Contract.

ARTICLE 27. SAFETY PROGRAM

A. GENERAL—In order to provide safety controls for the protection of the life and health of District and Contract employees and the general public; prevention of damage to property, materials, supplies, and equipment; and for avoidance of work interruptions in the performance of the Contract, the Contractor shall comply with all applicable Federal and local laws governing safety, health and sanitation including the Safety Standards, Rules and Regulations issued by the American National Standards, U. S. Department of Labor, U. S. Department of Health and Human Services, D. C. Minimum Wage and Industrial Safety Board and the latest edition of "Manual of Uniform Traffic Control Devices" issued by the Federal Highway Administration.

The Contractor shall also take or cause to be taken such additional safety measures as the Contracting Officer may determine to be reasonably necessary.

The Contractor shall designate one person to be responsible for carrying out the Contractor's obligation under this Article.

The Contractor shall maintain an accurate record of all accidents resulting in death, injury, occupational disease, and/or damage to property, materials, supplies, and equipment incident to work performed under the Contract. Copies of these reports shall be furnished to the Contracting Officer within two working days after occurrence.

The Contracting Officer will notify the Contractor of any noncompliance with the foregoing provisions and the action to be taken. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

This Article is applicable to all subcontractors used under the Contract and compliance with these provisions by the subcontractors will be the responsibility of the Contractor.

(In Contracts involving work of short duration or of non-hazardous character, the following Section B. will be deleted by Special Provision)

B. CONTRACTOR'S PROGRAM SUBMISSION—Prior to commencement of the work, the Contractor shall:

1. Submit in writing to the Contracting Officer for his approval his program for complying with this Article for accident prevention.

2. Meet with the Contracting Officer's Safety Representative after submission of the above program to develop a mutual understanding relative to the administration of the overall safety program.

ARTICLE 28. RETENTION OF RECORDS—Unless otherwise provided in the Contract, or by applicable statute, the Contractor, from the effective date of Contract completion and for a period of three years after final settlement under the Contract, shall preserve and make available to the District at all reasonable times at the office of the Contractor but without direct charge to the District, all his books, records, documents, and other evidence bearing on the costs and expenses of the Contractor under the Contract.

ARTICLE 29. RECOVERY OF DEBTS OWED THE DISTRICT---The Contractor hereby agrees that the District may use all or any portion of any consideration or refund due the Contractor under the Contract to satisfy, in whole or part, any debt due the District.

LABOR PROVISIONS
(Construction Contract)

ARTICLE 1. DAVIS-BACON ACT (40 USC 276a-276a 7) —Each Contractor and subcontractor at any tier contracting for any part of Contract work in excess of $2,000 for construction alteration, and/or repair, including painting and decorating of public buildings and public works and which requires or involves the employment of mechanics and/or laborers shall be subject to the Davis-Bacon Act provisions as follows:

A. MINIMUM WAGES—

1. All mechanics and laborers employed or working upon the site of the work or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the United States Department of Labor, hereinafter referred to as the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at wage rates not less than those contained in the wage determination decision of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such Laborers and mechanics; and the wage determination decision shall be posted by the contractor at the site of the work in a prominent place where it can be easily seen by the workers. For the purpose of this clause, contributions made or costs reasonably anticipated under section l(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of 29 CFR 5.5(a)(l)(iv). Also for the purpose of this clause; regular contributions made or costs incurred for more than a weekly period under plans, funds, or programs, but covering the particular weekly period, are deemed to be constructively made or incurred during such weekly period.

2. The contracting officer shall require that any class of laborers or mechanics, including apprentices and trainees, which is not listed in the wage determination and which is to be employed under the contract, shall be classified or reclassified conformably to the wage determination and a report of the action taken shall be sent by the Contracting Officer to the Secretary of Labor. In the event the interested parties cannot agree on the proper classification or reclassification of a particular class of laborers and mechanics, including apprentices and trainees, to be used, the question accompanied by the recommendation of the Contracting Officer shall be referred to the Secretary for final determination.

3. The Contracting Officer shall require, whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly wage rate and the contractor is obligated to pay a cash equivalent of such a fringe benefit, an hourly cash equivalent thereof to be established. In the event the interested parties cannot agree upon a cash equivalent of the fringe benefit, the question, accompanied by the recommendation of the Contracting Officer, shall be referred to the Secretary of Labor for determination.

4. If the Contractor does not make payments to a trustee or other third person, he may consider as part of the wages of any laborer or mechanic the amount o any costs reasonably anticipated in providing benefits under a plan or program of a type expressly listed in the wage determination decision of the Secretary of Labor which is a part of this contract: Provided, however, The Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the

contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

B. WITHHOLDING.—The Contracting Officer may withhold or cause to be withheld from the contractor so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices and trainees, employed by the contractor or any subcontractor on the work the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice or trainee, employed or working on the site of the work or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project, all or part of the wages required by the contract, the District may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

C. PAYROLLS AND BASIC RECORDS. —

1. Payrolls and basic records relating thereto will be maintained during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work, or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project. Such records will contain the name and address of each such employee, his correct classification, rates of pay. (including rates of contributions or costs anticipated of the types described in section l(b)(2) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(l) (iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section l(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits in enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing, to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits.

2. The contractor will submit weekly a copy of all payrolls to the Contracting Officer if the agency is a party to the contract, but if the agency is not such a party the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the Contracting Officer. The copy shall be accompanied by a statement signed by the employer or his agent indicating that the payrolls are correct and complete, that the wage rates contained therein are not less than those determined by the Secretary of Labor and that the classifications set forth for each laborer or mechanic conform with the work he performed. A submission of a "Weekly Statement of Compliance" which is required under this contract and the Copeland regulations of the Secretary of Labor (29 CFR, Part 3) and the filing with the initial payroll or any subsequent payroll of a copy of any findings by the Secretary of Labor under 29 CFR 5.5(a)(1)(iv) shall satisfy this requirement. The prime contractor shall be responsible for the submission of copies of payrolls of all subcontractors. The contractor will make the records required under the labor standards clauses of the contract available for inspection by authorized representatives of the District and the Department of Labor, and will permit such representatives to interview employees during working hours on the job. Contractors employing apprentices or trainees under approved programs shall include a notation on the first weekly certified payrolls submitted to the Contracting Officer that their employment is pursuant to an approved program and shall identify' the program.

ARTICLE 2. CONVICT LABOR (18 USC 438)—Convict labor shall not be used on Contract work unless otherwise provided by law.

ARTICLE 3. APPRENTICES AND TRAINEES

A. APPRENTICES—Apprentices shall be permitted to work as such only when they are registered, individually, under a bona fide apprenticeship program registered with the Apprenticeship Council, D.C. Department of Labor. The allowance ratio of apprentices to journeymen in any craft classification shall not be greater than the ratio permitted to the Contractor a to his entire work force under the registered program. Any employee listed on a payroll at an apprentice wage rate, who is not a trainee as defined in Section B. of this Article or is not registered as above, shall be paid the wage rate determined by the Secretary of Labor or the classifications of work he actually performed. The Contractor and Subcontractor shall furnish to the Contracting Officer written evidence of the registration of his appropriate ratios and wage rates for the areas of construction, prior to using any apprentice on the Contract.

B. TRAINEES—Trainees will be permitted to work as such when they are bona fide trainees employed pursuant to a program approved by the Contracting Officer and Apprenticeship Council, D.C. Department of Labor.

C. REQUIREMENTS—The Contractor agrees to hire for the performance of the Contract a number of apprentices or trainees or both, in each occupation, which bears to the average number of the journeymen in that occupation to be employed in the performance of the Contract the applicable ratios as determined by the Apprenticeship Council, 0. C. Department of Labor.

1. The Contractor shall assure that 25 percent of such apprentices or trainees in each occupation are in their first year of training, when feasible. Feasibility here involves a consideration of:

a. The availability of training opportunities for first year apprentices;

b. The hazardous nature of the work for beginning workers;

c. Excessive unemployment of apprentices in their second and subsequent years of training.

2. The Contractor shall maintain records of employment, by trade, of the number of apprentices and trainees, apprentices and trainees by first year of training, and of journeymen, and the wages paid and hours of work of such apprentices, trainees and journeymen. The Contractor shall make these records available for inspection upon request of the Contracting Officer and the Apprenticeship Council, 0. C. Department of Labor.

3. The Contractor who claims compliance based on the criterion stated in 29 CFR5.a. agrees to maintain records of employment as described in 29 CFR5.a..3(a)(2) on non-governmental and non-governmentally assisted construction work done during the performance of the Contract in the same labor market area. The Contractor shall make these records available for inspection upon request of the Contracting Officer and the Apprenticeship Council, D. C. Department of Labor.

4. The Contractor agrees to supply one copy of the written notices as required in accordance with 29 CFR. 5.a.4(c) at the request of the Contracting Officer. The Contractor shall supply at 3 month intervals during performance of the Contract and after completion of the Contract performance a statement containing a breakdown by craft of hours worked and wages paid for first year apprentices and trainees, other apprentices and trainees, and journeymen. Two copies of the statement shall be submitted to the Contracting Officer, who will submit a copy to the Apprenticeship Council, D. C. Department of Labor.

5. Section 5, D. C. Law 2—156, AC] 2—325, dated December 29, 1978, is hereby incorporated as part of this Amendment as follows:

> "All prime contractors and subcontractors who contract with the District of Columbia Government to perform construction or renovation work with a single contract or cumulative contracts of at least $500,000, let within a twelve (12) month period, shall be required to register an apprentice.—ship program with the District of Columbia Apprenticeship Council." 25 D.C. Register 6991.

ARTICLE 4. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT (40 USC 327- 330)

A. OVERTIME BASIS—Each Contractor and subcontractor at any tier contracting for any part of Contract work which may require or involve the employment of laborers, mechanics, watchmen or guards, apprentices or trainees shall not require or permit any laborer, mechanic, watchman or guard, apprentice or trainee in any workweek in which he is employed on such work, to work in excess of eight (8) hours in any calendar day or in excess of forty (40) hours in such workweek unless such laborer, mechanic, watchman or guard, apprentice or trainee receives compensation at a rate not less than one and one—half times his basic rate of pay for all hours worked in excess of eight (8) hours in any calendar day or in excess of forty (40) hours in such workweek, as the case may be.

B. LIABILITY FOR UNPAID WAGES—In the event of violation of the provisions of Section A, the Contractor and any subcontractor responsible therefore shall be liable to any affected employee for his unpaid wages. In addition, such Contractor and subcontractor shall be liable to the District for Liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer, mechanic, watchman or guard, apprentice or trainee employed in violation of any provision of Section A, in the awn of $10 for each calendar day on which such employee was required or permitted to work in excess of eight (8) hours or in excess of the standard workweek of forty (40) hours without payment of the overtime wages required by Section A.

The Contracting Officer may withhold or cause to be withheld from the Contractor such sums as administratively determined to satisfy any liability of the Contractor and subcontractors for unpaid wages and liquidated damages as herein provided. In the event of failure to pay any laborer, mechanic, watchman, or guard, apprentice or trainee employed or working on the work site, all or part of the wages required by the Contract, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance or guarantee of funds until such violations have ceased.

C. DISPUTES—Any Contractor or subcontractor aggrieved by the withholding of a sum as liquidated damages as provided shall have the right, within sixty (60) days thereafter, to appeal to the Contracting Officer in the case of liquidated damages withheld for the use and benefit of the District. The Contracting Officer shall have authority to review the administrative determination of liquidated damages and to issue a final order affirming such determination; or if it is found that the sum determined is incorrect or that the Contractor or subcontractor violated these Labor Provisions inadvertently notwithstanding the exercise of due care on his part and that of his agents, recommendations may be made to the Secretary of Labor that an appropriate adjustment in liquidated damages be made, or that the Contractor or subcontractor be relieved of liability for such liquidated damages. The Secretary will review all pertinent facts in the matter and may conduct such investigation as he deems necessary so as to affirm or reject the recommendation. The decision of the Secretary shall be final. In all such cases in which a Contractor or subcontractor may be aggrieved by a final order for the withholding of liquidated damages as herein before provided, the Contractor or subcontractor may, within sixty (60) days after such final order, file a claim per Article 7 of the General Provisions, provided, however, that final orders of the Contracting Officer or the Secretary of Labor as the case may be, shall be conclusive with respect to findings of fact if such findings are supported by substantial evidence.

D. VIOLATION PENALTY—If the Contractor or subcontractor who employs, directs & controls any laborer or mechanic employed in the performance of any work contemplated by the Contract, shall intentionally violate any provision herein, he shall be deemed guilty of a misdemeanor, and for each and every such offense shall, upon conviction, be punished by a fine of not to exceed $1,000 or by imprisonment for not more than six (6) months, or by both such fine and imprisonment, in the discretion of the court having jurisdiction thereof (Section 106 Title 1, P.L. 87—851, 40 USC Sec. 332, 76 Stat. 359).

E. HEALTH AND SAFETY STANDARDS—It is a condition. of the Contract, and shall be made a condition of each subcontract under the Contract, that the Contractor and any subcontractor shall not require any laborer or mechanic employed in performance of the Contract to work in surroundings or wider working condition which are unsanitary, hazardous, or dangerous to his health or safety, as determined under construction safety and health standards per 29 CFR Part 1518.

The Secretary of Labor is authorized to make such inspections, hold such hearings, issue such orders, and make such decisions based on findings of fact, as are deemed necessary to gain compliance with this Section and any health and safety standard promulgated by the Secretary. In the event that the Secretary of Labor determines non-compliance under the provisions of this Section after an opportunity for an adjudicatory hearing by the Secretary of any condition of the Contract, the District shall have the right to cancel the Contract, and to enter into other contracts for the completion of the Contract work, charging any additional cost to the Contractor.

ARTICLE 5. COPELAND ACT (18 USC 874, and 40 USC 276c) - Each Contractor and subcontractor at any tier contracting for any part of Contract work in excess of $2,000.0O shall be subject to the Copeland Act provisions as follow:

A. DEFINITION—As used in this Article, the term “employee” shall not apply to persons in classifications higher than that of laborer or mechanic and those who are the immediate supervisors of such employees.

B. WEEKLY COMPLIANCE STATEMENT—The Contractor and each subcontractor engaged in the construction, prosecution, completion or repair of any public building or public work shall furnish each week a statement with respect to the wages paid each of his employees engaged on work covered by these Labor Provisions during the preceding weekly payroll period. The statement shall be executed by the Contractor or subcontractor, or by an authorized officer or employee of the Contractor or subcontractor, who supervises the payment of wages, and shall be on the form attached at the end of these Labor Provisions and entitled ‘Weekly Statement of Compliance” (Form No. DC 2640-11).

Each weekly statement required shall be delivered by the Contractor or subcontractor, within seven (7) days after regular payment date of the payroll period, to a representative of the Contracting Officer in charge at the site of the building or work. After each examination and check as may be made, such statement, or copy thereof, shall be kept available, or shall be transmitted together with a report of any violation, in accordance with applicable procedures prescribed by the US. Department of Labor.

Upon a written finding by the Contracting Officer, the Secretary of Labor may provide reasonable limitations, variations, tolerances and exemptions from the requirements of this Section subject to such conditions as the Secretary of Labor may specify.

C. PAYROLLS AND RECORDS—The Contractor and each subcontractor shall preserve his weekly payroll records for a period of three (3) years from date of completion of the Contract. The payroll records shall set out accurately and completely the name, address- and Social Security Number of each laborer and mechanic, his correct classification, rate of pay, daily and weekly number of hours worked, deductions made, and actual wages paid. Such payroll records shall be made available at all times for inspection by the Contracting Officer, and by authorized representatives of the U.S. Department of Labor.

D. PAYROLL DEDUCTIONS NOT SUBJECT TO SECRETARY OF LABOR APPROVAL— Deductions made under the circumstances or in the situations described in paragraphs of this Section may be made without application to and approval at the Secretary of Labor:

1. Any deduction made in compliance with the requirements of Federal, State, or local law, such as Federal or State withholding income taxes and Federal social security taxes.

2. Any deduction of sums previously paid to the employee as a bona fide prepayment of wages when such prepayment is made without discount or interest. A "bona fide prepayment of wages" is considered to have been made only when cash or its equivalent has been advanced to the person employed in such manner as to give him complete freedom of disposition of the advanced funds.

3. Any deduction of amounts required by court process to be paid to another, unless the deduction is in favor of the Contractor, subcontractor, or any affiliated person, or when collusion or collaboration exists.

4. Any deduction constituting a contribution on behalf of the person employed to funds established by the employer, or representatives of employees, or both, for the purpose of providing either from principal or income, or both, medical or hospital care, pensions or annuities or retirement, death benefits, compensation for injuries, illness, accidents, sickness, or disability, or for insurance to provide any of the foregoing, or unemployment benefits, vacation pay, savings accounts, or similar payments for the benefit of employees, their families and dependents: Provided, however, that the following standards are met:

a. The deduction is not otherwise prohibited by law;

b. it is either voluntarily consented to by the employee in writing and in advance of the period in which the work is to be done and such consent is not a condition either for the obtaining of or for the continuation of employment, or provided for in a bona fide collective bargaining agreement between the Contractor or subcontractor and representatives of his employees;

c. No profit or other benefit is otherwise obtained, directly or indirectly, by the Contractor or subcontractor or any affiliated person in the form of commission, dividend, or otherwise; and

d. The deductions - shall serve the convenience and interest of the employee.

5. Any deduction contributing toward the purchase of United States Defense Stamps and Bonds when voluntarily authorized by the employee.

6. Any deduction requested by the employee to enable him to repay loans to or to purchase shares in credit unions organized and operated in accordance with Federal, State and District credit union statutes.

7. Any deduction voluntarily authorized by the employee for the making of contributions to governmental or quasi-governmental agencies, such as the American Red Cross.

8. Any deduction voluntarily authorized by the employee for the making of contributions to Community Chests, United Givers Funds, and similar charitable organizations.

9. Any deduction to pay regular union initiation fees and membership dues, not including fines or special assessments; provided, however, that a collective bargaining agreement between the Contractor or subcontractor and representatives of his employees provides for such deductions and the deductions are not otherwise prohibited by law.

10. Any deduction not more than for the "reasonable cost" of. board, lodging, or other facilities meeting the requirements of Section 3(m) of the Fair Labor Standards Act of 1938, as amended, and Part 531 of said title. When such a deduction is made the additional records required under 516.25(a) of this title shall be kept.

E. PAYROLL. DEDUCTIONS SUBJECT TO SECRETARY OF LABOR APPROVAL—The Contractor and any subcontractor may apply to the Secretary of Labor for permission to make any deduction not permitted under Section D. The Secretary may grant permission whenever be finds that:

1. The Contractor, subcontractor or any ai1iated person does not make a profit or benefit directly from the deduction, either in the form of a commission, dividend or otherwise;

2. The deduction, is not otherwise prohibited by law;

3. The deduction is either:

a. voluntarily consented to by the employee in writing and in advance of the period in which the work is to be done and such consent is not a condition either for the obtaining of employment or its continuance, or

b. provided for in a bona fide collective bargaining agreement between the Contractor or subcontractor and representatives of its employees; and

4. The deduction services the convenience and interest of the employee.

F. APPLICATIONS FOR SECRETARY OF LABOR APPROVAL—Any application for the making of payroll deductions under Section E. shall comply with the requirements prescribed in Paragraphs 1 through 5:

1. The application shall be in writing and shall be addressed to the Secretary of Labor.

2. The application shall identify the Contract under which the work in question is to be performed. Permission will be given for deductions only on specific, identified contracts, except upon a showing of exceptional circumstances.

3. The application shall state affirmatively that there is compliance with the standards set forth in Section B. The affirmation shall be accompanied by a full statement of the facts indicating such compliance.

4. The application shall include a description of the proposed deduction, the purpose to be served thereby, and the classes of laborers or mechanics front whose wages proposed deduction would be made.

5. The application shall state the name and business of any third person to whom any funds obtained from the proposed deductions are to be transmitted and the affiliation of such person, if any, with the applicant.

G. ACTION BY SECRETARY OF LABOR UPON APPLICATIONS—The Secretary will decide whether or not the requested deduction is permissible under provisions of Section B, and shall notify the applicant in writing of his decision.

H. PROHIBITED PAYROLL DEDUCTIONS—Deductions not elsewhere stipulated and which are not found to be permissible under Section B are prohibited.

I. **METHODS OF PAYMENT OF WAGES—**The payment of wages shall be by cash, negotiable instruments payable on demand, or the additional forms of compensation for which deductions are permissible. No other methods of payment shall be recognized on work subject to the Copeland Act.

ARTICLE 6. RESERVED

ARTICLE 7. NONSEGREGATED FACILITIES—The Contractor certifies that he does not and will not maintain or provide for his employees any segregated facility at any of his establishments; that he does not and will not permit his employees to perform their services at any location under his control where segregated facilities are maintained; and that he will obtain and retain identical certifications from proposed subcontractors prior to award or subcontracts.

"Segregated facilities" shall mean any waiting room, work area, wash and rest rooms, restaurant and other eating area, time clock, locker room and other storage or dressing area, parking lot, drinking fountain, recreation or entertainment area, transportation and housing facility, provided for employees which is segregated by explicit directive or is segregated on the basis of race, color, age, sex, religion or national origin, because of habit, local custom or otherwise. Penalty for violation or making false statements is prescribed in 18 USC 1001.

DISTRICT OF COLUMBIA
WEEKLY STATEMENT OF COMPLIANCE
(Construction)

Project No. Invitation No.	Contract No.	Date

WAGES AND HOURS

	Total This Period	Total To Date
Straight Time Hours Worked		
Overtime Hours Worked		
Overtime and Straight Time Hours Combined		
Wages Earned		

I, _____, _____
(Name of signatory party) (Title)

do hereby state

(1) That I pay or supervise the payment of the persons employed by _____ _____ on the _____;
(Contractor or Subcontractor) (Building or Work)

that during the payroll period commencing on the _____ day of _____, 19____, and ending on the _____ day of _____, 19____, all persons employed on said project have been paid full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of said _____ _____
(Contractor or Subcontractor)

from the full weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in 29 CFR Part 3 issued by the Secretary of Labor under the Copeland Act as amended (48 Stat. 948; 63 Stat. 108; 72 Stat. 967; 76 Stat. 537; 40 USC 276c), and described below:

(2) That any payroll otherwise under the Contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage determination incorporated into the Contract; that the classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentice employed in the above period is duly registered in a bona fide apprenticeship program registered with the Bureau of Apprenticeship Training, U.S. Department of Labor.

NOTE—Fringe Benefits Statement and Signature Block are on reverse.

Form No. DC 2640-11

FRINGE BENEFITS STATEMENT

The Contractor, or subcontractor as appropriate, hereby states that:

(WHERE ALL OR A MAJORITY OF THE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS)

( ) Section 1—In addition to the basic hourly wage rates paid to each employee listed in the above referenced payroll, payments of fringe benefits as listed in the Contract have been or will be made to appropriate programs for the benefit of such employees, except as noted in Section 3 below.

(WHERE ALL OR A MAJORITY OF THE FRINGE BENEFITS ARE PAID IN CASH)

( ) Section 2—Each employee listed in the above referenced payroll has been paid, as indicated on the payroll, the basic hourly wage rate plus an additional payment in the amount of the required fringe benefits as listed in the Contract, except as noted in Section 3 below.

WHERE PART OF THE FRINGE BENEFITS ARE PAID IN CASH AND PART ARE PAID TO PLANS, FUNDS, OR PROGRAMS)

( ) Section 3—All of the fringe benefit payments required by the Contract have been or will be made to appropriate programs, or have been made by cash payments in lieu thereof, or both, to the classifications and in the amounts set forth below:

CLASSIFICATION (Or Classification Code)	HOURLY AMOUNT		IDENTITY AND LOCATION OF PLAN, FUND OR PROGRAM
	Paid To Program	Paid In Cash	

Signature	Title

The willful falsification of either of the statements which appear above may subject the Contractor to civil or criminal prosecution. See 18 USC 1001 and 1020 and 31 USC 231.

Rev. July 1973

"THE LIVING WAGE ACT OF 2006"

Title I, D.C. Law No. 16-118, (D.C. Official Code §§ 2-220.01-.11)

Effective June 9, 2006, recipients of new contracts or government assistance shall pay affiliated employees and subcontractors who perform services under the contracts no less than the current living wage.Effective January 1, 2010, the living wage rate is $12.50.

The requirement to pay a living wage applies to:

- All recipients of contracts in the amount of $100,000 or more; and, all subcontractors of these recipients receiving $15,000 or more from the funds received by the recipient from the District of Columbia, and,
- All recipients of government assistance in the amount of $100,000 or more; and, all subcontractors of these recipients of government assistance receiving $50,000 or more in funds from government assistance received from the District of Columbia.

"Contract" means a written agreement between a recipient and the District government.
"Government assistance" means a grant, loan or tax increment financing that result in a financial benefit from an agency, commission, instrumentality, or other entity of the District government.
"Affiliated employee" means any individual employed by a recipient who received compensation directly from government assistance or a contract with the District of Columbia government, including any employee of a contractor or subcontractor of a recipient who performs services pursuant to government assistance or contract. The term "affiliated employee" does not include those individuals who perform only intermittent or incidental services with respect to the contract or government assistance or who are otherwise employed by the contractor, recipient or subcontractor.

Certain exceptions may apply where contracts or agreements are subject to wage determinations required by federal law which are higher than the wage required by this Act; contracts for electricity, telephone, water, sewer other services delivered by regulated utility; contracts for services needed immediately to prevent or respond to a disaster or eminent threat to the public health or safety declared by the Mayor; contracts awarded to recipients that provide trainees with additional services provided the trainee does not replace employees; tenants or retail establishments that occupy property constructed or improved by government assistance, provided there is no receipt of direct District government assistance; Medicaid provider agreements for direct care services to Medicaid recipients, provided that the direct care service is not provided through a home care agency, a community residential facility or a group home for mentally retarded persons; and contracts or other agreements between managed care organizations and the Health Care Safety Net Administration or the Medicaid Assistance Administration to provide health services.

Exemptions are provided for employees under 22 years of age employed during a school vacation period, or enrolled as a full-time student who works less than 25 hours per week, provided that other employees are not replaced, and for employees of nonprofit organizations that employ not more than 50 individuals.

Each recipient and subcontractor of a recipient shall provide this notice to each affiliate employee covered by this notice, and shall also post this notice concerning these requirements in a conspicuous site in the place of business.

All recipients and subcontractors shall retain payroll records created and maintained in the regular course of business under District of Columbia law for a period of at least 3 years.

This is a summary of the "Living Wage Act of 2006". For the complete text go to:
www.does.dc.gov *or* www.ocp.dc.gov

To file a complaint contact: **Department of Employment Services**
Office of Wage-Hour
64 New York Avenue, N.E., Room 3105, Washington, D.C. 20002
(202) 671-1880

LIVING WAGE ACT FACT SHEET

The "Living Wage Act of 2006," Title I of D.C. Law 16-18, (D.C. Official Code §§2-220.01-.11) became effective June 9, 2006. It provides that District of Columbia government contractors and recipients of government assistance (grants, loans, tax increment financing) in the amount of $100,000 or more shall pay affiliated employees wages no less than the current living wage rate.

Effective January 1, 2010, the living wage rate is $12.50 per hour.

Subcontractors of D.C. government contractors who receive $15,000 or more from the contract and subcontractors of the recipients of government assistance who receive $50,000 or more from the assistance are also required to pay their affiliated employees no less than the current living wage rate.

"Affiliated employee" means any individual employed by a recipient who receives compensation directly from government assistance or a contract with the District of Columbia government, including any employee of a contractor or subcontractor of a recipient who performs services pursuant to government assistance or a contract. The term "affiliated employee" does not include those individuals who perform only intermittent or incidental services with respect to the government assistance or contract, or who are otherwise employed by the contractor, recipient or subcontractor.

Exemptions – The following contracts and agreements are exempt from the Living Wage Act:

1. Contracts or other agreements that are subject to higher wage level determinations required by federal law (i.e., if a contract is subject to the Service Contract Act and certain wage rates are lower than the District's current living wage, the contractor must pay the higher of the two rates);

2. Existing and future collective bargaining agreements, provided that the future collective bargaining agreement results in the employee being paid no less than the current living wage;

3. Contracts for electricity, telephone, water, sewer or other services provided by a regulated utility;

4. Contracts for services needed immediately to prevent or respond to a disaster or eminent threat to public health or safety declared by the Mayor;

5. Contracts or other agreements that provide trainees with additional services including, but not limited to, case management and job readiness services, provided that the trainees do not replace employees subject to the Living Wage Act;

6. An employee, under 22 years of age, employed during a school vacation period, or enrolled as full-time student, as defined by the respective institution, who is in high school or at an accredited institution of higher education and who works less than 25 hours per week; provided that he or she does not replace employees subject to the Living Wage Act;

7. Tenants or retail establishments that occupy property constructed or improved by receipt of government assistance from the District of Columbia; provided, that the tenant or retail establishment did not receive direct government assistance from the District of Columbia;

8. Employees of nonprofit organizations that employ not more than 50 individuals and qualify for taxation exemption pursuant to Section 501 (c) (3) of the Internal Revenue Code of 1954, approved August 16, 1954 (68A Stat. 163; 26. U.S.C. §501(c)(3);

9. Medicaid provider agreements for direct care services to Medicaid recipients, provided, that the direct care service is not provided through a home care agency, a community residence facility, or a group home for mentally retarded persons as those terms are defined in section 2 of the Health-Care and Community Residence Facility, Hospice, and Home Care Licensure Act of 1983, effective February 24, 1984 (D.C. Law 5-48; D.C. Official Code §44-501); and

10. Contracts or other agreements between managed care organizations and the Health Care Safety Net Administration or the Medicaid Assistance Administration to provide health services.

Enforcement

The Department of Employment Services (DOES) and the D.C. Office of Contracting and Procurement (OCP) share monitoring responsibilities.

If you learn that a contractor subject to this law is not paying at least the current living wage you should report it to the Contracting Officer.

If you believe that your employer is subject to this law and is not paying you at least the current living wage, you may file a complaint with the DOES Office of Wage – Hour, located at 64 New York Ave., NE, Room 3105, (202) 671-1880.

For questions and additional information, contact the Office of Contracting and Procurement at (202) 727-0252 or the Department of Employment Services on (202) 671-1880.

Please note: *This fact sheet is for informational purposes only as required by Section 106 of the Living Wage Act. It should not be relied on as a definitive statement of the Living Wage Act or any regulations adopted pursuant to the law.*

Construction Contractor's Performance Evaluation Guidelines

CONSTRUCTION CONTRACTOR PERFORMANCE EVALUATION GUIDELINES

1. INTRODUCTION

DEFINITIONS

The term "Contractor" means the Construction General Contractor.

The term "Administrator" means the Administrator of Construction in the Office of Property Management's (OPM) Construction Division.

The term "Deputy Director" means the Deputy Director of Construction in the Office of Property Management's Construction Division.

The term "Project Manager" means the Individual assigned to manage the Project by the Office of Property Management's Construction Division.

The term "Client" means the District agency for which the Office of Property Management is managing the Project.

The term "Project" means an Office of Property Management managed construction project.

The term "Representatives" means OPM's third party professionals, such as architects and engineers.

The acronym "QA/QC" means Quality Assurance/Quality Control.

The acronym "SOV" means Schedule of Values.

The Contractor Performance Evaluation System has been developed to evaluate the performance of contractors on current construction projects. This system makes it possible for the Office of Property Management to review the Contractor's performance on OPM managed construction projects.

OPM will conduct construction contractor performance evaluations for all construction projects managed by OPM regardless of the method of procurement.

2. SCHEDULE OF EVALUATION

(A) OPM will evaluate a Contractor's performance during the course of each Project. The minimum frequency of evaluations will be based on the percent of physical work completed, as shown in the following table:

(B)

MINIMUM FREQUENCIES OF PERFORMANCE EVALUATIONS

Contract Duration	Evaluation Frequency
Up to 4 months	One: at final completion
Between 4 to 12 months	Two: at 50% and final completion
Beyond 12 months	Five: at 15%, 30%, 50%, 75% and final completion

(B) In addition to the above, OPM reserves the right to evaluate a Contractor's performance at any time during a Project provided that no less than thirty (30) calendar days has elapsed since the last performance evaluation.

3. PERFORMANCE EVALUATION

The OPM Project Manager (PM) will be responsible for ensuring that the Contractor Performance Evaluation Form (Exhibit A) is completed and submitted to the Administrator in accordance with the above Section 2. The Contractor Performance Evaluation Form consists of two parts: Part 1 Summary Report, and Part 2 OPM Project Manager Report. Upon completing Part 2, the PM will complete Part 1 Summary Report and calculate the Contractor's overall performance rating for the project to-date. The PM will be responsible for completing and submitting its evaluation to the OPM Senior Project Manager (Senior PM) within 5 business days of Contractor's completion of an evaluation milestone as set forth in the table in Section 2(A) above, and additionally will be responsible for completing and submitting its evaluation to the Senior PM at such other times as OPM deems appropriate, in its sole discretion, in accordance with Section 2(B) above.

The Senior PM will be responsible for submitting the completed Contractor Performance Evaluation Form to the Administrator for review approval. The Administrator will review the Contractor Performance Evaluation Form to ensure that ratings are fair, consistent, and accurate based on the underlying facts and supporting documentation.

Upon approval, the Administrator will forward the Contractor Performance Evaluation Form to the Deputy Director for approval and signature. The final evaluation form will be sent to the Contractor per Section 6 of these guidelines.

4. EVALUATION CRITERIA

As identified on the Contractor Performance Evaluation Form, the evaluation criteria and sub-factors of each criteria are:

QUALITY OF WORK

- Quality of Workmanship
- Quality of Subcontractors' Work
- Compliance with Plans and Specifications
- Adequacy of the QA/QC Plan
- Adequacy of the QA/QC Testing
- Implementation of the QA/QC Plan
- Quality of QA/QC Documentation

- Storage of Materials
- Adequacy of Materials
- Use of Specified Materials
- Quality of Submittals
- Timely Correction of Deficient Work

COST CONTROL

- Practices Change Order Avoidance and Minimization
- Change Order Documentation
- Change Order Pricing (based on the percentage calculated by dividing the total value of the change orders since the last evaluation by the total Project Budget applicable to the same period, the rating for this sub-factor shall be: $\leq 3\% = 100$, $\leq 10\% = 90$, $\leq 15\% = 80$, $\leq 20\% = 70$, $\geq 20\% = 60$
- Timely Performs Change Order Work
- Subcontractor Change Order Review and Approval

SCHEDULE/TIME MANAGEMENT

- Adequacy of Initial Project Schedule
- Adherence to Approved Schedule
- Schedule Update Timeliness and Accuracy (Monthly)
- Timely Submittal of and Adherence to Recovery Schedule (If Applicable)
- Timely Notification of Conditions Impacting Schedule (such as, inspectors, material lead times, coordination with other city agencies)
- Timely Submission of Shop Drawings
- Timely Payments to Subcontractors and Vendors
- Timely Conducting of all Inspections, including, for example, inspections for permits (materials, mechanical systems, close-out, etc.)

MANAGEMENT

- Cooperation/Responsiveness with OPM Project Staff, Client and Representatives
- Coordination with Other Primes
- Coordination and Control of Subcontractors
- Professional Conduct
- Management of Personnel/Resources
- Adequate Amount of Workforce, Materials and Equipment to Meet Schedule
- Job-site Supervision
- Adequacy of Daily Work Log
- Review/Resolution of Subcontractor's Issues
- Compliance with Laws, Regulations, Permits, Inspections, Testing
- Housekeeping (i.e. cleanliness of job site, trailer, etc.)
- Invoices adhere to approved S.O.V./% Complete

LABOR STANDARDS

- Prompt Correction of Deficiencies
- Certified Payrolls Properly Completed and Submitted
- Compliance with Labor Laws
- Compliance with Prevailing Wage Laws
- Trained and Skilled Workforce

SAFETY STANDARDS

- Adequacy of Safety Plan
- Implementation of Safety Plan
- Minimizes Job-site Accidents
- On-site Safety Maintenance
- Compliance with Worker Exposure Requirements
- Compliance with Drug/Alcohol Abuse Requirements
- Adequacy of Regulatory Compliance Documentation

CLOSE-OUT

- Prompt Submission and Quality Completion of Punch List
- Prompt Submission and Quality Completion of As-built Drawings, O&M Manuals, Warranties, etc.
- Adequacy of User Training
- Supports Building Commissioning
- Demobilization and Site Clean-up

5. PERFORMANCE EVALUATION RATING SYSTEM

In evaluating and rating each criteria and subfactor on the Contractor Performance Evaluation Form, the evaluator will use the following rating systems. The ratings reflect the District's satisfaction with the Contractor's performance of the requirements of the Project from the date of the last evaluation (or from Project commencement if it is a first Project evaluation) **to the date of the current evaluation).**

<u>Excellent (100)</u>
When applied to the individual evaluation sub-factor, a rating of excellent should be given if the contractor work far exceeds the contract requirements by consistently exhibiting excellent performance typically meets and regularly exceeds the contract requirements.

<u>Good (90)</u>
When applied to the individual evaluation sub-factor, a rating of good should be given if the Contractor often exceeds the contract requirements and frequently provides a high level of performance, typically meets, and often exceeds the contract requirements.

<u>Satisfactory (80)</u>
When applied to the individual evaluation sub-factor, a rating of satisfactory should be given if the Contractor provides an acceptable level of performance consistently meeting the contract requirements.

<u>Marginal (70)</u>
When applied to the individual evaluation sub-factor, a rating of satisfactory should be given if the Contractor performs slightly below the requirements of the contract, meeting the contract requirements on an intermittent basis.

<u>Unsatisfactory (60)</u>

When applied to the individual evaluation sub-factor, a rating of unsatisfactory should be given if the Contractor fails to meet important contract requirements, resulting in a negative impact on the entire project.

For any performance evaluation rating value below Satisfactory (80.0), the evaluator must provide written comments with specific explanations of how and when a Contractor failed to meet the contract requirements.

6. NOTIFICATION TO CONTRACTOR

OPM will notify the Contractor of the results of the most recent performance evaluation. The notification will include a cover letter, and a copy of the Contractor Performance Evaluation Form with supporting documents, if any. If the overall Performance Rating is below Satisfactory (80.0), the cover letter will set forth a timeframe in which the Contractor must correct deficiencies to achieve an overall performance rating of at least satisfactory (80.0). If the Contractor fails to remedy the deficiencies within this timeframe, OPM will input results into the OPM database and submit a copy of evaluation and supporting documents to the Office of Contracts and Procurement (OCP) for inclusion in the Contractor's OCP file.

7. CONTRACTOR CHALLENGES

A Contractor who wishes to challenge a performance evaluation shall submit its challenge in writing to the Deputy Director, with a copy to the Administrator, postmarked within fifteen (15) calendar days of date of notice.

The written challenge must include a detailed explanation, and documentation, if any, of the specific grounds for the challenge.

Failure to timely challenge a performance evaluation in the manner required will be deemed to be a waiver of Contractor's right to challenge that performance evaluation.

If a challenge, in accordance with this Section 7, is given by a Contractor, the results of the Contractor's performance evaluation will not be final (entered into the OPM database) until the Deputy Director renders a final written decision. Upon arriving at a final decision, the Deputy Director, or his designee, will forward said decision to the Contractor. If the Deputy Director's final decision is to maintain the overall Performance Rating, the Deputy Director will forward a copy of the decision to OCP and the Contractor shall be added to the OPM database and a copy of evaluation and supporting documents will be provided to OCP for inclusion in the Contractor's OCP file.

8. MULTIPLE PERFORMANCE EVALUATION RATINGS

At the completion of a Project, the Contractor will be given a Final Performance Evaluation Rating which will be calculated by averaging <u>all</u> Performance Ratings given in the course of the Project.

Exhibit A

CONTRACTOR PERFORMANCE EVALUATION FORM

Part 1
Summary Report

DATE **1/16/09**_____

CONTRACTOR _____

CONTACT NAME _____

PROJECT NUMBER _____

PROJECT NAME _____

PROJECT ADDRESS _____

EVALUATION SCHEDULE (based on physical work):

Circle One: 15% 30% 50% 75% Final Other_____

EVALUATOR _____ **DATE** _____

INSTRUCTIONS:

The Office of Property Management (OPM) should complete a performance evaluation form for each prime contract according to the evaluation schedule set forth above. It is important to use the point ranking system specified on this form.

	SUMMARY RATING	N/A
QUALITY OF WORK		
COST CONTROL		
SCHEDULE/TIME MANAGEMENT		
MANAGEMENT		
COMPLIANCE WITH SAFETY STANDARDS		
CLOSEOUT (Final Only)		
OVERALL PERFORMANCE RATING*		

*****Sum of Summary Ratings divided by number of categories evaluated.

_____ _____
PROJECT MANAGER/DATE **SR. PROJECT MANAGER/DATE**

_____ _____
ADMINISTRATOR/DATE **DEPUTY DIRECTOR/DATE**

Exhibit A
CONTRACTOR PERFORMANCE EVALUATION FORM
Part 2
Construction Inspection Supervisor Detailed Report

DATE _____
CONTRACTOR _____
CONTACT NAME _____
PROJECT NUMBER _____
PROJECT NAME _____
PROJECT ADDRESS _____

EVALUATION SCHEDULE
Circle One: 15% 30% 50% 75% Final Other_____

EVALUATOR _____ **DATE** _____

QUALITY OF WORK	**N/A**	**Excellent**	**Good**	**Satisfactory**	**Marginal**	**Unsatis-factory**
Quality of Workmanship		100	90	80	70	60
Quality of Subcontractor's Work		100	90	80	70	60
Compliance with Plans and Specifications		100	90	80	70	60
Implementation of the QA/QC Plan		100	90	80	70	60
Adequacy of the QA/QC Plan		100	90	80	70	60
Adequacy of QA/QC Testing		100	90	80	70	60
Quality of QA/QC Documentation		100	90	80	70	60
Storage of Materials		100	90	80	70	60
Adequacy of Materials		100	90	80	70	60
Use of Specified Materials		100	90	80	70	60
Quality of Submittals		100	90	80	70	60
Identification and Timely Correction of Deficient Work		100	90	80	70	60
Summary Rating (Sum of values circled divided by number of sub-factors evaluated)						

Comments for Individual or Summary Ratings less than 80: _____
_____

COST CONTROL	**N/A**	**Excellent**	**Good**	**Satisfactory**	**Marginal**	**Unsatisfactory**
Practices Change Order Avoidance and Minimization		100	90	80	70	60
Change Order Documentation		100	90	80	70	60
Change Order Pricing		100	90	80	70	60
Timely Performs Change Order Work		100	90	80	70	60
Subcontractor Change Order Review and Approval		100	90	80	70	60
Summary Rating (Sum of values circled divided by number of sub-factors evaluated)						

Comments for Individual or Summary Ratings less than 80: _____
_____

Exhibit A

CONTRACTOR PERFORMANCE EVALUATION FORM

SCHEDULE/TIME MANAGEMENT	**N/A**	**Excellent**	**Good**	**Satisfactory**	**Marginal**	**Unsatis-factory**
Adequacy of Initial Project Schedule		100	90	80	70	60
Adherence to Approved Schedule		100	90	80	70	60
Schedule Update Timeliness and Accuracy		100	90	80	70	60
Timely Submittal and Adherence to Recovery Schedule		100	90	80	70	60
Timely Notification of Conditions Impacting Schedule, Tie-ins, Shut-downs, etc.		100	90	80	70	60
Time Submission of Shop Drawings		100	90	80	70	60
Timely Payments to Subcontractors and Vendors (Compliance with Prompt Payment Act)		100	90	80	70	60
Timely in Obtaining Permits, Conducting Inspections, etc.		100	90	80	70	60
Summary Rating (Sum of values circled divided by number of sub-factors evaluated)						

Comments for Individual or Summary Ratings less than 80:_____

_____

MANAGEMENT	**N/A**	**Excellent**	**Good**	**Satisfactory**	**Marginal**	**Unsatisfactory**
Cooperation/Responsiveness with OPM Project Staff, Client and Representatives		100	90	80	70	60
Coordination with Other Primes		100	90	80	70	60
Coordination and Control of Subcontractors		100	90	80	70	60
Professional Conduct		100	90	80	70	60
Management of Personnel/Resources		100	90	80	70	60
Provides Adequate Amount of Workforce, Materials and Equipment to Meet Schedule		100	90	80	70	60
Job-Site Supervision		100	90	80	70	60
Adequacy of Daily Work Log		100	90	80	70	60
Review/Resolution of Subcontractor's Issues		100	90	80	70	60
Practices Claim Avoidance and Minimization		100	90	80	70	60
Compliance with Laws, Regulations, Permits, Inspections, Testing		100	90	80	70	60
Housekeeping		100	90	80	70	60
Invoices adhere to approved S.O.V. % complete						
Summary Rating (Sum of values circled divided by number of sub-factors evaluated)						

Comments for Individual or Summary Ratings less than 80:_____

_____

Exhibit A

CONTRACTOR PERFORMANCE EVALUATION FORM

LABOR STANDARDS	**N/A**	**Excellent**	**Good**	**Satisfactory**	**Marginal**	**Unsatisfactory**
Correction of Noted Deficiencies		100	90	80	70	60
Payrolls Properly Completed and Submitted		100	90	80	70	60
Compliance with Labor Laws		100	90	80	70	60
Compliance with Prevailing Wage Law		100	90	80	70	60
Trained and Skilled Workforce		100	90	80	70	60
Summary Rating (Sum of values circled divided by number of sub-factors evaluated)						

Comments for Individual or Summary Ratings less than 80:_____

_____

SAFETY STANDARDS	**N/A**	**Excellent**	**Good**	**Satisfactory**	**Marginal**	**Unsatisfactory**
Adequacy of Safety Plan		100	90	80	70	60
Implementation of Safety Plan		100	90	80	70	60
Minimizes Job-site Accidents		100	90	80	70	60
On-site Safety Maintenance		100	90	80	70	60
Compliance with Worker Exposure Requirements		100	90	80	70	60
Compliance with Drug/Alcohol Abuse Requirements		100	90	80	70	60
Adequacy of Regulatory Compliance Documentation		100	90	80	70	60
Summary Rating (Sum of values circled divided by number of sub-factors evaluated)						

Comments for Individual or Summary Ratings less than 80:_____

_____

CLOSE-OUT	**N/A**	**Excellent**	**Good**	**Satisfactory**	**Marginal**	**Unsatisfactory**
Promptness/Quality of Punch List		100	90	80	70	60
Promptness/Quality of As-built Drawings, O&M Manuals, Warranties, etc…		100	90	80	70	60
Adequacy of User Training		100	90	80	70	60
Supports Building Commissioning		100	90	80	70	60
Demobilization and Site Clean-up		100	90	80	70	60
Summary Rating (Sum of values circled divided by number of sub-factors evaluated)						

Comments for Individual or Summary Ratings less than 80:_____

_____

Exhibit A
CONTRACTOR PERFORMANCE EVALUATION FORM

INSTRUCTIONS:
In the space provided below, if applicable, provide additional text to identify and to describe how specific individuals or firms exerted a positive or negative impact on the contractor's performance on this project. The text provided below is for informational purposes only and should already be factored into the evaluation ratings.

Contractor's Personnel

Subcontractor's Personnel