

Photograph #25



Homogenous Material Description

HA-25: beige duct caulk

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

660 SF

Additional Notes

Photograph #26



Homogenous Material Description

HA-26: white caulk on HVAC / wall

Asbestos Present (Yes/No/Assumed)

Yes

Total Quantity Present

10 LF

Additional Notes

3% Chrysotile

Photograph #27



Homogenous Material Description

HA-27: 12" grey mottle floor tile / mastic

Asbestos Present (Yes/No/Assumed)

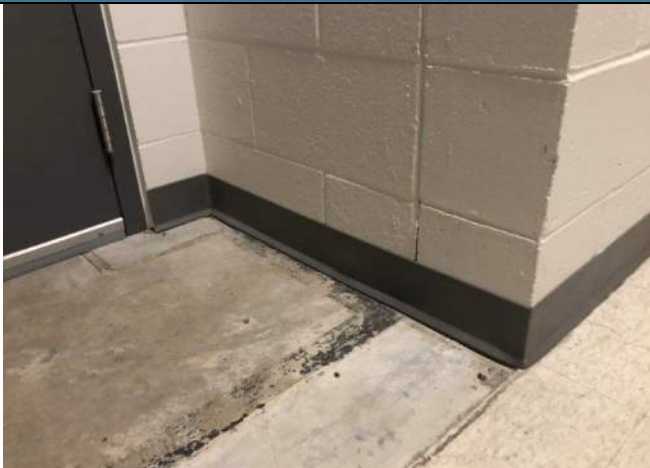
No

Total Quantity Present

1150 SF

Additional Notes

Photograph #28



Homogenous Material Description

HA-28: Cove base - 4" grey vinyl with adhesive

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

9665 LF

Additional Notes

Photograph #29



Homogenous Material Description

HA-29: grey duct caulk

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

20 SF

Additional Notes

Photograph #30



Homogenous Material Description

HA-30: Light brown carpet mastic

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

6000 SF

Additional Notes

Photograph #31



Homogenous Material Description
HA-31: Ceiling panel – 2' rough texture
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
50715 SF
Additional Notes

Photograph #32



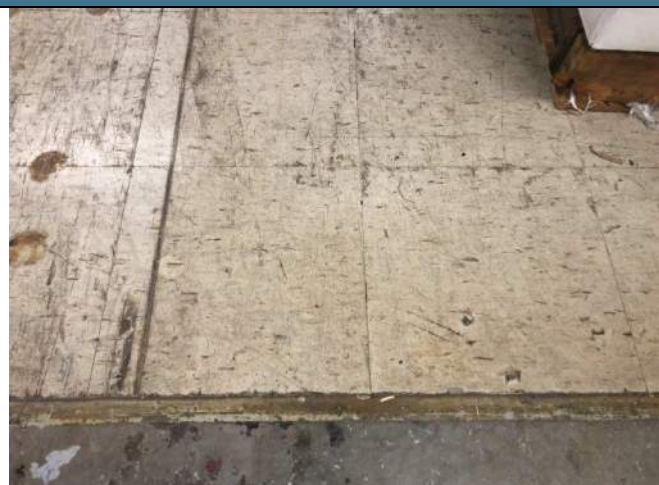
Homogenous Material Description
HA-32: Fireproofing – pressed on grey patching
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
854 SF
Additional Notes

Photograph #33



Homogenous Material Description
HA-33: Cove base – 4" black vinyl / adhesive
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
345 LF
Additional Notes

Photograph #34



Homogenous Material Description
HA-34: 12" light brown floor tile with grey/brown mottle, and mastic
Asbestos Present (Yes/No/Assumed)
Trace Chrysotile
Total Quantity Present
780 SF
Additional Notes

Photograph #35



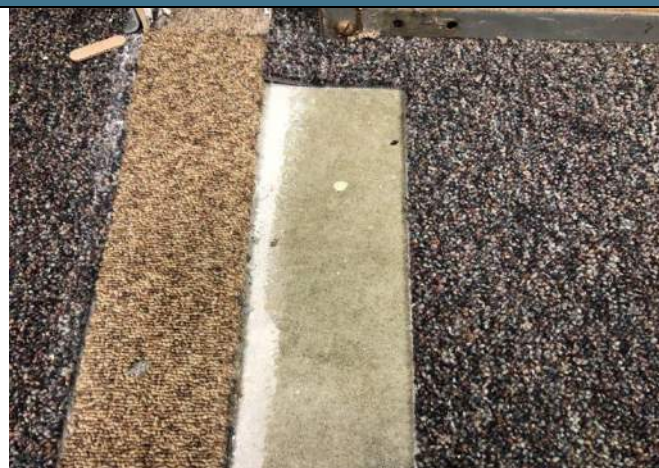
Homogenous Material Description
HA-35: 12" white tile with grey / blue mottle, and adhesive
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
330 SF
Additional Notes

Photograph #36



Homogenous Material Description
HA-36: Wallboard panel walls
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
3720 SF
Additional Notes

Photograph #37



Homogenous Material Description
HA-37: Translucent green carpet mastic
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
67215 SF
Additional Notes

Photograph #38



Homogenous Material Description
HA-38: grey caulk, window perimeter
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
690 LF
Additional Notes

Photograph #39



Homogenous Material Description
HA-39: Plaster column casings
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
9920 SF
Additional Notes

Photograph #40



Homogenous Material Description

HA-40: Rolled-in insulation – yellow fiberglass with black paper

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

730 SF

Additional Notes

Photograph #41



Homogenous Material Description

HA-41: Sink undercoating – grey spray-on with black sticker

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

1 Sink

Additional Notes

Photograph #42



Homogenous Material Description

HA-42: Grey stone pattern ceramic tile

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

1240 SF

Additional Notes

Photograph #43



Homogenous Material Description

HA-43: Joint compound - patching

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

15 SF

Additional Notes

Photograph #44



Homogenous Material Description

HA-44: Beige duct caulk

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

30 SF

Additional Notes

Photograph #45



Homogenous Material Description

HA-45: Black tar tape

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

10 SF

Additional Notes

Photograph #46



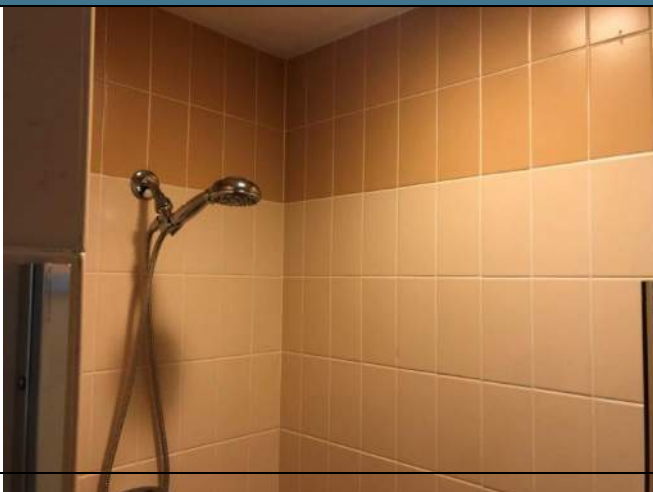
Homogenous Material Description
HA-46: Rolled-in insulation – yellow fiberglass with foil cover, around ducts
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
7993 SF
Additional Notes

Photograph #47



Homogenous Material Description
HA-47: 1” beige/grey ceramic floor tile
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
2370 SF
Additional Notes

Photograph #48



Homogenous Material Description
HA-48: 4” beige/brown ceramic wall tile
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
140 SF
Additional Notes

Photograph #49



Homogenous Material Description

HA-49: 12" light brown floor tile with white/red streaks, and mastic

Asbestos Present (Yes/No/Assumed)

Yes

Total Quantity Present

960 SF

Additional Notes

Floor tile: 0.75% Chrysotile
Mastic: 2% Chrysotile

Photograph #50



Homogenous Material Description

HA-50: Black glaze in door windows

Asbestos Present (Yes/No/Assumed)

Yes

Total Quantity Present

120 Doors

Additional Notes

6% Chrysotile

Photograph #51



Homogenous Material Description

HA-51: Penetration mud, grey

Asbestos Present (Yes/No/Assumed)

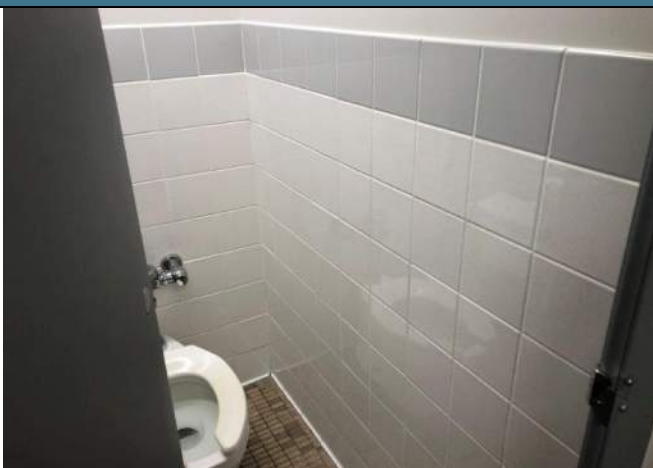
No

Total Quantity Present

34 SF

Additional Notes

Photograph #52



Homogenous Material Description
HA-52: 6" white/grey wall tile
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
2700 SF
Additional Notes

Photograph #53



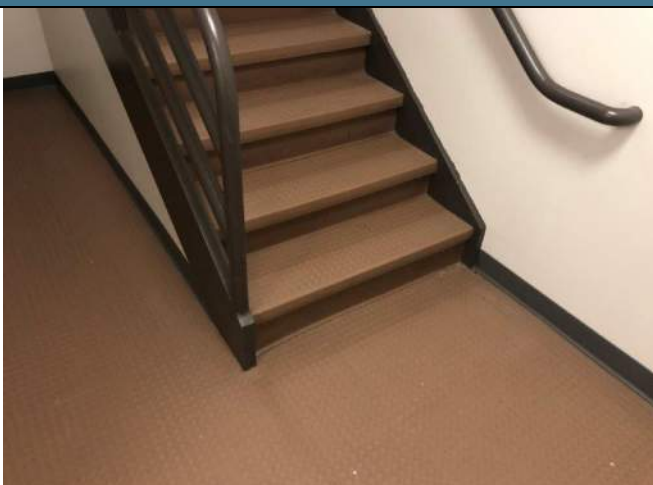
Homogenous Material Description
HA-53: White caulk on restroom fixtures
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
280 LF
Additional Notes

Photograph #54



Homogenous Material Description
HA-54: Elevator door insulation
Asbestos Present (Yes/No/Assumed)
Assumed
Total Quantity Present
15 Doors
Additional Notes

Photograph #55



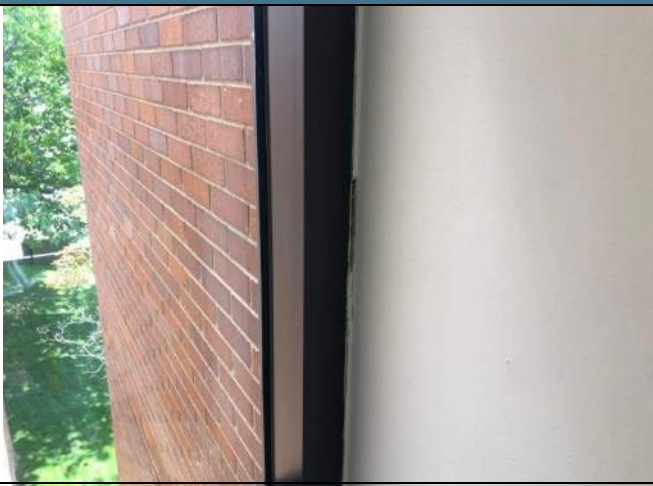
Homogenous Material Description
HA-55: Floor sheeting – brown with round raised treads, and mastic
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
3600 SF
Additional Notes

Photograph #56



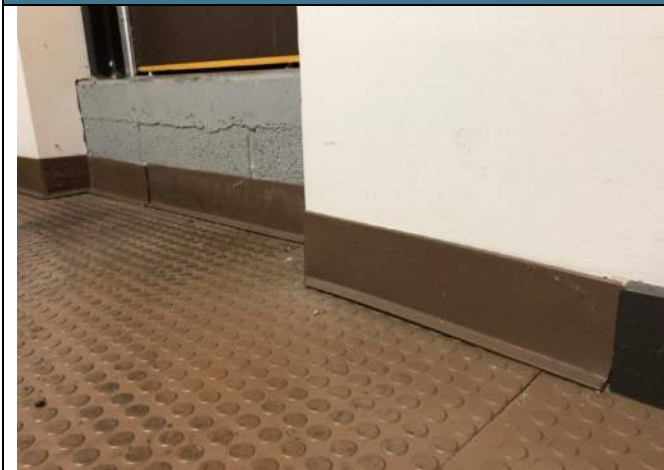
Homogenous Material Description
HA-56: Plaster – underside of stairs
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
3600 SF
Additional Notes

Photograph #57



Homogenous Material Description
HA-57: Yellowish white caulk – window frame perimeters
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
1005 LF
Additional Notes

Photograph #58



Homogenous Material Description

HA-58: Cove base – 4" brown vinyl / adhesive

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

90 LF

Additional Notes

Photograph #59



Homogenous Material Description

HA-59: Ceiling pane' 2'x4' pinhole/fissure

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

700 SF

Additional Notes

Photograph #60



Homogenous Material Description

HA-60: White penetration mud, on pipes

Asbestos Present (Yes/No/Assumed)

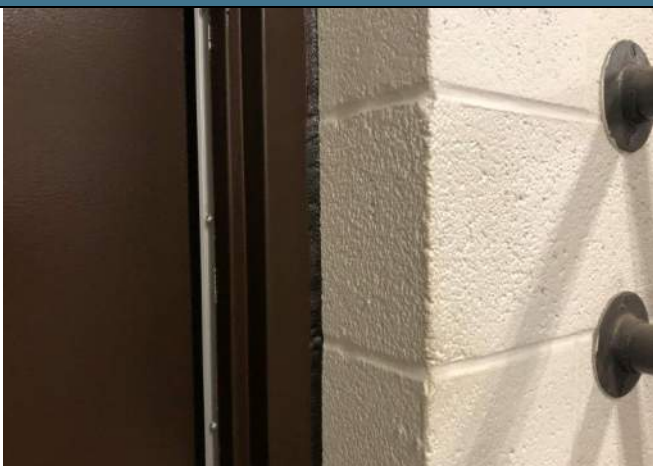
No

Total Quantity Present

130 SF

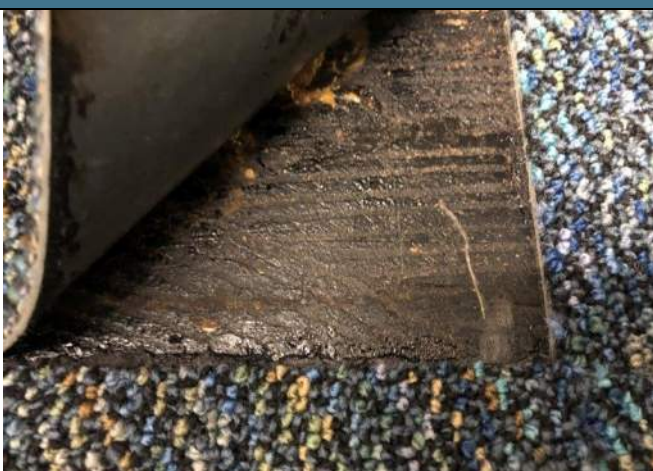
Additional Notes

Photograph #61



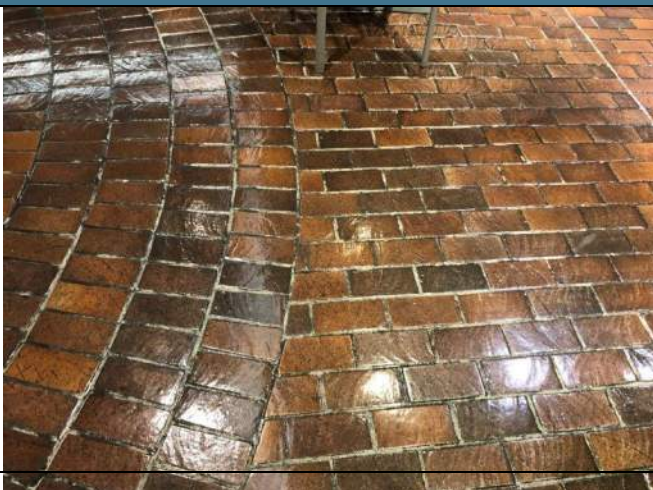
Homogenous Material Description
HA-61: Black caulk, perimeter of door frames
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
110 LF
Additional Notes

Photograph #62



Homogenous Material Description
HA-62: Black mastic, from former tile
Asbestos Present (Yes/No/Assumed)
Yes
Total Quantity Present
490 SF
Additional Notes
2% Chrysotile

Photograph #63



Homogenous Material Description
HA-63: Brick mortar –red brick floor
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
1260 SF
Additional Notes

Photograph #64



Homogenous Material Description

HA-64: Penetration mud, dark grey

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

40 SF

Additional Notes

Photograph #65



Homogenous Material Description

HA-65: White caulk – perimeter of counter window frames

Asbestos Present (Yes/No/Assumed)

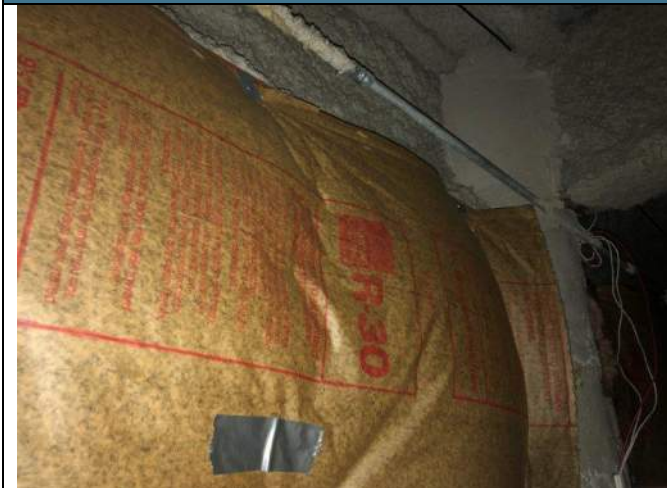
No

Total Quantity Present

775 LF

Additional Notes

Photograph #66



Homogenous Material Description

HA-66: Rolled-in insulation – fiberglass with brown paper and black adhesive

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

240 SF

Additional Notes

Photograph #67



Homogenous Material Description
HA-67: Sink undercoating – black spray-on with sticker
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
2 Sinks
Additional Notes

Photograph #68



Homogenous Material Description
HA-68: Glass block grout
Asbestos Present (Yes/No/Assumed)
Assumed
Total Quantity Present
90 sF
Additional Notes

Photograph #69



Homogenous Material Description
HA-69: Sink undercoating – grey spray-on
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
1 Sink
Additional Notes

Photograph #70



Homogenous Material Description

HA-70: Dark grey caulk, elevator frame perimeter

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

30 LF

Additional Notes

Photograph #71



Homogenous Material Description

HA-71: Exterior concrete walkways

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

2440 SF

Additional Notes

Photograph #72



Homogenous Material Description

HA-72: Expansion joint in concrete walkways

Asbestos Present (Yes/No/Assumed)

No

Total Quantity Present

960 LF

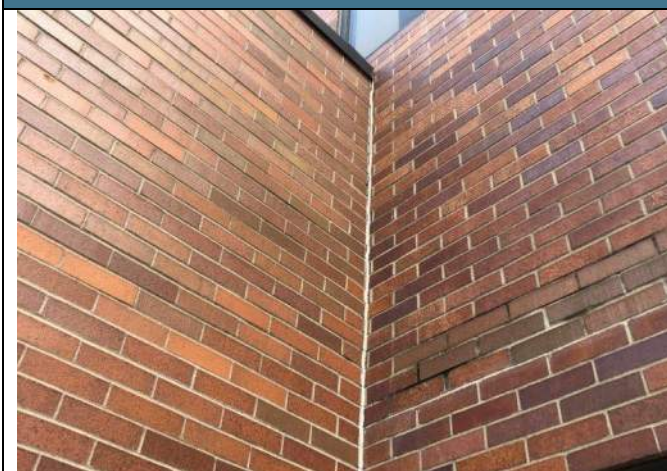
Additional Notes

Photograph #73



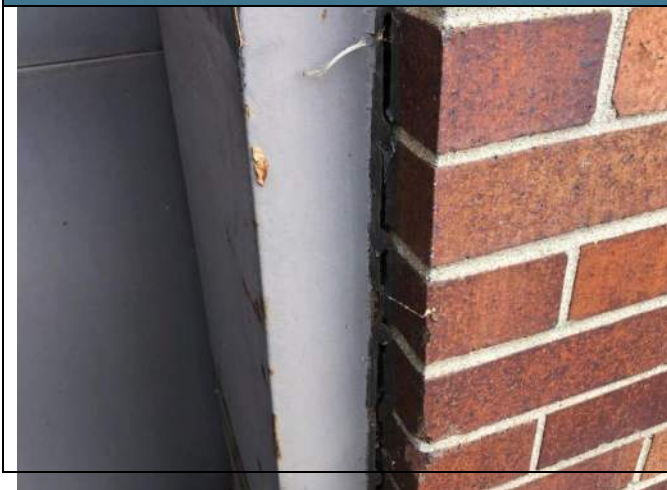
Homogenous Material Description
HA-73: Brick mortar – red brick siding
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
32070 SF
Additional Notes

Photograph #74



Homogenous Material Description
HA-74: White caulk – seams of brick siding
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
1650 LF
Additional Notes

Photograph #75



Homogenous Material Description
HA-75: Black caulk – perimeter of bay doors
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
60 LF
Additional Notes

Photograph #76



Homogenous Material Description
HA-76: Grey caulk in concrete walkways
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
270 LF
Additional Notes

Photograph #77



Homogenous Material Description
HA-77: Dark grey caulk, on granite capstones
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
1760 LF
Additional Notes

Photograph #78



Homogenous Material Description
HA-78: Black caulk on metal window frames
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
2640 LF
Additional Notes

Photograph #79



Homogenous Material Description
HA-79: Red expansion joint, in brick siding
Asbestos Present (Yes/No/Assumed)
No
Total Quantity Present
780 LF
Additional Notes

Photograph #80



Homogenous Material Description
HA-80: Roofing materials – rubber membrane flat roof
Asbestos Present (Yes/No/Assumed)
Assumed
Total Quantity Present
20000 SF
Additional Notes

Photograph #81



Homogenous Material Description
HA-81: Roofing tar -black
Asbestos Present (Yes/No/Assumed)
Assumed
Total Quantity Present
5620 LF
Additional Notes

Photograph #82



Homogenous Material Description

HA-82: Black caulk – on flashing

Asbestos Present (Yes/No/Assumed)

Assumed

Total Quantity Present

320 LF

Additional Notes

Photograph #83



Homogenous Material Description

HA-83: caulk – grey on flashing

Asbestos Present (Yes/No/Assumed)

Assumed

Total Quantity Present

150 LF

Additional Notes

Photograph #84



Homogenous Material Description

HA-84: caulk –white, on flashing

Asbestos Present (Yes/No/Assumed)

Assumed

Total Quantity Present

150 LF

Additional Notes

APPENDIX C

ASBESTOS LABORATORY RESULTS



**ENVIRONMENTAL TESTING
LABORATORIES, INC.**

37575 W HURON RIVER DRIVE
ROMULUS, MICHIGAN 48174
(734) 955-6600
FAX: (734) 955-6604

To: Atlas - Novi
46555 Humboldt Dr. Suite 100
Novi, Michigan 48377

ETL Job: 271589
Client Project: 188BS24470

Attention: Robert Smith
Project Location: 411 E Genesee Avenue, Saginaw, MI 48607
Jerome T. Hart State Office Building

Lab Sample Number	Client Sample Number	Sample Type	Completed
1696093	2-CC-A	Asbestos	08/14/2024
1696094	2-CC-B	Asbestos	08/14/2024
1696095	2-CC-C	Asbestos	08/14/2024
1696096	3-CC-A	Asbestos	08/14/2024
1696097	3-CC-B	Asbestos	08/14/2024
1696098	3-CC-C	Asbestos	08/14/2024
1696099	4-CC-A	Asbestos	08/14/2024
1696100	4-CC-B	Asbestos	08/14/2024
1696101	4-CC-C	Asbestos	08/14/2024
1696102	5-BM-A	Asbestos	08/14/2024
1696103	5-BM-B	Asbestos	08/14/2024
1696104	5-BM-C	Asbestos	08/14/2024
1696105	6-BM-A	Asbestos	08/14/2024
1696106	6-BM-B	Asbestos	08/14/2024
1696107	6-BM-C	Asbestos	08/14/2024
1696108	7-EJ-A	Asbestos	08/14/2024

Lab Sample Number	Client Sample Number	Sample Type	Completed
1696109	7-EJ-B	Asbestos	08/14/2024
1696110	7-EJ-C	Asbestos	08/14/2024
1696111	8-FP-A	Asbestos	08/14/2024
1696112	8-FP-B	Asbestos	08/14/2024
1696113	8-FP-C	Asbestos	08/14/2024
1696114	8-FP-D	Asbestos	08/14/2024
1696115	8-FP-E	Asbestos	08/14/2024
1696116	8-FP-F	Asbestos	08/14/2024
1696117	8-FP-G	Asbestos	08/14/2024
1696118	8-FP-H	Asbestos	08/14/2024
1696119	9-PI-A	Asbestos	08/14/2024
1696120	9-PI-B	Asbestos	08/14/2024
1696121	9-PI-C	Asbestos	08/14/2024
1696122	10-PI-A	Asbestos	08/14/2024
1696123	10-PI-B	Asbestos	08/14/2024
1696124	10-PI-C	Asbestos	08/14/2024
1696125	12-PF-A	Asbestos	08/13/2024
1696126	12-PF-B	Asbestos	08/13/2024
1696127	12-PF-C	Asbestos	08/13/2024
1696128	14-GTM-A	Asbestos	08/13/2024
1696129	14-GTM-B	Asbestos	08/13/2024
1696130	14-GTM-C	Asbestos	08/13/2024
1696131	17-TZ-A	Asbestos	08/14/2024
1696132	17-TZ-B	Asbestos	08/14/2024
1696133	17-TZ-C	Asbestos	08/14/2024
1696134	18-WBS-A	Asbestos	08/14/2024

Lab Sample Number	Client Sample Number	Sample Type	Completed
1696135	18-WBS-B	Asbestos	08/14/2024
1696136	18-WBS-C	Asbestos	08/14/2024
1696137	19-IC-A	Asbestos	08/14/2024
1696138	19-IC-B	Asbestos	08/14/2024
1696139	19-IC-C	Asbestos	08/14/2024
1696140	20-IC-A	Asbestos	08/14/2024
1696141	20-IC-B	Asbestos	08/14/2024
1696142	20-IC-C	Asbestos	08/14/2024
1696143	21-IC-A	Asbestos	08/14/2024
1696144	21-IC-B	Asbestos	08/14/2024
1696145	21-IC-C	Asbestos	08/14/2024
1696146	22-IC-A	Asbestos	08/14/2024
1696147	22-IC-B	Asbestos	08/14/2024
1696148	22-IC-C	Asbestos	08/14/2024
1696149	23-IC-A	Asbestos	08/14/2024
1696150	23-IC-B	Asbestos	08/14/2024
1696151	23-IC-C	Asbestos	08/14/2024
1696152	24-IC-A	Asbestos	08/14/2024
1696153	24-IC-B	Asbestos	08/14/2024
1696154	24-IC-C	Asbestos	08/14/2024
1696155	25-IC-A	Asbestos	08/14/2024
1696156	25-IC-B	Asbestos	08/14/2024
1696157	25-IC-C	Asbestos	08/14/2024
1696158	26-IC-A	Asbestos	08/14/2024
1696159	26-IC-B	Asbestos	08/14/2024
1696160	26-IC-C	Asbestos	08/14/2024

Lab Sample Number	Client Sample Number	Sample Type	Completed
1696161	27-FT-A	Asbestos	08/14/2024
1696162	27-FT-B	Asbestos	08/14/2024
1696163	27-FT-C	Asbestos	08/14/2024
1696164	28-CB-A	Asbestos	08/14/2024
1696165	28-CB-B	Asbestos	08/14/2024
1696166	28-CB-C	Asbestos	08/14/2024
1696167	29-IC-A	Asbestos	08/14/2024
1696168	29-IC-B	Asbestos	08/14/2024
1696169	29-IC-C	Asbestos	08/14/2024
1696170	30-CM-A	Asbestos	08/14/2024
1696171	30-CM-B	Asbestos	08/14/2024
1696172	30-CM-C	Asbestos	08/14/2024
1696173	31-CP-A	Asbestos	08/14/2024
1696174	31-CP-B	Asbestos	08/14/2024
1696175	31-CP-C	Asbestos	08/14/2024
1696176	32-FP-A	Asbestos	08/14/2024
1696177	32-FP-B	Asbestos	08/14/2024
1696178	32-FP-C	Asbestos	08/14/2024
1696179	33-CB-A	Asbestos	08/14/2024
1696180	33-CB-B	Asbestos	08/14/2024
1696181	33-CB-C	Asbestos	08/14/2024
1696182	34-FT-A	Asbestos	08/14/2024
1696183	34-FT-B	Asbestos	08/14/2024
1696184	34-FT-C	Asbestos	08/14/2024
1696185	35-FT-A	Asbestos	08/15/2024
1696186	35-FT-B	Asbestos	08/15/2024

Lab Sample Number	Client Sample Number	Sample Type	Completed
1696187	35-FT-C	Asbestos	08/15/2024
1696188	36-WB-A	Asbestos	08/15/2024
1696189	36-WB-B	Asbestos	08/15/2024
1696190	36-WB-C	Asbestos	08/15/2024
1696191	37-CM-A	Asbestos	08/15/2024
1696192	37-CM-B	Asbestos	08/15/2024
1696193	37-CM-C	Asbestos	08/15/2024
1696194	38-IC-A	Asbestos	08/15/2024
1696195	38-IC-B	Asbestos	08/15/2024
1696196	38-IC-C	Asbestos	08/15/2024
1696197	39-PL-A	Asbestos	08/15/2024
1696198	39-PL-B	Asbestos	08/15/2024
1696199	39-PL-C	Asbestos	08/15/2024
1696200	39-PL-D	Asbestos	08/15/2024
1696201	39-PL-E	Asbestos	08/15/2024
1696202	40-RI-A	Asbestos	08/15/2024
1696203	40-RI-B	Asbestos	08/15/2024
1696204	40-RI-C	Asbestos	08/15/2024
1696205	41-SU-A	Asbestos	08/15/2024
1696206	41-SU-B	Asbestos	08/15/2024
1696207	41-SU-C	Asbestos	08/15/2024
1696208	42-GM-A	Asbestos	08/15/2024
1696209	42-GM-B	Asbestos	08/15/2024
1696210	42-GM-C	Asbestos	08/15/2024
1696211	43-JC-A	Asbestos	08/15/2024
1696212	43-JC-B	Asbestos	08/15/2024

Lab Sample Number	Client Sample Number	Sample Type	Completed
1696213	43-JC-C	Asbestos	08/15/2024
1696214	44-IC-A	Asbestos	08/15/2024
1696215	44-IC-B	Asbestos	08/15/2024
1696216	44-IC-C	Asbestos	08/15/2024
1696217	45-DT-A	Asbestos	08/15/2024
1696218	45-DT-B	Asbestos	08/15/2024
1696219	45-DT-C	Asbestos	08/15/2024
1696220	46-RI-A	Asbestos	08/15/2024
1696221	46-RI-B	Asbestos	08/15/2024
1696222	46-RI-C	Asbestos	08/15/2024
1696223	47-GM-A	Asbestos	08/15/2024
1696224	47-GM-B	Asbestos	08/15/2024
1696225	47-GM-C	Asbestos	08/15/2024
1696226	48-GM-A	Asbestos	08/15/2024
1696227	48-GM-B	Asbestos	08/15/2024
1696228	48-GM-C	Asbestos	08/15/2024
1696229	49-FT-A	Asbestos	08/15/2024
1696230	49-FT-B	Asbestos	08/15/2024
1696231	49-FT-C	Asbestos	08/15/2024
1696232	50-WG-A	Asbestos	08/15/2024
1696233	50-WG-B	Asbestos	08/15/2024
1696234	50-WG-C	Asbestos	08/15/2024
1696235	51-PM-A	Asbestos	08/15/2024
1696236	51-PM-B	Asbestos	08/15/2024
1696237	51-PM-C	Asbestos	08/15/2024
1696238	52-GM-A	Asbestos	08/15/2024

Lab Sample Number	Client Sample Number	Sample Type	Completed
1696239	52-GM-B	Asbestos	08/15/2024
1696240	52-GM-C	Asbestos	08/15/2024
1696241	53-IC-A	Asbestos	08/15/2024
1696242	53-IC-B	Asbestos	08/15/2024
1696243	53-IC-C	Asbestos	08/15/2024
1696244	55-FS-A	Asbestos	08/15/2024
1696245	55-FS-B	Asbestos	08/15/2024
1696246	55-FS-C	Asbestos	08/15/2024
1696247	56-PL-A	Asbestos	08/15/2024
1696248	56-PL-B	Asbestos	08/15/2024
1696249	56-PL-C	Asbestos	08/15/2024
1696250	56-PL-D	Asbestos	08/15/2024
1696251	56-PL-E	Asbestos	08/15/2024
1696252	57-IC-A	Asbestos	08/15/2024
1696253	57-IC-B	Asbestos	08/15/2024
1696254	57-IC-C	Asbestos	08/15/2024
1696255	58-CB-A	Asbestos	08/15/2024
1696256	58-CB-B	Asbestos	08/15/2024
1696257	58-CB-C	Asbestos	08/15/2024
1696258	59-CP-A	Asbestos	08/15/2024
1696259	59-CP-B	Asbestos	08/15/2024
1696260	59-CP-C	Asbestos	08/15/2024
1696261	60-PM-A	Asbestos	08/15/2024
1696262	60-PM-B	Asbestos	08/15/2024
1696263	60-PM-C	Asbestos	08/15/2024
1696264	61-IC-A	Asbestos	08/15/2024

Lab Sample Number	Client Sample Number	Sample Type	Completed
1696265	61-IC-B	Asbestos	08/15/2024
1696266	61-IC-C	Asbestos	08/15/2024
1696267	62-MA-A	Asbestos	08/15/2024
1696268	62-MA-B	Asbestos	08/15/2024
1696269	62-MA-C	Asbestos	08/15/2024
1696270	63-BM-A	Asbestos	08/15/2024
1696271	63-BM-B	Asbestos	08/15/2024
1696272	63-BM-C	Asbestos	08/15/2024
1696273	64-PM-A	Asbestos	08/15/2024
1696274	64-PM-B	Asbestos	08/15/2024
1696275	64-PM-C	Asbestos	08/15/2024
1696276	65-IC-A	Asbestos	08/15/2024
1696277	65-IC-B	Asbestos	08/15/2024
1696278	65-IC-C	Asbestos	08/15/2024
1696279	66-RI-A	Asbestos	08/15/2024
1696280	66-RI-B	Asbestos	08/15/2024
1696281	66-RI-C	Asbestos	08/15/2024
1696282	67-SU-A	Asbestos	08/15/2024
1696283	67-SU-B	Asbestos	08/15/2024
1696284	67-SU-C	Asbestos	08/15/2024
1696285	69-SU-A	Asbestos	08/15/2024
1696286	69-SU-B	Asbestos	08/15/2024
1696287	69-SU-C	Asbestos	08/15/2024
1696288	70-IC-A	Asbestos	08/15/2024
1696289	70-IC-B	Asbestos	08/15/2024
1696290	70-IC-C	Asbestos	08/15/2024

Lab Sample Number	Client Sample Number	Sample Type	Completed
1696291	71-CC-A	Asbestos	08/15/2024
1696292	71-CC-B	Asbestos	08/15/2024
1696293	71-CC-C	Asbestos	08/15/2024
1696294	72-EJ-A	Asbestos	08/15/2024
1696295	72-EJ-B	Asbestos	08/15/2024
1696296	72-EJ-C	Asbestos	08/15/2024
1696297	73-BM-A	Asbestos	08/15/2024
1696298	73-BM-B	Asbestos	08/15/2024
1696299	73-BM-C	Asbestos	08/15/2024
1696300	74-EC-A	Asbestos	08/15/2024
1696301	74-EC-B	Asbestos	08/15/2024
1696302	74-EC-C	Asbestos	08/15/2024
1696303	75-EC-A	Asbestos	08/15/2024
1696304	75-EC-B	Asbestos	08/15/2024
1696305	75-EC-C	Asbestos	08/15/2024
1696306	76-EC-A	Asbestos	08/15/2024
1696307	76-EC-B	Asbestos	08/15/2024
1696308	76-EC-C	Asbestos	08/15/2024
1696309	77-EC-A	Asbestos	08/15/2024
1696310	77-EC-B	Asbestos	08/15/2024
1696311	77-EC-C	Asbestos	08/15/2024
1696312	78-EC-A	Asbestos	08/15/2024
1696313	78-EC-B	Asbestos	08/15/2024
1696314	78-EC-C	Asbestos	08/15/2024
1696315	79-EJ-A	Asbestos	08/15/2024
1696316	79-EJ-B	Asbestos	08/15/2024

Lab Sample Number	Client Sample Number	Sample Type	Completed
1696317	79-EJ-C	Asbestos	08/15/2024

Reviewed by: 
Emily Schroeder

Summary			
Method	Sample	Layer	Mastic
PLM	291	25	
Point Count	6		



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Polarized Light Microscopy Asbestos Analysis Report

To : Atlas - Novi

46555 Humboldt Dr. Suite 100

Novi, Michigan 48377

Location : 411 E Genesee Avenue, Saginaw, MI 48607

Jerome T. Hart State Office Building

ETL Job : 271589

Client Project : 188BS24470

Date Collected : 07/31/2024

Date Received : 08/13/2024

Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696093 2-CC-A	Concrete Chip	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696094 2-CC-B	Concrete Chip	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696095 2-CC-C	Concrete Chip	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696096 3-CC-A	Concrete Chip	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696097 3-CC-B	Concrete Chip	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696098 3-CC-C	Concrete Chip	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696099 4-CC-A	Concrete Chip	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696100 4-CC-B	Concrete Chip	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696101 4-CC-C	Concrete Chip	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696102 5-BM-A	Brick Mortar	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696103 5-BM-B	Brick Mortar	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696104 5-BM-C	Brick Mortar	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696105 6-BM-A	Brick Mortar	Beige Non-Fibrous Homogenous	PLM 5% Cellulose PLM 5% Fiberglass	PLM 90% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696106 6-BM-B	Brick Mortar	Beige Non-Fibrous Homogenous	PLM 5% Cellulose PLM 5% Fiberglass	PLM 90% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696107 6-BM-C	Brick Mortar	Beige Non-Fibrous Homogenous	PLM 5% Cellulose PLM 5% Fiberglass	PLM 90% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696108 7-EJ-A	Expansion Joint	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696109 7-EJ-B	Expansion Joint	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696110 7-EJ-C	Expansion Joint	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696111 8-FP-A	Fireproofing	Gray Fibrous Homogenous	PLM 1% Cellulose PLM 70% Mineral wool	PLM 29% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696112 8-FP-B	Fireproofing	Gray Fibrous Homogenous	PLM 1% Cellulose PLM 70% Mineral wool	PLM 29% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696113 8-FP-C	Fireproofing	Gray Fibrous Homogenous	PLM 1% Cellulose PLM 70% Mineral wool	PLM 29% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696114 8-FP-D	Fireproofing	Gray Fibrous Homogenous	PLM 1% Cellulose PLM 70% Mineral wool	PLM 29% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696115 8-FP-E	Fireproofing	Gray Fibrous Homogenous	PLM 1% Cellulose PLM 70% Mineral wool	PLM 29% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696116 8-FP-F	Fireproofing	Gray Fibrous Homogenous	PLM 1% Cellulose PLM 70% Mineral wool	PLM 29% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696117 8-FP-G	Fireproofing	Gray Fibrous Homogenous	PLM 1% Cellulose PLM 70% Mineral wool	PLM 29% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696118 8-FP-H	Fireproofing	Gray Fibrous Homogenous	PLM 1% Cellulose PLM 70% Mineral wool	PLM 29% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696119 9-PI-A	Pipe Insulation	Yellow Non-Fibrous Homogenous	PLM 80% Other fibrous	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696119 9-PI-A	Brittle Material	Blue Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696119 9-PI-A	Brittle Material	Clear Non-Fibrous Homogenous	PLM 30% Fiberglass	PLM 70% Other	PLM None Detected
Layer-3 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696120 9-PI-B	Pipe Insulation	Yellow Non-Fibrous Homogenous	PLM 80% Other fibrous	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696120 9-PI-B	Brittle Material	Blue Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696120 9-PI-B	Brittle Material	Clear Non-Fibrous Homogenous	PLM 30% Fiberglass	PLM 70% Other	PLM None Detected
Layer-3 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696121 9-PI-C	Pipe Insulation	Yellow Non-Fibrous Homogenous	PLM 80% Other fibrous	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696121 9-PI-C	Brittle Material	Blue Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696121 9-PI-C	Brittle Material	Clear Non-Fibrous Homogenous	PLM 30% Fiberglass	PLM 70% Other	PLM None Detected
Layer-3 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696122 10-PI-A	Pipe Insulation	Yellow Fibrous Homogenous	PLM 80% Fiberglass	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696122 10-PI-A	Fibrous Backing	Silver Fibrous Homogenous	PLM 30% Cellulose	PLM 70% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696123 10-PI-B	Pipe Insulation	Yellow Fibrous Homogenous	PLM 80% Fiberglass	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696123 10-PI-B	Fibrous Backing	Silver Fibrous Homogenous	PLM 30% Cellulose	PLM 70% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696124 10-PI-C	Pipe Insulation	Yellow Fibrous Homogenous	PLM 80% Fiberglass	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696124 10-PI-C	Fibrous Backing	Silver Fibrous Homogenous	PLM 30% Cellulose	PLM 70% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696125 12-PF-A	Pipe Fitting	Yellow Fibrous Homogenous	PLM 80% Fiberglass	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/13/2024					
1696125 12-PF-A	Brittle Material	Orange Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/13/2024					
1696126 12-PF-B	Pipe Fitting	Yellow Fibrous Homogenous	PLM 80% Fiberglass	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/13/2024					
1696126 12-PF-B	Brittle Material	Orange Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/13/2024					
1696127 12-PF-C	Pipe Fitting	Yellow Fibrous Homogenous	PLM 80% Fiberglass	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/13/2024					
1696127 12-PF-C	Brittle Material	Orange Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/13/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696128 14-GTM-A	Gasket Material	Brown Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/13/2024					
1696129 14-GTM-B	Gasket Material	Brown Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/13/2024					
1696130 14-GTM-C	Gasket Material	Brown Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/13/2024					
1696131 17-TZ-A	Terrazzo	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696132 17-TZ-B	Terrazzo	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696133 17-TZ-C	Terrazzo	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696134 18-WBS-A	Wallboard System	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696134 18-WBS-A	Joint Compound	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696135 18-WBS-B	Wallboard System	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696135 18-WBS-B	Joint Compound	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696136 18-WBS-C	Wallboard System	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696136 18-WBS-C	Joint Compound	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696137 19-IC-A	Interior Caulk	White Fibrous Non-Homogenous	PLM 30% Fiberglass PLM 1% Cellulose	PLM 69% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024 With Insulation					
1696138 19-IC-B	Interior Caulk	White Fibrous Non-Homogenous	PLM 30% Fiberglass PLM 1% Cellulose	PLM 69% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024 With Insulation					
1696139 19-IC-C	Interior Caulk	White Fibrous Non-Homogenous	PLM 30% Fiberglass PLM 1% Cellulose	PLM 69% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024 With Insulation					
1696140 20-IC-A	Interior Caulk	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696141 20-IC-B	Interior Caulk	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696142 20-IC-C	Interior Caulk	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696143 21-IC-A	Interior Caulk	Red Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696144 21-IC-B	Interior Caulk	Red Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696145 21-IC-C	Interior Caulk	Red Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696146 22-IC-A	Interior Caulk	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696147 22-IC-B	Interior Caulk	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696148 22-IC-C	Interior Caulk	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Polarized Light Microscopy Asbestos Analysis Report

To : Atlas - Novi

46555 Humboldt Dr. Suite 100

Novi, Michigan 48377

Location : 411 E Genesee Avenue, Saginaw, MI 48607

Jerome T. Hart State Office Building

ETL Job : 271589

Client Project : 188BS24470

Date Collected : 07/31/2024

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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696149 23-IC-A	Interior Caulk	White Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696150 23-IC-B	Interior Caulk	White Non-Fibrous Homogenous	PLM 3% Cellulose	PLM 97% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696151 23-IC-C	Interior Caulk	White Non-Fibrous Homogenous	PLM 4% Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696152 24-IC-A	Interior Caulk	Off White Non-Fibrous Homogenous	PLM 4% Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696153 24-IC-B	Interior Caulk	Off White Non-Fibrous Homogenous	PLM 4% Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696154 24-IC-C	Interior Caulk	Off White Non-Fibrous Homogenous	PLM 4% Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696155 25-IC-A	Interior Caulk	Beige Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696156 25-IC-B	Interior Caulk	Beige Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696157 25-IC-C	Interior Caulk	Beige Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696158 26-IC-A	Interior Caulk	Off White Non-Fibrous Homogenous	PLM 4% Cellulose	PLM 93% Other	PLM 3% Chrysotile
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696159 26-IC-B		Positive Stop			
Analyst: OJ Ivey Date Analyzed : 08/14/2024 Sample Not Analyzed					
1696160 26-IC-C		Positive Stop			
Analyst: OJ Ivey Date Analyzed : 08/14/2024 Sample Not Analyzed					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696161 27-FT-A	Floor Tile	Gray Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696161 27-FT-A	Adhesive	Tan Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-2 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696162 27-FT-B	Floor Tile	Gray Non-Fibrous Homogenous	PLM 3% Cellulose	PLM 97% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696162 27-FT-B	Adhesive	Tan Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696163 27-FT-C	Floor Tile	Gray Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696163 27-FT-C	Adhesive	Tan Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-2 Analyst: OJ Ivey Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696164 28-CB-A	Cove Base	Gray Non-Fibrous Homogenous	PLM 4% Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696164 28-CB-A	Adhesive	Beige Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696165 28-CB-B	Cove Base	Gray Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696165 28-CB-B	Adhesive	Beige Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-2 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696166 28-CB-C	Cove Base	Gray Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696166 28-CB-C	Adhesive	Beige Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-2 Analyst: OJ Ivey Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696167 29-IC-A	Interior Caulk	Gray Non-Fibrous Homogenous	PLM 3% Cellulose	PLM 97% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696168 29-IC-B	Interior Caulk	Gray Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696169 29-IC-C	Interior Caulk	Gray Non-Fibrous Homogenous	PLM 5% Cellulose	PLM 95% Other	PLM None Detected
Layer-1 Analyst: OJ Ivey Date Analyzed : 08/14/2024					
1696170 30-CM-A	Carpet Mastic	Light Brown Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696171 30-CM-B	Carpet Mastic	Light Brown Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696172 30-CM-C	Carpet Mastic	Light Brown Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696173 31-CP-A	Ceiling Panel	Gray Fibrous Homogenous	PLM 70% Mineral wool	PLM 30% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696174 31-CP-B	Ceiling Panel	Gray Fibrous Homogenous	PLM 70% Mineral wool	PLM 30% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696175 31-CP-C	Ceiling Panel	Gray Fibrous Homogenous	PLM 70% Mineral wool	PLM 30% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696176 32-FP-A	Fireproofing	Gray Fibrous Homogenous	PLM 30% Fiberglass PLM 30% Cellulose	PLM 40% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696177 32-FP-B	Fireproofing	Gray Fibrous Homogenous	PLM 30% Fiberglass PLM 30% Cellulose	PLM 40% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696178 32-FP-C	Fireproofing	Gray Fibrous Homogenous	PLM 30% Cellulose PLM 30% Fiberglass	PLM 40% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696179 33-CB-A	Cove Base	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696179 33-CB-A	Adhesive	Yellow Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696179 33-CB-A	Brittle Material	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-3 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696179 33-CB-A		Layer Missing			
Layer-4 Analyst: Tia Ray Date Analyzed : 08/14/2024 Layer Not Analyzed					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696180 33-CB-B	Cove Base	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696180 33-CB-B		Layer Missing			
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024 Layer Not Analyzed					
1696180 33-CB-B	Brittle Material	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-3 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696180 33-CB-B	Cove Base	Brown Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-4 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696181 33-CB-C	Cove Base	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696181 33-CB-C		Layer Missing			
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024 Layer Not Analyzed					
1696181 33-CB-C	Brittle Material	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-3 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696181 33-CB-C	Cove Base	Brown Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-4 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696182 34-FT-A	Floor Tile	Light Brown Non-Fibrous Homogenous		PC 100% Other	PC None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696182 34-FT-A	Mastic	Yellow Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696182 34-FT-A	Brittle Material	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-3 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696182 34-FT-A	Rubbery Material	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-4 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696183 34-FT-B	Floor Tile	Light Brown Non-Fibrous Homogenous		PC 100% Other	PC None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696183 34-FT-B	Mastic	Yellow Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696183 34-FT-B	Brittle Material	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-3 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696183 34-FT-B	Rubbery Material	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-4 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696184 34-FT-C	Floor Tile	Light Brown Non-Fibrous Homogenous		PC 100% Other	PC Trace Chrysotile
Layer-1 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696184 34-FT-C	Mastic	Yellow Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696184 34-FT-C	Brittle Material	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-3 Analyst: Tia Ray Date Analyzed : 08/14/2024					
1696184 34-FT-C	Rubbery Material	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-4 Analyst: Tia Ray Date Analyzed : 08/14/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696185 35-FT-A	Tile	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696185 35-FT-A	Mastic	White Non-Fibrous Homogenous	PLM 6% Cellulose	PLM 94% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696185 35-FT-A	Fibrous Material	Black Fibrous Homogenous	PLM 92% Cellulose	PLM 8% Other	PLM None Detected
Layer-3 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696186 35-FT-B	Tile	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696186 35-FT-B	Mastic	White Non-Fibrous Homogenous	PLM 6% Cellulose	PLM 94% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696186 35-FT-B	Cementitious Material	Gray Non-Fibrous Homogenous	PLM 92% Cellulose	PLM 8% Other	PLM None Detected
Layer-3 Analyst: Ben Jones Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696187 35-FT-C	Tile	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696187 35-FT-C	Mastic	White Non-Fibrous Homogenous	PLM 6% Cellulose	PLM 94% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696187 35-FT-C	Fibrous Material	Black Fibrous Homogenous	PLM 92% Cellulose	PLM 8% Other	PLM None Detected
Layer-3 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696188 36-WB-A	Wallboard	White Non-Fibrous Homogenous	PLM 16% Cellulose	PLM 84% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696188 36-WB-A	Fibrous Material	Gray Fibrous Homogenous	PLM 96% Cellulose	PLM 4% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696188 36-WB-A	Fibrous Material	Brown Fibrous Homogenous	PLM 96% Cellulose	PLM 4% Other	PLM None Detected
Layer-3 Analyst: Ben Jones Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696189 36-WB-B	Wallboard	White Non-Fibrous Homogenous	PLM 16% Cellulose	PLM 84% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696189 36-WB-B	Fibrous Material	Gray Fibrous Homogenous	PLM 96% Cellulose	PLM 4% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696189 36-WB-B	Fibrous Material	Brown Fibrous Homogenous	PLM 96% Cellulose	PLM 4% Other	PLM None Detected
Layer-3 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696190 36-WB-C	Wallboard	White Non-Fibrous Homogenous	PLM 16% Cellulose	PLM 84% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696190 36-WB-C	Fibrous Material	Gray Fibrous Homogenous	PLM 96% Cellulose	PLM 4% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696190 36-WB-C	Fibrous Material	Brown Fibrous Homogenous	PLM 96% Cellulose	PLM 4% Other	PLM None Detected
Layer-3 Analyst: Ben Jones Date Analyzed : 08/15/2024					



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(734) 955-6600, Fax: (734) 955-6604

Polarized Light Microscopy Asbestos Analysis Report

To : Atlas - Novi

46555 Humboldt Dr. Suite 100

Novi, Michigan 48377

Location : 411 E Genesee Avenue, Saginaw, MI 48607

Jerome T. Hart State Office Building

ETL Job : 271589

Client Project : 188BS24470

Date Collected : 07/31/2024

Date Received : 08/13/2024

Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696191 37-CM-A	Carpet Mastic	Green Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696192 37-CM-B	Carpet Mastic	Green Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696193 37-CM-C	Carpet Mastic	Green Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 98% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696194 38-IC-A	Interior Caulk	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696195 38-IC-B	Interior Caulk	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696196 38-IC-C	Interior Caulk	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696197 39-PL-A	Plaster	Gray Non-Fibrous Homogenous	PLM 8% Cellulose	PLM 92% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696197 39-PL-A	Skim Coat	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696198 39-PL-B	Plaster	Gray Non-Fibrous Homogenous	PLM 8% Cellulose	PLM 92% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696198 39-PL-B	Skim Coat	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696199 39-PL-C	Plaster	Gray Non-Fibrous Homogenous	PLM 8% Cellulose	PLM 92% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696199 39-PL-C	Skim Coat	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696200 39-PL-D	Plaster	Gray Non-Fibrous Homogenous	PLM 8% Cellulose	PLM 92% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696200 39-PL-D	Skim Coat	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696201 39-PL-E	Plaster	Gray Non-Fibrous Homogenous	PLM 8% Cellulose	PLM 92% Other	PLM None Detected
Layer-1 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696201 39-PL-E	Skim Coat	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Ben Jones Date Analyzed : 08/15/2024					
1696202 40-RI-A	Rolled-In Insulation	Yellow Fibrous Non-Homogenous	PLM 40% Cellulose PLM 40% Fiberglass	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024 With Fibrous Backing					
1696203 40-RI-B	Rolled-In Insulation	Yellow Fibrous Non-Homogenous	PLM 40% Cellulose PLM 40% Fiberglass	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024 With Fibrous Backing					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696204 40-RI-C	Rolled-In Insulation	Yellow Fibrous Non-Homogenous	PLM 40% Cellulose PLM 40% Fiberglass	PLM 20% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024 With Fibrous Backing					
1696205 41-SU-A	Sink Undercoating	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696205 41-SU-A	Granular Material	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696206 41-SU-B	Sink Undercoating	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696206 41-SU-B	Granular Material	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696207 41-SU-C	Sink Undercoating	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696207 41-SU-C	Granular Material	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696208 42-GM-A	Mortar	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696208 42-GM-A	Grout	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696209 42-GM-B	Mortar	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696209 42-GM-B	Grout	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696210 42-GM-C	Mortar	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696210 42-GM-C	Grout	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696211 43-JC-A	Joint Compound	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696212 43-JC-B	Joint Compound	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696213 43-JC-C	Joint Compound	White Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696214 44-IC-A	Interior Caulk	Beige Non-Fibrous Homogenous	PLM 1% Cellulose PLM 5% Fiberglass	PLM 94% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696215 44-IC-B	Interior Caulk	Beige Non-Fibrous Homogenous	PLM 1% Cellulose PLM 5% Fiberglass	PLM 94% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696216 44-IC-C	Interior Caulk	Beige Non-Fibrous Homogenous	PLM 1% Cellulose PLM 5% Fiberglass	PLM 94% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696217 45-DT-A	Duct Tape	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696218 45-DT-B	Duct Tape	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696219 45-DT-C	Duct Tape	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696220 46-RI-A	Rolled-in Insulation	Yellow Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696221 46-RI-B	Rolled-in Insulation	Yellow Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696222 46-RI-C	Rolled-in Insulation	Yellow Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696223 47-GM-A	Grout	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696223 47-GM-A	Mortar	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696224 47-GM-B	Grout	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696224 47-GM-B	Mortar	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696225 47-GM-C	Grout	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696225 47-GM-C	Mortar	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696226 48-GM-A	Grout	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696226 48-GM-A	Mortar	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696227 48-GM-B	Grout	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696227 48-GM-B	Mortar	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696228 48-GM-C	Grout	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696228 48-GM-C	Mortar	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696229 49-FT-A	Floor Tile	Light Brown Non-Fibrous Homogenous	PC Trace Cellulose	PC 99.5% Other	PC 0.5% Chrysotile
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696229 49-FT-A	Mastic	Black/Yellow Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 98% Other	PLM 2% Chrysotile
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024 With Spongy Material					
1696230 49-FT-B	Floor Tile	Light Brown Non-Fibrous Homogenous	PC Trace Cellulose	PC 99.25% Other	PC 0.75% Chrysotile
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696230 49-FT-B		Positive Stop			
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024 Layer Not Analyzed					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696231 49-FT-C	Floor Tile	Light Brown Non-Fibrous Homogenous	PC Trace Cellulose	PC 99.5% Other	PC 0.5% Chrysotile
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696231 49-FT-C		Positive Stop			
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024 Layer Not Analyzed					
1696232 50-WG-A	Window Glaze	Red Non-Fibrous Homogenous	PLM 2% Cellulose	PLM 92% Other	PLM 6% Chrysotile
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696233 50-WG-B		Positive Stop			
Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024 Sample Not Analyzed					
1696234 50-WG-C		Positive Stop			
Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024 Sample Not Analyzed					
1696235 51-PM-A	Penetration Mud	Gray Non-Fibrous Homogenous	PLM Trace Cellulose PLM Trace Fiberglass	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					

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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696236 51-PM-B	Penetration Mud	Gray Non-Fibrous Homogenous	PLM Trace Cellulose PLM Trace Fiberglass	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696237 51-PM-C	Penetration Mud	Gray Non-Fibrous Homogenous	PLM Trace Cellulose PLM Trace Fiberglass	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696238 52-GM-A	Grout	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696238 52-GM-A	Mortar	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696239 52-GM-B	Grout	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696239 52-GM-B	Mortar	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696240 52-GM-C	Grout	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696240 52-GM-C	Mortar	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696241 53-IC-A	Interior Caulk	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696242 53-IC-B	Interior Caulk	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					
1696243 53-IC-C	Interior Caulk	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Shelby Fogelsong Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696244 55-FS-A	Floor Sheeting	Brown Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696244 55-FS-A	Adhesive	Beige Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696245 55-FS-B	Floor Sheeting	Brown Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696245 55-FS-B	Adhesive	Beige Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696246 55-FS-C	Floor Sheeting	Brown Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696246 55-FS-C	Adhesive	Beige Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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Polarized Light Microscopy Asbestos Analysis Report

To : Atlas - Novi

46555 Humboldt Dr. Suite 100

Novi, Michigan 48377

Location : 411 E Genesee Avenue, Saginaw, MI 48607

Jerome T. Hart State Office Building

ETL Job : 271589

Client Project : 188BS24470

Date Collected : 07/31/2024

Date Received : 08/13/2024

Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696247 56-PL-A	Plaster	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696247 56-PL-A	Skim Coat	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696248 56-PL-B	Plaster	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696248 56-PL-B	Skim Coat	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696249 56-PL-C	Plaster	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696249 56-PL-C	Skim Coat	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696250 56-PL-D	Plaster	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696250 56-PL-D	Skim Coat	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696251 56-PL-E	Plaster	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696251 56-PL-E	Skim Coat	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696252 57-IC-A	Interior Caulk	Yellowish Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024 With Powdery Material					
1696253 57-IC-B	Interior Caulk	Yellowish Non-Fibrous Non-Homogenous	PLM 4% Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024 With Powdery Material					

ETL, Inc. maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced without written approval by ETL, Inc. Test Method EPA 600/R-93-116 & EPA 600/M4-82/020 or NYSDOH-ELAP item 198.1 and/or 198.6 was used to analyze all samples. Matrix interference and/or resolution limits (i.e. detecting asbestos in non-friable organically bound materials) may yield false results in certain circumstances. Quantitative transmission electron microscopy (TEM) is currently the only method that can pronounce materials as non-asbestos containing. Interpretation and use of test results are the responsibility of the client. ETL, Inc. is not responsible for the accuracy of the results when requested to physically separate and analyze layered samples. Any PLM results below 10% should be re-analyzed using the EPA recommended Point Count method. Any material that has greater than 1% asbestos content is considered to be an Asbestos Containing Material (ACM). These materials are regulated by both OSHA and the EPA and must be treated accordingly. Results are related to only to samples that were tested. An estimate of uncertainty can be provided at the client's request.



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696254 57-IC-C	Interior Caulk	Yellowish Non-Fibrous Non-Homogenous	PLM 4% Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024 With Powdery Material					
1696255 58-CB-A	Cove Base	Brown Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696255 58-CB-A	Adhesive	Tan Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696256 58-CB-B	Cove Base	Brown Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696256 58-CB-B	Adhesive	Tan Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696257 58-CB-C	Cove Base	Brown Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696257 58-CB-C	Adhesive	Tan Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696258 59-CP-A	Ceiling Panel	Gray Non-Fibrous Homogenous	PLM 98% Cellulose	PLM 2% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696259 59-CP-B	Ceiling Panel	Gray Non-Fibrous Homogenous	PLM 98% Cellulose	PLM 2% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696260 59-CP-C	Ceiling Panel	Gray Non-Fibrous Homogenous	PLM 98% Cellulose	PLM 2% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696261 60-PM-A	Penetration Mudding	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696262 60-PM-B	Penetration Mudding	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696263 60-PM-C	Penetration Mudding	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696264 61-IC-A	Interior Caulk	Black Non-Fibrous Homogenous	PLM 3% Cellulose	PLM 97% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696265 61-IC-B	Interior Caulk	Black Non-Fibrous Homogenous	PLM 3% Cellulose	PLM 97% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696266 61-IC-C	Interior Caulk	Black Non-Fibrous Homogenous	PLM 3% Cellulose	PLM 97% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696267 62-MA-A	Mastic	Black Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 98% Other	PLM 2% Chrysotile
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696268 62-MA-B		Positive Stop			
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024 Layer Not Analyzed					
1696269 62-MA-C		Positive Stop			
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024 Layer Not Analyzed					
1696270 63-BM-A	Brick Mortar	Red Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696270 63-BM-A	Cementitious Material	Gray Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696270 63-BM-A	Cementitious Material	White Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-3 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696271 63-BM-B	Brick Mortar	Red Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696271 63-BM-B	Cementitious Material	Gray Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696271 63-BM-B	Cementitious Material	White Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-3 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696272 63-BM-C	Brick Mortar	Red Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696272 63-BM-C	Cementitious Material	Gray Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696272 63-BM-C	Cementitious Material	White Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-3 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696273 64-PM-A	Penetration Mud	Gray Non-Fibrous Homogenous	PLM 4% Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696273 64-PM-A	Tacky Material	Red Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696274 64-PM-B	Penetration Mud	Gray Non-Fibrous Homogenous	PLM 4% Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696274 64-PM-B	Tacky Material	Red Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696275 64-PM-C	Penetration Mud	Gray Non-Fibrous Homogenous	PLM 4% Cellulose	PLM 96% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696275 64-PM-C	Tacky Material	Red Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696276 65-IC-A	Interior Caulk	White Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696276 65-IC-A	Rubbery Material	Orange Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696277 65-IC-B	Interior Caulk	White Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696278 65-IC-C	Interior Caulk	White Non-Fibrous Non-Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696279 66-RI-A	Rolled-in Insulation	Yellow Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696279 66-RI-A	Paper	Brown Fibrous Homogenous	PLM 100% Cellulose		PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696279 66-RI-A	Adhesive	Black Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-3 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696280 66-RI-B	Rolled-in Insulation	Yellow Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696280 66-RI-B	Paper	Brown Fibrous Homogenous	PLM 100% Cellulose		PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696280 66-RI-B	Adhesive	Black Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-3 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696281 66-RI-C	Rolled-in Insulation	Yellow Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696281 66-RI-C	Paper	Brown Fibrous Homogenous	PLM 100% Cellulose		PLM None Detected
Layer-2 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696281 66-RI-C	Adhesive	Black Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-3 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696282 67-SU-A	Sink Undercoating	Black Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696283 67-SU-B	Sink Undercoating	Black Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					
1696284 67-SU-C	Sink Undercoating	Black Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Nico Alvarez-Lopez Date Analyzed : 08/15/2024					



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1696285 69-SU-A	Sink Undercoating	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696286 69-SU-B	Sink Undercoating	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696287 69-SU-C	Sink Undercoating	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696288 70-IC-A	Interior Caulk	Dark Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696289 70-IC-B	Interior Caulk	Dark Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696290 70-IC-C	Interior Caulk	Dark Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696291 71-CC-A	Concrete Chip	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696292 71-CC-B	Concrete Chip	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696293 71-CC-C	Concrete Chip	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696294 72-EJ-A	Expansion Joint	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696295 72-EJ-B	Expansion Joint	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696296 72-EJ-C	Expansion Joint	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					



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1696297 73-BM-A	Brick Mortar	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696298 73-BM-B	Brick Mortar	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696299 73-BM-C	Brick Mortar	Gray Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696300 74-EC-A	Expansion Caulk	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696301 74-EC-B	Expansion Caulk	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696302 74-EC-C	Expansion Caulk	White Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					



Certificate of Analysis

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Polarized Light Microscopy Asbestos Analysis Report

To : Atlas - Novi

46555 Humboldt Dr. Suite 100

Novi, Michigan 48377

Location : 411 E Genesee Avenue, Saginaw, MI 48607

Jerome T. Hart State Office Building

ETL Job : 271589

Client Project : 188BS24470

Date Collected : 07/31/2024

Date Received : 08/13/2024

Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696303 75-EC-A	Expansion Caulk	Black Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696304 75-EC-B	Expansion Caulk	Black Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696305 75-EC-C	Expansion Caulk	Black Non-Fibrous Homogenous	PLM Trace Cellulose	PLM 100% Other	PLM None Detected
Layer-1 Analyst: Chris Canilao Date Analyzed : 08/15/2024					
1696306 76-EC-A	Exterior Caulk	Light Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696307 76-EC-B	Exterior Caulk	Light Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696308 76-EC-C	Exterior Caulk	Light Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696309 77-EC-A	Exterior Caulk	Dark Grey Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696310 77-EC-B	Exterior Caulk	Dark Grey Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696311 77-EC-C	Exterior Caulk	Dark Grey Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696311 77-EC-C	Cementitious Material	Gray Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-2 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696312 78-EC-A	Exterior Caulk	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696313 78-EC-B	Exterior Caulk	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696314 78-EC-C	Exterior Caulk	Black Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696315 79-EJ-A	Expansion Joint	Red Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					
1696316 79-EJ-B	Expansion Joint	Red Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
1696317 79-EJ-C	Expansion Joint	Red Non-Fibrous Homogenous	PLM 1% Cellulose	PLM 99% Other	PLM None Detected
Layer-1 Analyst: Tia Ray Date Analyzed : 08/15/2024					

Lab Supervisor/Other Signatory

Analyst:

Ben Jones

Chris Canilao

Nico Alvarez-Lopez

Shelby Fogelsong

OJ Ivey

Tia Ray



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Sample	Description	Appearance	% Fibrous	% Non-Fibrous	% Asbestos
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400 Point Count Results by EPA 600/R-93/116 PLM (denoted by "PC")
Item 198.1: PLM Methods for Identifying and Quantitating Asbestos in Bulk Samples
Item 198.6: PLM Methods for Identifying and Quantitating Asbestos in Non-Friable Organically Bound Bulk Samples
EPA 600/R-93/116: Method for Determination of Asbestos in Bulk Building Materials
EPA 600/M4-82-020: Interim Method for Determination of Asbestos in Bulk Insulation Samples
A % Asbestos result of "Trace" indicates that the analyzed material was found to contain less than 1% asbestos and would not be considered an Asbestos Containing Material (ACM).

ETL, Inc. maintains liability limited to cost of analysis. This report relates only to the samples reported and may not be reproduced without written approval by ETL, Inc. Test Method EPA 600/R-93-116 & EPA 600/M4-82/020 or NYSDOH-ELAP item 198.1 and/or 198.6 was used to analyze all samples. Matrix interference and/or resolution limits (i.e. detecting asbestos in non-friable organically bound materials) may yield false results in certain circumstances. Quantitative transmission electron microscopy (TEM) is currently the only method that can pronounce materials as non-asbestos containing. Interpretation and use of test results are the responsibility of the client. ETL, Inc. is not responsible for the accuracy of the results when requested to physically separate and analyze layered samples. Any PLM results below 10% should be re-analyzed using the EPA recommended Point Count method. Any material that has greater than 1% asbestos content is considered to be an Asbestos Containing Material (ACM). These materials are regulated by both OSHA and the EPA and must be treated accordingly. Results are related to only to samples that were tested. An estimate of uncertainty can be provided at the client's request.

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Bulk Asbestos Chain of Custody

ETL Project #: 271589

Client:	Atlas Technical Consultants	Contact: Rob Smith	Project Location/name: 411 E GENESEE AVENUE, SAGINAW, MICHIGAN, 48607 - JEROME T. HART STATE OFFICE BUILDING
		Phone: 248-669-5140	
Address:	46555 Humboldt Dr. Ste. 100 Novi, MI 48377	Fax: 248-669-5147	Client Project #: 188BS24470
		E-mail:	
Please Provide Results: ☐ Email ☐ Fax ☐ Verbal ☐ Other _____			Date Sampled: 7/31/2024

Turnaround Time (TAT): ☐ RUSH ☐ Same Day ☐ 24 hr ☐ 48 hr ☐ Standard (3-5 days) ☒ Other 72 hours

PLM Instructions

(Check all that apply)

- | | |
|--|--|
| ☒ PLM EPA600/R-93/116, 1993 (Standard method) | ☒ Stop at 1st Positive - |
| Point Counting: ☐ 400 Points* ☐ NYSDOH ELAP 198.1, 2002* | Clearly mark Homogenous Group |
| ☐ Gravimetric Reduction* ☐ NYSDOH ELAP 198.6, 2010* | |
| ☐ PLM Non-Building Material (Dust, Wipe, Tape) | ☐ Soil or Vermiculite Analysis* |

* Additional charge and turnaround may be required

Lab ID	Sample ID	Material Description	Sample Location	Quantity
<u>093</u>	1 - Not sampled	Fire door	NA	NA
<u>094</u>	2-CC-A	Concrete chip - poured concrete deck	FS-1	NA
<u>095</u>	2-CC-B	Concrete chip - poured concrete deck	FS-27	NA
<u>096</u>	2-CC-C	Concrete chip - poured concrete deck	FS-137	NA
<u>097</u>	3-CC-A	Concrete chip - poured concrete walls	FS-1	NA
<u>098</u>	3-CC-B	Concrete chip - poured concrete walls	FS-3	NA
<u>099</u>	3-CC-C	Concrete chip - poured concrete walls	FS-5	NA
<u>100</u>	4-CC-A	Concrete Chip - raised concrete pads	FS-1	NA
<u>101</u>	4-CC-B	Concrete Chip - raised concrete pads	FS-12	NA
	4-CC-C	Concrete Chip - raised concrete pads	FS-48	NA

		Date	Time
Relinquished (Name/Organization):	Andrew DeLodder / Atlas Technical Consultants	8/9/2024	1430 am/pm
Received (Name/ETL):	<i>[Signature]</i>	8/13/24	10:03 am/pm
Sample Login (Name/ETL):	<i>[Signature]</i>	8/13/24	10:57 am/pm
Stereoscopical/Sample Analysis (Name/ETL):	<i>[Signature]</i>		1:11 am/pm
Results (Name/ETL):	<i>[Signature]</i>		1:11 am/pm
QA/QC Review (Name/ETL):	<i>[Signature]</i>	8-15-24	2:03 am/pm

Special Instructions: • 1st Positive Stop;
• Composite all drywall/joint compound samples if any layer of system is greater than 1% asbestos;
• Point Count ALL PLASTER samples Trace to 3% asbestos content
• Point Count ALL SAMPLES Trace to 1% asbestos content

Remarks

**IN ORDER TO ENSURE RESULTS BY SPECIFIED TAT, THE LAB MUST BE EMAILED/CALLED WITH THE QUANTITY OF SAMPLES TO BE SHIPPED OR DROPPED OFF

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Bulk Asbestos
Chain of Custody

ETL Project #:

271589

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Lab ID	Sample ID	Material Description	Sample Location	QUANTITY
102	5-BM-A	Brick mortar - CMU block mortar	FS-1	NA
103	5-BM-B	Brick mortar - CMU block mortar	FS-3	NA
104	5-BM-C	Brick mortar - CMU block mortar	FS-4	NA
105	6-BM-A	Brick mortar - beige floor/deck patching	FS-9	NA
106	6-BM-B	Brick mortar - beige floor/deck patching	FS-50	NA
107	6-BM-C	Brick mortar - beige floor/deck patching	FS-76	NA
108	7-EJ-A	Expansion joint - CMU block walls, white caulk	FS-1	NA
109	7-EJ-B	Expansion joint - CMU block walls, white caulk	FS-4	NA
110	7-EJ-C	Expansion joint - CMU block walls, white caulk	FS-4	NA
111	8-FP-A	Fireproofing - sprayed-on, grey	FS-3	NA
112	8-FP-B	Fireproofing - sprayed-on, grey	FS-9	NA
113	8-FP-C	Fireproofing - sprayed-on, grey	FS-27	NA
114	8-FP-D	Fireproofing - sprayed-on, grey	FS-50	NA
115	8-FP-E	Fireproofing - sprayed-on, grey	FS-139	NA
116	8-FP-F	Fireproofing - sprayed-on, grey	FS-139	NA
117	8-FP-G	Fireproofing - sprayed-on, grey	FS-120	NA
118	8-FP-H	Fireproofing - sprayed-on, grey	FS-138	NA
119	9-PI-A	Pipe insulation - plastic wrapped foam with adhesive and tape	FS-1	NA
120	9-PI-B	Pipe insulation - plastic wrapped foam with adhesive and tape	FS-1	NA
121	9-PI-C	Pipe insulation - plastic wrapped foam with adhesive and tape	FS-1	NA
122	10-PI-A	Pipe insulation - paper wrapped fiberglass	FS-1	NA
123	10-PI-B	Pipe insulation - paper wrapped fiberglass	FS-50	NA
124	10-PI-C	Pipe insulation - paper wrapped fiberglass	FS-76	NA
—	11 - NOT SAMPLED	Pipe insulation - metal wrapped pipes - ASSUMED	NA	NA
125	12-PF-A	Pipe fitting - plastic wrapped fiberglass	FS-1	NA
126	12-PF-B	Pipe fitting - plastic wrapped fiberglass	FS-50	NA
127	12-PF-C	Pipe fitting - plastic wrapped fiberglass	FS-76	NA
—	13 - NOT SAMPLED	Tank insulation - metal wrapped tanks - ASSUMED	NA	NA
128	14-GTM-A	Gasket material - brown composite between mechanical pipe seams	FS-1	NA
129	14-GTM-B	Gasket material - brown composite between mechanical pipe seams	FS-1	NA
130	14-GTM-C	Gasket material - brown composite between mechanical pipe seams	FS-1	NA
—	15 - NOT SAMPLED	Gasket material - white, canvas gasket on boiler plates - ASSUMED	NA	NA
—	16 - NOT SAMPLED	Vibration dampener - black, vinyl - ASSUMED	NA	NA
131	17-TZ-A	Terrazzo - utility sink	FS-1	NA
132	17-TZ-B	Terrazzo - utility sink	FS-62	NA
133	17-TZ-C	Terrazzo - utility sink	FS-90	NA
134	18-WBS-A	Wallboard system - walls/ceiling	FS-13	NA
135	18-WBS-B	Wallboard system - walls/ceiling	FS-50	NA
136	18-WBS-C	Wallboard system - walls/ceiling	FS-118	NA
137	19-IC-A	Interior caulk - white, silicone, on seams of pipe insulation	FS-39	NA
138	19-IC-B	Interior caulk - white, silicone, on seams of pipe insulation	FS-76	NA
139	19-IC-C	Interior caulk - white, silicone, on seams of pipe insulation	FS-137	NA
140	20-IC-A	Interior caulk - white, hard, seams of wallboard system walls	FS-1	NA
141	20-IC-B	Interior caulk - white, hard, seams of wallboard system walls	FS-1	NA
142	20-IC-C	Interior caulk - white, hard, seams of wallboard system walls	FS-1	NA

2 of 6

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**Bulk Asbestos
Chain of Custody**

ETL Project #: 271589

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Lab ID	Sample ID	Material Description	Sample Location	QUANTITY
143	21-IC-A	Interior caulk - red, void/penetration filler	FS-4	NA
144	21-IC-B	Interior caulk - red, void/penetration filler	FS-76	NA
145	21-IC-C	Interior caulk - red, void/penetration filler	FS-138	NA
146	22-IC-A	Interior caulk - off-white, soft, perimeter of airway (FS-2) vent and access hatch	FS-1	NA
147	22-IC-B	Interior caulk - off-white, soft, perimeter of airway (FS-2) vent and access hatch	FS-1	NA
148	22-IC-C	Interior caulk - off-white, soft, perimeter of airway (FS-2) vent and access hatch	FS-1	NA
149	23-IC-A	Interior caulk - white, hard, alligator cracking texture, perimeter of metal door frames	FS-12	NA
150	23-IC-B	Interior caulk - white, hard, alligator cracking texture, perimeter of metal door frames	FS-27	NA
151	23-IC-C	Interior caulk - white, hard, alligator cracking texture, perimeter of metal door frames	FS-43	NA
152	24-IC-A	Interior caulk - pipe sealant - off-white, on fire protection water lines	FS-1	NA
153	24-IC-B	Interior caulk - pipe sealant - off-white, on fire protection water lines	FS-60	NA
154	24-IC-C	Interior caulk - pipe sealant - off-white, on fire protection water lines	FS-75	NA
155	25-IC-A	Interior caulk - beige, duct caulk, sandwiched between seams of HVAC duct panels	FS-3	NA
156	25-IC-B	Interior caulk - beige, duct caulk, sandwiched between seams of HVAC duct panels	FS-15	NA
157	25-IC-C	Interior caulk - beige, duct caulk, sandwiched between seams of HVAC duct panels	FS-48	NA
158	26-IC-A	Interior caulk - off-white, hard, HVAC wall penetrations	FS-3	NA
159	26-IC-B	Interior caulk - off-white, hard, HVAC wall penetrations	FS-3	NA
160	26-IC-C	Interior caulk - off-white, hard, HVAC wall penetrations	FS-3	NA
161	27-FT-A	Floor tile - 12" grey with grey mottle, and adhesive	FS-4	NA
162	27-FT-B	Floor tile - 12" grey with grey mottle, and adhesive	FS-4	NA
163	27-FT-C	Floor tile - 12" grey with grey mottle, and adhesive	FS-14	NA
164	28-CB-A	Cove base - 4" grey vinyl with adhesive	FS-15	NA
165	28-CB-B	Cove base - 4" grey vinyl with adhesive	FS-16	NA
166	28-CB-C	Cove base - 4" grey vinyl with adhesive	FS-20	NA
167	29-IC-A	Interior caulk - grey, duct caulk, smeared on exterior side of the duct seams	FS-4	NA
168	29-IC-B	Interior caulk - grey, duct caulk, smeared on exterior side of the duct seams	FS-4	NA
169	29-IC-C	Interior caulk - grey, duct caulk, smeared on exterior side of the duct seams	FS-4	NA
170	30-CM-A	Carpet mastic - light brown	FS-8	NA
171	30-CM-B	Carpet mastic - light brown	FS-9	NA
172	30-CM-C	Carpet mastic - light brown	FS-10	NA
173	31-CP-A	Ceiling panel - 2'x2' rough texture	FS-32	NA
174	31-CP-B	Ceiling panel - 2'x2' rough texture	FS-65	NA
175	31-CP-C	Ceiling panel - 2'x2' rough texture	FS-141	NA
176	32-FP-A	Fireproofing - pressed-on, grey patch material	FS-63	NA
177	32-FP-B	Fireproofing - pressed-on, grey patch material	FS-100	NA
178	32-FP-C	Fireproofing - pressed-on, grey patch material	FS-124	NA
179	33-CB-A	Cove base - 4" black vinyl with adhesive	FS-12	NA
180	33-CB-B	Cove base - 4" black vinyl with adhesive	FS-17	NA
181	33-CB-C	Cove base - 4" black vinyl with adhesive	FS-62	NA
182	34-FT-A	Floor tile - 12" light brown tile with grey and brown mottle	FS-119	NA
183	34-FT-B	Floor tile - 12" light brown tile with grey and brown mottle	FS-141	NA
184	34-FT-C	Floor tile - 12" light brown tile with grey and brown mottle	FS-6	NA
185	35-FT-A	Floor tile - 12" white tile with grey and blue mottle	FS-6	NA
186	35-FT-B	Floor tile - 12" white tile with grey and blue mottle	FS-9	NA
187	35-FT-C	Floor tile - 12" white tile with grey and blue mottle	FS-12	NA

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Bulk Asbestos
Chain of Custody

ETL Project #: 271589

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Lab ID	Sample ID	Material Description	Sample Location	QUANTITY
188	36-WB-A	Wallboard - 2" wide wallboard panels with canvas wallpaper cover used as interior walls	FS-13	NA
189	36-WB-B	Wallboard - 2" wide wallboard panels with canvas wallpaper cover used as interior walls	FS-9	NA
190	36-WB-C	Wallboard - 2" wide wallboard panels with canvas wallpaper cover used as interior walls	FS-10	NA
191	37-CM-A	Carpet mastic - translucent green, under carpet tiles	FS-72	NA
192	37-CM-B	Carpet mastic - translucent green, under carpet tiles	FS-76	NA
193	37-CM-C	Carpet mastic - translucent green, under carpet tiles	FS-141	NA
194	38-IC-A	Interior caulk - grey, perimeter of metal window frames	FS-10	NA
195	38-IC-B	Interior caulk - grey, perimeter of metal window frames	FS-29	NA
196	38-IC-C	Interior caulk - grey, perimeter of metal window frames	FS-58	NA
197	39-PL-A	Plaster - cylindrical column casings	FS-9	NA
198	39-PL-B	Plaster - cylindrical column casings	FS-47	NA
199	39-PL-C	Plaster - cylindrical column casings	FS-50	NA
200	39-PL-D	Plaster - cylindrical column casings	FS-78	NA
201	39-PL-E	Plaster - cylindrical column casings	FS-118	NA
202	40-RI-A	Roll-in insulation - yellow fiberglass with black paper	FS-58	NA
203	40-RI-B	Roll-in insulation - yellow fiberglass with black paper	FS-86	NA
204	40-RI-C	Roll-in insulation - yellow fiberglass with black paper	FS-29	NA
205	41-SU-A	Sink undercoating - grey spray-on with black stick-on	FS-10	NA
206	41-SU-B	Sink undercoating - grey spray-on with black stick-on	FS-10	NA
207	41-SU-C	Sink undercoating - grey spray-on with black stick-on	FS-10	NA
208	42-GM-A	Ceramic tile, grout, mortar - grey stone pattern tile in various sizes with grey grout	FS-10	NA
209	42-GM-B	Ceramic tile, grout, mortar - grey stone pattern tile in various sizes with grey grout	FS-36	NA
210	42-GM-C	Ceramic tile, grout, mortar - grey stone pattern tile in various sizes with grey grout	FS-115	NA
211	43-JC-A	Joint compound - patching	FS-10	NA
212	43-JC-B	Joint compound - patching	FS-10	NA
213	43-JC-C	Joint compound - patching	FS-10	NA
214	44-IC-A	Interior caulk - beige duct caulk, hard, brushed on HVAC duct exterior seams	FS-12	NA
215	44-IC-B	Interior caulk - beige duct caulk, hard, brushed on HVAC duct exterior seams	FS-12	NA
216	44-IC-C	Interior caulk - beige duct caulk, hard, brushed on HVAC duct exterior seams	FS-43	NA
217	45-DT-A	Duct tape - black tar tape, applied on corners/seams of HVAC ducts	FS-12	NA
218	45-DT-B	Duct tape - black tar tape, applied on corners/seams of HVAC ducts	FS-12	NA
219	45-DT-C	Duct tape - black tar tape, applied on corners/seams of HVAC ducts	FS-12	NA
220	46-RI-A	Roll-in insulation - yellow fiberglass with foil cover, wrapped around ducts with foil canvas tape	FS-39	NA
221	46-RI-B	Roll-in insulation - yellow fiberglass with foil cover, wrapped around ducts with foil canvas tape	FS-76	NA
222	46-RI-C	Roll-in insulation - yellow fiberglass with foil cover, wrapped around ducts with foil canvas tape	FS-141	NA
223	47-GM-A	Ceramic tile, grout, mortar - 1" beige/grey floor tile	FS-14	NA
224	47-GM-B	Ceramic tile, grout, mortar - 1" beige/grey floor tile	FS-34	NA
225	47-GM-C	Ceramic tile, grout, mortar - 1" beige/grey floor tile	FS-61	NA
226	48-GM-A	Ceramic tile, grout, mortar - 4" beige/brown wall tile	FS-14	NA
227	48-GM-B	Ceramic tile, grout, mortar - 4" beige/brown wall tile	FS-62	NA
228	48-GM-C	Ceramic tile, grout, mortar - 4" beige/brown wall tile	FS-90	NA
229	49-FT-A	Floor tile - 12" light brown tile with white and reddish brown streaks	FS-15	NA
230	49-FT-B	Floor tile - 12" light brown tile with white and reddish brown streaks	FS-30	NA
231	49-FT-C	Floor tile - 12" light brown tile with white and reddish brown streaks	FS-31	NA

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Bulk Asbestos
Chain of Custody

ETL Project #: 271589

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Lab ID	Sample ID	Material Description	Sample Location	QUANTITY
232	50-WG-A	Window glaze - metal doors with windows	FS-30	NA
233	50-WG-B	Window glaze - metal doors with windows	FS-42	NA
234	50-WG-C	Window glaze - metal doors with windows	FS-49	NA
235	51-PM-A	Penetration mud - grey mortar around pipe penetrations	FS-59	NA
236	51-PM-B	Penetration mud - grey mortar around pipe penetrations	FS-87	NA
237	51-PM-C	Penetration mud - grey mortar around pipe penetrations	FS-112	NA
238	52-GM-A	Ceramic tile, grout, mortar - 6" white/grey wall tile	FS-14	NA
239	52-GM-B	Ceramic tile, grout, mortar - 6" white/grey wall tile	FS-34	NA
240	52-GM-C	Ceramic tile, grout, mortar - 6" white/grey wall tile	FS-61	NA
241	53-IC-A	Interior caulk - white, on sinks/toilets	FS-113	NA
242	53-IC-B	Interior caulk - white, on sinks/toilets	FS-18	NA
243	53-IC-C	Interior caulk - white, on sinks/toilets	FS-45	NA
—	54 - NOT SAMPLED	Elevator door - ASSUMED	NA	NA
244	55-FS-A	Floor sheeting - brown with raised round treads, and adhesive	FS-24	NA
245	55-FS-B	Floor sheeting - brown with raised round treads, and adhesive	FS-25	NA
246	55-FS-C	Floor sheeting - brown with raised round treads, and adhesive	FS-26	NA
247	56-PL-A	Plaster - underside of stairs	FS-24	NA
248	56-PL-B	Plaster - underside of stairs	FS-24	NA
249	56-PL-C	Plaster - underside of stairs	FS-25	NA
250	56-PL-D	Plaster - underside of stairs	FS-26	NA
251	56-PL-E	Plaster - underside of stairs	FS-26	NA
252	57-IC-A	Interior caulk - yellowish, outer perimeter of metal window frames	FS-24	NA
253	57-IC-B	Interior caulk - yellowish, outer perimeter of metal window frames	FS-76	NA
254	57-IC-C	Interior caulk - yellowish, outer perimeter of metal window frames	FS-86	NA
255	58-CB-A	Cove base - 4" brown vinyl with adhesive	FS-24	NA
256	58-CB-B	Cove base - 4" brown vinyl with adhesive	FS-25	NA
257	58-CB-C	Cove base - 4" brown vinyl with adhesive	FS-26	NA
258	59-CP-A	Ceiling panel - 2'x4' pinhole/fissure	FS-24	NA
259	59-CP-B	Ceiling panel - 2'x4' pinhole/fissure	FS-25	NA
260	59-CP-C	Ceiling panel - 2'x4' pinhole/fissure	FS-26	NA
261	60-PM-A	Penetration mud - white mud on pipe penetrations	FS-28	NA
262	60-PM-B	Penetration mud - white mud on pipe penetrations	FS-43	NA
263	60-PM-C	Penetration mud - white mud on pipe penetrations	FS-75	NA
264	61-IC-A	Interior caulk - black, metal door frame perimeter	FS-27	NA
265	61-IC-B	Interior caulk - black, metal door frame perimeter	FS-32	NA
266	61-IC-C	Interior caulk - black, metal door frame perimeter	FS-44	NA
267	62-MA-A	Mastic - black mastic from former floor tile	FS-29	NA
268	62-MA-B	Mastic - black mastic from former floor tile	FS-30	NA
269	62-MA-C	Mastic - black mastic from former floor tile	FS-31	NA
270	63-BM-A	Brick mortar - red/brown brick floor	FS-32	NA
271	63-BM-B	Brick mortar - red/brown brick floor	FS-32	NA
272	63-BM-C	Brick mortar - red/brown brick floor	FS-32	NA
273	64-PM-A	Penetration mud - dark grey, sticky	FS-33	NA
274	64-PM-B	Penetration mud - dark grey, sticky	FS-48	NA
275	64-PM-C	Penetration mud - dark grey, sticky	FS-139	NA

ENVIRONMENTAL TESTING LABORATORIES, INC

38900 HURON RIVER DRIVE
ROMULUS, MICHIGAN 48174
(734) 955-6600
FAX: (734) 992-2261
www.2ell.com

Bulk Asbestos
Chain of Custody

ETL Project #:

270581

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Lab ID	Sample ID	Material Description	Sample Location	QUANTITY
276	65-IC-A	Interior caulk - white, perimeter of window frames/counter windows	FS-37	NA
277	65-IC-B	Interior caulk - white, perimeter of window frames/counter windows	FS-42	NA
278	65-IC-C	Interior caulk - white, perimeter of window frames/counter windows	FS-72	NA
279	66-RI-A	Rolled-in insulation - yellow fiberglass with brown paper and black adhesive	FS-39	NA
280	66-RI-B	Rolled-in insulation - yellow fiberglass with brown paper and black adhesive	FS-76	NA
281	66-RI-C	Rolled-in insulation - yellow fiberglass with brown paper and black adhesive	FS-76	NA
282	67-SU-A	Sink undercoating - black spray-on with sticker	FS-44	NA
283	67-SU-B	Sink undercoating - black spray-on with sticker	FS-44	NA
284	67-SU-C	Sink undercoating - black spray-on with sticker	FS-46	NA
—	68 - NOT SAMPLED	Glass block grout - grey - ASSUMED	NA	NA
285	69-SU-A	Sink undercoating - grey spray-on	FS-119	NA
286	69-SU-B	Sink undercoating - grey spray-on	FS-119	NA
287	69-SU-C	Sink undercoating - grey spray-on	FS-119	NA
288	70-IC-A	Interior caulk - dark grey, perimeter of elevator frame	FS-27	NA
289	70-IC-B	Interior caulk - dark grey, perimeter of elevator frame	FS-27	NA
290	70-IC-C	Interior caulk - dark grey, perimeter of elevator frame	FS-27	NA
291	71-CC-A	Concrete chip - exterior walk-ways	EA-1	NA
292	71-CC-B	Concrete chip - exterior walk-ways	EA-2	NA
293	71-CC-C	Concrete chip - exterior walk-ways	EA-3	NA
294	72-EJ-A	Expansion joint - concrete walkways	EA-1	NA
295	72-EJ-B	Expansion joint - concrete walkways	EA-3	NA
296	72-EJ-C	Expansion joint - concrete walkways	EA-4	NA
297	73-BM-A	Brick mortar - red brick siding with grey mortar	EA-2	NA
298	73-BM-B	Brick mortar - red brick siding with grey mortar	EA-3	NA
299	73-BM-C	Brick mortar - red brick siding with grey mortar	EA-4	NA
300	74-EC-A	Exterior caulk - white, seams of brick siding	EA-1	NA
301	74-EC-B	Exterior caulk - white, seams of brick siding	EA-2	NA
302	74-EC-C	Exterior caulk - white, seams of brick siding	EA-4	NA
303	75-EC-A	Exterior caulk - black, perimeter of service doors, overhead roll-up bay doors	EA-1	NA
304	75-EC-B	Exterior caulk - black, perimeter of service doors, overhead roll-up bay doors	EA-1	NA
305	75-EC-C	Exterior caulk - black, perimeter of service doors, overhead roll-up bay doors	EA-1	NA
306	76-EC-A	Exterior caulk - light grey, on concrete walkways	EA-1	NA
307	76-EC-B	Exterior caulk - light grey, on concrete walkways	EA-1	NA
308	76-EC-C	Exterior caulk - light grey, on concrete walkways	EA-1	NA
309	77-EC-A	Exterior caulk - dark grey, between brick siding and granite capstone	EA-1	NA
310	77-EC-B	Exterior caulk - dark grey, between brick siding and granite capstone	EA-3	NA
311	77-EC-C	Exterior caulk - dark grey, between brick siding and granite capstone	EA-4	NA
312	78-EC-A	Exterior caulk - black, on metal window frames	EA-1	NA
313	78-EC-B	Exterior caulk - black, on metal window frames	EA-1	NA
314	78-EC-C	Exterior caulk - black, on metal window frames	EA-3	NA
315	79-EJ-A	Expansion joint - red, in brick siding	EA-1	NA
316	79-EJ-B	Expansion joint - red, in brick siding	EA-2	NA
317	79-EJ-C	Expansion joint - red, in brick siding	EA-3	NA
—	END OF COC	END OF COC	END OF COC	NA

APPENDIX D

LEAD LABORATORY RESULTS



30105 Beverly Road
Romulus, MI 48174
Ph: 734-629-8161; Fax: 734-629-8431

Certificate of Analysis: Lead In Paint by EPA SW-846 Method 7000B/3050B*

Client : Atlas Technical Consultants
46555 Humboldt Dr.
Novi, MI 48377

Attn : Dawn LeCesne **Email :** dawn.lecesne@oneatlas.com
Phone : 248-669-5140 **Fax :** 248-669-5147

AAT Project : 1057573
Sampling Date : 07/31/2024
Date Received : 08/13/2024
Date Analyzed : 08/15/2024
Date Reported : 08/15/2024

Client Project : 188BS24470

Project Location : 411 E GENESEE AVE SAGINAW MI 48607

Lab Sample ID	Client Code	Sample Description	PPM	Result Lead (% by weight)	Calculated R L (% by weight)
9645729	1-LBP-BLACK	EXT BLACK PAINT WIN FRAME PNLS	23.2	0.00232	0.000806
9645730	2-LBP-WHITE	INT WHITE PAINT	16.1	0.00161	0.000699
9645731	3-LBP-GREY	INT GREY PAINT	27.5	0.00275	0.000755

Analyst Signature

Nathan Ditty

ND = Not Detected, N/A = Not Available, RL = Reporting Limit, Analytical Reporting Limit is 5 ug/sample. For true values assume (3) significant figures. The method, batch, and sample Quality Control are acceptable unless otherwise stated. AAT internal SOP S218. The laboratory operates in accord with ISO 17025 guidelines and holds limited scopes of accreditation under AIHA-LAP and NY State DOH ELAP programs. These results are submitted pursuant to AAT, LLC current terms and conditions of sale, including the company's standard warranty and limitation of liability provisions. Analytical results relate to the samples as received by the lab. Results in mg/cm2 are calculated based on sample area dimensions supplied by the client. AAT will not assume any liability or responsibility for the manner in which the results are used or interpreted. Reproduction of this document other than in its entirety is not authorized by AAT, LLC. AAT does not blank correct reported values. Sample data apply only to items analyzed. Current EPA/HUD Interim Standard for lead in paint samples is: 5000 PPM (parts per million) or ug/g which is equivalent to 0.5% by weight. EPA definition of lead-based paint: 1.0 mg/cm2. New York City Regulatory Limits: 0.25% by weight or 0.5 mg/cm2 for investigations for a child. MD and Philadelphia definition of lead-based paint: 0.7 mg/cm2. Note: Samples are stored for 15 days following report date. * = Validated modified method

AIHA LAP- Lab ID #100986, NY State DOH ELAP -Lab ID #11864, State of Ohio- Lab ID # 10042





30105 Beverly Road
Romulus, MI 48174
Ph: 734-629-8161; Fax: 734-629-8431

To : Atlas Technical Consultants
46555 Humboldt Dr.
Novi, MI 48377

Attn : Dawn LeCesne

Email : dawn.lecesne@oneatlas.com

Phone : 248-669-5140

Project Location : 411 E GENESEE AVE SAGINAW MI 48607

AAT Project : 1057573

Client Project : 188BS24470

Date Reported : 08/15/2024

Sample	Client Code	Analysis Requested	Completed	Analyst
9645729	1-LBP-BLACK	Lead Paint	08/15/2024	Nathan Ditty
9645730	2-LBP-WHITE	Lead Paint	08/15/2024	Nathan Ditty
9645731	3-LBP-GREY	Lead Paint	08/15/2024	Nathan Ditty

Reviewed By

Elyse Bidle
Quality Assurance Coordinator

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**30105 BEVERLY RD.
ROMULUS MI 48174
(734) 699-LABS (5227)
FAX: (734) 699-8407**



Website: www.accurate-test.com

LA 1103923

SUBMITTING COMPANY
Atlas Technical Consultants

2650 Horizon Drive SE #110
Grand Rapids, MI 49546

CONTACT INFORMATION

Office: 616-698-3131

Fax:

Cell: 616-560-3546

Email: customersupport@accurate-test.biz

#PO

Email: Andrew.DeLodder@oneatlas.com

PROJECT NUMBER		188BS24470		SAMPLING DATE:		7/31/2024		
PROJECT ADDRESS		411 E Genesee Ave, Saginaw, Mi, 48607						
SAMPLE START TIME		1330		SAMPLE END TIME		1400		
RISK ASSESSOR		Andrew DeLodder						
LAB ID # <i>9045729</i>	CLIENT	SAMPLE ID	DESCRIPTION	WS, WT, F	WIPE AREA (e.g. 12 In X 12 In)	REQUESTED ANALYSIS		LEAD
		1-LBP-Black	Exterior black paint (window frames, panels)			SINGLE WIPE DUST ()		
		2-LBP-White	Interior white paint			COMPOSITE SOIL ()		
		2-LBP-Grey	Interior grey paint			PAINT CHIP	% By Wt (x)	mg/cm ²
TURNAROUND TIME (please check one)		SAME DAY () 24 Hour () 48 Hour () 72 hours (x)						
If no TAT is indicated, default is 72 hours								
CLIENT COMMENTS		SAMPLES SHIPPED 3						
NY STATE SAMPLES		(check here)						
SAMPLE CONDITION		SEALS INTACT Y N CONTAINERS LABELED Y N RECVD & ACCEPTED Y N						
LAB REMARKS		1894 1057573						
LAB PROJECT NUMBER								
DATE		TIME						
8/2/2024		AM PM						

By submitting samples to AAT, the client agrees to AAT's terms and conditions.

AAT is not responsible for shipping delays

SECTION 005000 - AVAILABILITY OF ELECTRONIC FILES

PART 1 - GENERAL

1.1 POLICY

- A. As a service to bidders, contractors, subcontractors, vendors, material suppliers and others needing electronic copies of drawing files, the Architect will provide electronic files via file transfer through the Project Website in accordance with the following policy.
1. In accepting and utilizing any drawings or data generated and furnished by WTA Architects, the Receiver agrees that all such electronic files are instruments of service of WTA Architects and its consultants, who shall be deemed the author, and shall retain all common law, statutory law and other rights, without limitation, including copyrights.
 2. The Receiver agrees not to reuse these electronic files, in whole or in part, for any purpose other than for the Project. The Receiver agrees not to transfer these electronic files to others without the prior written consent of WTA Architects or its consultants. The Receiver further agrees that WTA Architects and its consultants shall have no responsibility or liability to Receiver or others for any changes made it shall be the Receiver's responsibility to be aware of changes made by WTA Architects, its consultants or the Owner.
 3. It is further understood and agreed that the undersigned Receiver will hold WTA Architects and its consultants harmless, indemnify and defend WTA Architects and its consultants from all claims, liabilities, losses, etc., including attorney's fees arising out of the use or misuse of the transferred items.
 4. It is understood and agreed that the items transmitted are prepared from electronic files current at the time of preparation. **All files are AutoCAD 2019.** The Receiver will specify on request form if an older version is required.
 5. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
 6. As a record of information to be transmitted, WTA Architects will prepare a duplicate back-up for its files, which may be electronic or hard-copy.
 7. Compensation for providing this material will be as follows: Fees waived.
 8. A signed copy of the Release Letter must be received before files will be released.

1.2 REQUEST PROCEDURE

- B. To receive files the attached Release Letter must be completed in full and submitted to the Project Manager at WTA Architects.
1. A signed copy of the Release Letter must be submitted; faxed or emailed copies will be accepted.
 2. Upon remittance of the signed Release Letter, allow five working days for processing.

EXTERIOR ENTRANCE REPLACEMENT FOR:
JEROME T. HART STATE OFFICE BUILDING
SAGINAW, MICHIGAN

FILE NO. 171/25046.CTS
PROJECT NO. 2025009

Firm Requesting Files:

Date: _____

Name: _____
Company: _____
Address: _____
City, State, Zip: _____

Phone: _____

Re: Letter of Authorization for Electronic File Transfers

Project Name: _____

WTA Project No.: _____

Dear Sir:

Per your request, WTA Architects will transmit the requested electronic files via file transfer through the project website upon receipt of this letter with conditions of agreement as stated.

1. In accepting and utilizing any drawings or data generated and furnished by WTA Architects, the Receiver agrees that all such electronic files are instruments of service of WTA Architects and its consultants, who shall be deemed the author, and shall retain all common law, statutory law and other rights, without limitation, including copyrights.
2. The Receiver agrees not to reuse these electronic files, in whole or in part, for any purpose other than for the Project. The Receiver agrees not to transfer these electronic files to others without the prior written consent of WTA Architects or its consultants. The Receiver further agrees that WTA Architects and its consultants shall have no responsibility or liability to the Receiver or others for any changes made it shall be the Contractors responsibility to be aware of changes made by WTA Architects, its consultants or the Owner.
3. It is further understood and agreed that the undersigned will hold WTA Architects and its consultants harmless, indemnify and defend WTA Architects and its consultants from all claims, liabilities, losses, etc., including attorney's fees arising out of the use or misuse of the transferred items.
4. It is understood and agreed that the items transmitted are prepared from electronic files current at the time of preparation. **All files are AutoCAD 2019**, unless requested otherwise.
5. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
6. As a record of information to be transmitted, we will prepare a duplicate back-up for our files, which may be electronic or hard-copy.
7. Compensation for providing this material will be as follows: Fees waived. Please remit to WTA Architects and allow five working days for processing.

Fee: \$ WAIVED Drawings: _____

Signed: _____ Printed Name/Title: _____

To be Completed by WTA Architects, Inc.

Released (Signed By): _____ WTA Architects, Inc.

Printed Name/Title: _____ Date: _____

END OF SECTION 005000

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Work restrictions.
5. Specification and drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Jerome T. Hart State Office Building

1. Project Location: 411 E. Genesee Ave, Saginaw, MI 48607

B. Owner: Department of Technology, Management and Budget (DTMB)

1. Owner's Representative: DTMB - Chris Schanbeck

C. Architect: WTA Architects; 100 S. Jefferson Ave.; Saginaw, Michigan 48607; 989-752-8107 ph.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Project Work includes, but is not necessarily limited to, storefront replacement, exterior ramp and stair renovations, paving and landscaping, and snow melt system. Other renovations include site lighting, ADA parking striping and ADA parking signage.

B. Type of Contract.

1. Project will be constructed under a single prime contract.

1.4 ACCESS TO SITE

- A. General: Contractor shall have use of Project site for construction operations and as indicated on Drawings by the scope of construction work and as indicated by requirements of this Section.
 - 1. Jerome T. Hart State Office Building will be operational during construction.
- B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine construction operations to the Work Limits indicated on Drawings.
 - 2. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, Patrons 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 by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.5 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Work in the existing building may be performed during normal business working hours of, unless otherwise indicated.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Controlled Substances: Use of tobacco products and other controlled substances within the existing building and on Project site is not permitted.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

- A. 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. Imperative mood and streamlined language are generally used in the Specifications. 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.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

- A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- 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. List 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 - Brick Repointing:
 - 1. Description: Remove existing brick mortar to a depth of one (1) inch minimum and repoint with new mortar according to Section 042000 "Unit Masonry."
 - 2. Unit of Measurement: One lineal foot.
- B. Unit Price No. 2 - Brick Removal and Install:
 - 1. Description: Remove seven (7) full brick units and replace with new brick to match existing, according to Section 042000 "Unit Masonry." Based on seven brick units per square foot. This unit price shall be used where seven or more brick units are removed and replaced at a repair location.
 - 2. Unit of Measurement: One square foot.

C. Unit Price No. 3 - Sidewalk Replacement:

1. Description: Remove existing concrete sidewalk and replace with new. Cost for removal shall be based upon an assumed four-inch-thick wire mesh reinforced pavement, including all sawcutting, removal, and disposal costs. New concrete paving will be based on five-inch-thick paving reinforced with 6x6 W2.9xW2.9 W.W.F. Include adjustment and preparation of base material as necessary to accommodate change in paving thickness.
2. Unit of Measurement: One square foot.

END OF SECTION 012200

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form acceptable to Architect.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be

- provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
- j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.
- 1.4 QUALITY ASSURANCE
- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.
- 1.5 PROCEDURES
- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.
- 1.6 SUBSTITUTIONS
- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform

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and consistent, is compatible with other products, and is acceptable to all
contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Daily construction reports.
 - 2. Site condition reports.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

PART 2 - PRODUCTS

2.1 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events.
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Meter readings and similar recordings.
 - 12. Emergency procedures.
 - 13. Orders and requests of authorities having jurisdiction.
 - 14. Change Orders received and implemented.
 - 15. Construction Change Directives received and implemented.
 - 16. Services connected and disconnected.
 - 17. Equipment or system tests and startups.
 - 18. Partial completions and occupancies.
 - 19. Substantial Completions authorized.
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

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

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include information requested in form fields in Newforma Project Center's Submittal page.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.

- g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 - 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include

list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
 - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 - 2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
 - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 - 3. Indicate methods to be used to avoid trapping water in finished work.

1.4 QUALITY ASSURANCE

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

- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

2.2 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 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 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.
- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

- B. Sanitary Facilities: Coordinate with Owner for access and use of existing toilet and washing facilities.
- C. Temporary 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. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 - 1. Utilize designated area within existing building for temporary field offices.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. 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. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- D. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs so they are legible at all times.
- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control measures.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: Work Limits, as indicated on Drawings.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. 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

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have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.

2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

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

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.5 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements

in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
 1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.
- B. Related Sections:
 - 1. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 INFORMATIONAL SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- B. Certified Surveys: Submit two copies signed by land surveyor or professional engineer.
- C. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.3 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning

sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.

2. Establish limits on use of Project site.
 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 4. Inform installers of lines and levels to which they must comply.
 5. Check the location, level and plumb, of every major element as the Work progresses.
 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
- C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- D. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. 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.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Remove and replace damaged, defective, or non-conforming Work.
- K. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
 1. Special attention to lay-down and project trailer areas. These site areas to be protected and restored (if necessary) to original condition. Including parking surfaces, curbs, concrete walks, landscaping, turf, etc.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017310 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Firestop Systems" for patching fire-rated construction.
 - 2. Divisions 2 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 21, 22, 23, 26, 27 and 28 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 1. Primary operational systems and equipment.
 - 2. Fire-protection systems.
 - 3. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 1. Piping, ductwork, vessels, and equipment.
 - 2. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building and site's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
 - 1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.

a. Roofing.

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

1.5 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 - 4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 017310

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 - 5. Submit testing, adjusting, and balancing records.

6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1.5 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
 1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.6 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order, starting with exterior areas first, listed by room or space number.
 - 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 - 4. Submit list of incomplete items in the following format:
 - a. PDF Electronic File: Architect will return annotated file.

1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranties in Paper Form:
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. 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.
 - c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - e. Vacuum and mop concrete.
 - f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - h. Remove labels that are not permanent.
 - i. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - l. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA ACR.
 - m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - n. Clean strainers.
 - o. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for preparing operation and maintenance manuals, including:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.

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 operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - 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 draft submittals.
 - 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.
- 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 Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Name and contact information for Commissioning Authority.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance 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 "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section 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 below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.3 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 Owner'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 Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Sections:
 - 1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 2. Divisions 02 through 49 Sections for specific requirements for project record documents of the Work in those Sections.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit two sets of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal: Submit PDF electronic files of marked-up record prints and two sets of plots from corrected record digital data files. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal: Submit PDF electronic files of marked-up record prints. Print each Drawing, whether or not changes and additional information were recorded.
 - c. Final Submittal: Submit PDF electronic files of marked-up record prints, two sets of record digital data files, and two sets of record digital data file plots. Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or

- similar entity, to provide information for preparation of corresponding marked-up record prints.
- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it.
 - c. Record and check the markup before enclosing concealed installations.
2. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 2. Format: DWG, Version 2010, operating in Microsoft Windows operating system.
 3. Format: Annotated PDF electronic file with comment function enabled.
 4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 5. Refer instances of uncertainty to Architect through General Contractor for resolution.
 6. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. Note related Change Orders, Record Product Data and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, Record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition,

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protected from deterioration and loss. Provide access to project record documents
for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.

1.2 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of selective demolition activities with starting and ending dates for each activity.
- C. Predemolition photographs or video.

1.5 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

1.6 FIELD CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: Hazardous materials have been identified on site. Refer to section 003126 "Existing Hazardous Material Information" for testing and survey information.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
- F. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.7 WARRANTY

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

PART 2 - PRODUCTS

2.1 PERFORMANCE 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 ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition.
- B. 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.
- C. Inventory and record the condition of items to be removed and salvaged.

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.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. 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.
 - 3. Disconnect, demolish, and remove plumbing and HVAC systems, equipment, and components indicated on Drawings 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 and leave in place.
 - 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 Owner.
 - 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 and leave in place.

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, 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.

- C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION

- 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. 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 portable fire-suppression devices during flame-cutting operations.
 - 4. Maintain fire watch during and for at least a half hour after flame-cutting operations.
 - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 6. Dispose of demolished items and materials promptly.
- B. 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.
- 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 Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 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 Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 CLEANING

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 - 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.
- B. Burning: Do not burn demolished materials.

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- C. 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 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

1.3 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.
- C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an MCA Exterior Concrete Finisher and a supervisor who is MCA certified with experience installing and finishing exterior concrete like this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.6 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1.
 - 1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M).

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301 (ACI 301M).
2. ACI 117 (ACI 117M).

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.4 CONCRETE MATERIALS

- A. Cementitious Materials:
 1. Portland Cement: ASTM C 150/C 150M, Type I.
- B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.
- C. Air-Entraining Admixture: ASTM C 260/C 260M.
- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- E. Water: ASTM C 94/C 94M and potable.

2.5 VAPOR RETARDERS

- A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).
- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Normal-Weight Concrete:
 - 1. Exterior: Exterior concrete foundations and slabs exposed to de-icing:
 - a. Minimum Compressive Strength: 4500 psi (31 MPa) at 28 days.
 - b. Maximum W/C Ratio: 0.40 air-entrained.
 - 2. Slump Limit:
 - a. Foundations: 3 inches plus or minus 1 inch.
 - b. Slabs and Walls: 4 inches plus or minus 1 inch.
 - 3. Air Content: Provide air entraining at all exterior exposures.
 - a. Maintain within range permitted by ACI 301 (ACI 301M). Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

2.10 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

2.12 CONCRETE FINISHING

- A. Cure-Seal-Hardener: Clear, penetrating Silane coating that provides salt and water repellency to concrete and masonry.
 - 1. Basis-of-Design Product: Subject to compliance with requirements provide Curecrete Distribution, Salt Slayer or Architect approved equal.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).
- C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLATWORK

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
- C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 (ACI 301M) for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 CONCRETE SURFACE REPAIRS

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as a clean surface. Remove all surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Staining, discoloration, and other aesthetic defects resulting from construction access and traffic is sufficient reason to require replacement. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each 2000 sq. ft. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39; test one specimen at seven days and two specimens at 28 days.
 - a. All tests shall meet or exceed the specified compressive strengths.
- C. Test results to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- E. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- F. Concrete paving will be considered defective if it does not pass tests and inspections.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- H. Prepare test and inspection reports.

END OF SECTION 033000

SECTION 04 2000 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

1. Concrete block.
2. Clay facing brick.
3. Mortar and grout.
4. Reinforcement and anchorage.
5. Flashings.
6. Accessories.
7. Brick Removal and Replacement

1.2 SUBMITTALS

- A. Product Data: Provide data for the following:
 1. Masonry Units:
 - a. Include data on material properties.
 - b. Masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Brick units:
 - a. For exposed brick, include test report for efflorescence according to ASTM C 67.
 - b. Include size-variation data verifying that the actual range of sizes falls within specified tolerances.
 3. Cementitious materials. Include name of manufacturer, brand name and type.
 4. Mortar admixtures.
 5. Preblended, dry mortar mixes. Include description of type and proportion of ingredients.
 6. Grout mixes. Include description of type and proportion of ingredients.
 7. Anchors, ties, weep/cavity vent, preformed control-joint gaskets, cavity drainage material, and metal accessories.
- B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for masonry.
 1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special units.
 2. Reinforcing: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars.
 - a. Comply with ACI 315.
 3. Flashings: Provide details of embedded flashings including end dams, corners, drips, weeps.
- C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C91/C 91M for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirements.
- D. Samples: Submit 3 samples of facing brick to illustrate color, texture, and extremes of color range.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.

- G. Cold-Weather and Hot-Weather Procedures: Detail description of methods, material, and equipment to be used to comply with requirements.

1.3 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing the masonry construction, salvage, and restoration work of the type specified and with at least 5 years of documented experience.

1.4 MOCK-UP

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for material and execution.
- B. Construct a masonry wall as a mock-up panel sized 8 feet long by 4 feet high; include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), through-wall flashing (omit masonry above half of flashings, wall insulation, and sealant-filled joint at least 16 inches long in exterior wall in mock-up).
- C. Locate where directed.
- D. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
- E. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
- F. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - 1. Approval of mockups is also for other materials and construction qualities specifically approved by Architect in writing.
 - 2. Approval of mockups does not constitute approval of deviations from Contract Documents contained in the mock-ups unless Architect specifically approves such deviations in writing.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Store masonry units on elevated platforms in a dry location. If units are not stored in a enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, protections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 PRODUCTS

2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.

2.1 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
 - 2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
 - 3. Load-Bearing and Non-Loadbearing Units: ASTM C90, normal weight.

- a. Standard Units:
 - 2) Exposed Faces: Manufacturer's standard color and texture as approved by Architect per ASTM C90.
- 3) Manufacturers:
 - (a) Consumers Concrete Corp.: www.consumersconcrete.com.
 - (b) Echelon by Oldcastle: www.echelonmasonry.com.
 - (c) Fendt Builder's Supply, Inc.: www.fendtproducts.com.
 - (d) Grand Blanc Cement Products: www.grandblancementproducts.com.
 - (e) Michigan Certified Products, Inc.: www.micertconcrete.com.
 - (f) National Block Company: www.nationalblock.com.
 - (g) Substitutions: See Section 012500 - Product Requirements.

2.2 BRICK UNITS

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 - 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Manufacturers: Provide products from the manufacturer listed for each brick type.
 - 1. Brick Tech Architectural, Inc.: www.interstatebrick.com.
 - 2. Belden Brick Company
 - 3. Substitutions: Not permitted.
- C. Facing Brick:
 - 1. Special shapes: Provide molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
 - 2. Field Brick.
 - a. Manufacturer: Belden Brick Company
 - 2) Substitutions: Not permitted.
 - b. ASTM C216, Type FBS, Grade SW.
 - c. Size (Actual): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long (Modular).
 - d. Color/Blend: 470-479 Dark A.
 - e. Texture: Vertical Cut.
 - 3. Field Brick.
 - a. Manufacturer: Belden Brick Company
 - 2) Substitutions: Not permitted.
 - b. ASTM C216, Type FBS, Grade SW.
 - c. Size (Actual): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long (Modular).
 - d. Color/Blend: Custom Blend, Match Existing
 - e. Texture: Smooth.

2.4 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M.
- B. Mortar Cement: ASTM C1329.
- C. Portland Cement: ASTM C150/C150M, Type I.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Mortar Aggregate: ASTM C144.
- F. Grout Aggregate: ASTM C404.
- G. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 - 1. Color(s): 94X.
 - 2. Manufacturers:
 - a. Davis Colors: www.daviscolors.com.
 - b. Lambert Corporation: www.lambertusa.com.
 - c. Solomon Colors: www.solomoncolors.com/sle.
 - d. Substitutions: See Section 012500 - Product Requirements.
- H. Water: Clean and potable.
- I. Packaged Dry Material for Mortar for Unit Masonry:
 - 1. At Contractor's option, prepackaged dry material for mortar may be used subject to compliance with mortar requirements of this section including, but not limited to, the following:
 - a. Mortar Types: As indicated.
 - b. Color(s): As selected by Architect from manufacturer's full range.
 - c. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
 - 2. Portland Cement Based: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - a. Manufacturers:
 - 1) Amerimix, an Oldcastle brand; www.amerimix.com.
 - 2) The QUIKRETE Companies; www.quikcrete.com.
 - 3) SPEC MIX, Inc.; www.specmix.com.
 - 4) Substitutions: See Section 012500 - Product Requirements.
 - 3. Masonry Cement Based: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
 - a. Manufacturers:
 - 1) Amerimix, an Oldcastle brand; www.amerimix.com.
 - 2) The QUIKRETE Companies; www.quikcrete.com.
 - 3) SPEC MIX, Inc.; www.specmix.com.
 - 4) Substitutions: See Section 012500 - Product Requirements.
- K. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
 - 1. At Contractor's option, prepackaged dry material for grout may be used subject to compliance with grout requirements of this section.
 - 2. Manufacturers:
 - a. Amerimix, an Oldcastle brand; www.amerimix.com.
 - b. The QUIKRETE Companies; www.quikcrete.com.
 - c. SPEC MIX, Inc.; www.specmix.com.
 - d. Substitutions: See Section 012500 - Product Requirements.

2.5 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
 - 1. Basis-of-Design Product: The design for each item specified is based on the product named. Provide either the named product or a comparable product by one of the following:
 - a. Fero Corp.; www.ferocorp.com.
 - b. Heckmann Building Products; www.heckmannbuildingprods.com.
 - c. Hohmann & Barnard, Inc.; www.h-b.com.
 - d. Wire-Bond; www.wirebond.com.
 - e. Substitutions: See Section 012500 - Product Requirements.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; Uncoated.
- C. Reinforcing Bar Positioners: 0.156 inch, ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B.
 - 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: RB and RB-Twin Rebar Positioners.
- D. Reinforcing Bar Lap Joint Ties: ASTM A1064/A1064M steel wire, mill galvanized to 16 CFR 1201 Class 3.
 - 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: Spyra-Lox Rebar Lap- Joint Tie.
- E. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
 - 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 120 Truss-Mesh or 220 Ladder-Mesh.
- F. Adjustable Multiple Wythe Joint Reinforcement: Truss or ladder type with adjustable ties or tabs spaced at 16 in on center ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
 - 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 170 Truss LOX-ALL Adjustable Eye Wire or 270 Ladder LOX-ALL Adjustable Eye Wire with 2X-HOOK.
- G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches; hot dip galvanized to ASTM A153/A153M Class B.
 - 1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 344 Rigid Partition Anchor.
- H. Dovetail Anchor Slots for Connecting to Concrete: 2-piece anchors that permit differential movement between masonry and concrete frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
 - 1. Concrete frame: Dovetail anchors of bent steel, nominal 1 inch width by 1 inch deep by 0.03 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - a. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 305 Dovetail Slot with 315 Flexible Dovetail Brick Ties.

- I. Adjustable Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 1. For cold-formed metal framing and sheathing back-up.
 2. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners.
 3. Wire ties: Rectangular shape, 0.1875 inch thick.
 4. Vertical adjustment: Not less than 2 inches.
 5. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: HB-213 anchors with 2X-HOOK.

2.6 FLASHINGS

- A. Flexible Fabric Flashing - Self-Adhering: Self-adhering stainless steel/polymer fabric flashing. ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric. Flashing shall be self-adhering using a pressure-sensitive adhesive.
 1. Type 304 stainless steel.
 - a. Thickness: 2 mils, minimum.
 2. Basis-of-Design Product: Provide York Manufacturing, Inc.; York 304: www.yorkmfg.com, or one of the following products:
 - a. Hohmann & Barnard, Inc.; Mighty-Flash SA: www.h-b.com.
 - b. Wire-Bond; Bond-N-Flash SA: www.wirebond.com.
 - c. Substitutions: See Section 012500 - Product Requirements.
 3. Factory-Fabricated Inside and Outside Flashing Corners and End Dams: Stainless steel.
 - a. Manufacturer shall be the same as flexible fabric flashing manufacturer.
 4. Factory-Fabricated Drip Plates including Inside and Outside Corners: Stainless steel.
 - a. Pre-formed smooth drip plates with hemmed edges.
 - b. Manufacturer shall be the same as stainless steel/polymer fabric flashing manufacturer.
 5. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
 - a. Manufacturer shall be the same as flexible fabric flashing manufacturer.

2.7 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints. ASTM D2000, 2AA-805.
 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/sle.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. Substitutions: See Section 012500 - Product Requirements.
- B. Compressible Joint Filler: Closed cell neoprene; oversized 50 percent to joint width; self expanding; in maximum lengths available. ASTM D1056, Grade 2A1.
 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/sle.
 - b. WIRE-BOND: www.wirebond.com/#sle.
 - c. Substitutions: See Section 012500 - Product Requirements.
- C. Building Paper: ASTM D226/D226M, Type I ("No.15") asphalt felt.

- D. Weep Inserts and Cavity Vents:
 - 1. Type: Plastic cellular/honeycomb design.
 - 2. Color(s): As selected by Architect from manufacturer's full range.
 - 3. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; QV Quadro- Vent or a comparable product by one of the following:
 - a. Advanced Building Products Inc.; www.advancedbuildingproducts.com.
 - b. Heckmann Building Products; www.heckmannbuildingprods.com.
 - c. Mortar Net Solutions; www.mortarnet.com.
 - d. Wire-Bond; www.wirebond.com.
 - e. Substitutions: See Section 012500 - Product Requirements.
- E. Mortar and Grout Screen: 1/4 inch square, polypropylene monofilament screening for preventing grout flow; width sized to match masonry widths.
 - 1. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; MGS or a comparable product by one of the following:
 - a. Heckmann Building Products; www.heckmannbuildingprods.com.
 - b. Wire-Bond; www.wirebond.com.
 - c. Substitutions: See Section 012500 - Product Requirements.
- F. Masonry Cleaners:
 - 1. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - a. Basis-of-Design Products: Provide PROSOCO, Inc.; www.prosoco.com: Sure Klean 600 or Sure Klean Vana Trol or a comparable product by one of the following:
 - 1) Diedrich Technologies, Inc.; www.diedrichtechnologies.com.
 - 2) Substitutions: See Section 012500 - Product Requirements.

2.8 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Masonry below grade and in contact with earth: Type M.
 - 2. Exterior, loadbearing masonry: Type S.
 - 3. Exterior, non-loadbearing masonry: Type N.
 - 4. Precast concrete units: Same Type as wall masonry in which unit is set.
 - 5. Pointing Mortar: Type N.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
 - 1. Brick Mortar Color: Match existing.
- C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
 - 1. Grout Strength: 3000 psi at 28 days, unless otherwise indicated.
- D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that foundations are within tolerances specified.
- C. Verify that related items provided under other sections are properly sized and located.
- D. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- E. Verify that reinforcing dowels are properly placed.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

3.3 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- E. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.4 BRICK REMOVAL AND REPLACEMENT

- A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
 - 1. When removing single bricks, remove material from center of brick and work toward outside edges.
- B. Support and protect remaining masonry that surrounds removal area.
- C. Maintain adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels as required.
- D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.
- E. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.
- F. Replace removed damaged brick with new brick matching existing brick.

- G. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
 - 1. Maintain joint width for replacement units to match existing joints.
 - 2. Use setting buttons or shims to set units accurately spaced with uniform joints.
- H. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.) Use wetting methods that ensure that units are nearly saturated, but surface is dry when laid.
 - 1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
 - 2. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.
- I. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
 - 1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.5 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Existing Masonry: Match coursing and bonding of existing masonry unless otherwise indicated.
- D. Concrete Masonry Units: Unless otherwise indicated:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.
 - 4. Mortar Joint Thickness: 3/8 inch.
- E. Brick Units: Unless otherwise indicated:
 - 1. Bond: Running.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches.
 - 3. Mortar Joints: Concave.
 - 4. Mortar Joint Thickness: 3/8 inch.

3.6 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high-pressure cleaning methods.
- E. Interlock intersections and external corners.
- F. Tooth-in new masonry work with existing, unless otherwise indicated on Drawings.
- G. Tooth-in cutting and patching masonry work unless otherwise indicated on Drawings.
- H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar, and replace.

- I. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- J. Cut mortar joints flush where wall tile is scheduled, or resilient base is scheduled.
- K. Isolate cast stone units and precast architectural concrete units from clay masonry with building paper or similar method of providing a continuous bond break/slip plane.
- L. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Allow cleaned surfaces to dry before setting.
 - 3. Wet joint surfaces thoroughly before applying mortar.
 - 4. Rake out mortar joints for pointing with sealant.

3.7 WEEPS INSERTS/CAVITY VENTS

- A. Install weep inserts in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 24 inches on center horizontally below shelf angles and lintels and near top of walls.

3.8 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.
 - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.
- C. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.9 HORIZONTAL JOINT REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in the first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Masonry to Structural Steel and Concrete:
 - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under

- specific wall type, space anchors at maximum of 24 inches horizontally and 24 inches vertically.
- F. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8-inch mortar cover to the outside face of the anchor.

3.10 MASONRY FLASHINGS

- A. General:
1. Install masonry flashings according to manufacturer's instructions and as indicated on the Drawings.
 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 3. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.
 4. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - a. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 8 inches, minimum, to form watertight pan at non-masonry construction.
 5. Terminate flashing up 8 inches minimum on vertical surface of backing:
 - a. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's direction, unless otherwise indicated.
 - b. Anchor vertical leg of flashing into backing with a termination bar and sealant.
 6. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7, unless more stringent requirements are specified in this section.
- B. Flexible Fabric Flashing:
1. Use factory-fabricated drip plates, corners and end dams.
 2. Extend flexible fabric flashing to within 1/4 inch of exterior face of masonry overlapping metal drip plate.
 3. Extend flexible fabric flashing full width of cavity space and turn up inner masonry wythe or sheathing at least 14 inches.
 4. Secure flexible fabric flashing to wall with continuous termination bar and apply sealant across top of termination bar.

3.11 VERTICAL MASONRY REINFORCEMENT

- A. Reinforcement: Size and place vertical masonry reinforcement to comply with TMS 402/602 requirements and as indicated on Drawings.
- B. Place and consolidate grout fill without displacing reinforcing.

3.12 GROUTING

- A. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
- B. Perform grouting by means of high-lift technique, except in locations that mandate use of low-lift grouting technique.
1. Do not use high-lift grouting where size of cavities mandates use of fine grout.
- C. Low-Lift Grouting:
1. Limit height of pours to 12 inches.
 2. Limit height of masonry to 16 inches above each pour.

3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- D. High-Lift Grouting:
1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
 2. Clean out masonry cells and other cavities to be grouted by high pressure water spray or compressed air. Remove debris, allow to dry, and inspect before sealing cleanout openings.
 3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
 4. Place grout for spanning elements in single, continuous pour.

3.13 GROUTED COMPONENTS

- A. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- B. Place and consolidate grout fill without displacing reinforcing.
- C. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.14 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
 1. Refer to Section 07 9200 - Joint Sealants for sealant installation.
- C. Control Joints to be spaced at no greater than the least of 1.5 times the height of the masonry wall, 24'-0" max, or as shown on design documents. Control Joints shall be provided within 12'-0" or .75 times the height of the masonry wall of the corners of the wall construction.

3.15 TOLERANCES

- A. Dimensions and Locations of Elements:
 1. Location of elements in plan; do not vary from that indicated on Drawings by more than:
 - a. Plus or minus 1/2 inch.
 2. Dimensions in cross section; do not vary from that indicated on Drawings by more than:
 - a. Minus 1/4 inch.
 - b. Plus 1/2 inch.
 3. Maximum Variation from Alignment of Columns and Pilasters: 1/4 inch.
 4. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
 5. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
 6. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
 7. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

8. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
9. Lines and Levels:
 - a. Maximum variation from level:
 - 1) Includes, but is not limited to, the following:
 - (a) Lintels.
 - (b) Sills.
 - (c) Parapets.
 - (d) Reveals.
 - (e) Other conspicuous lines.
 - 2) Do not vary from level by more than:
 - (a) 1/4 inch in 20 feet.
 - (b) 1/2 in in 40 feet or more.
 - b. Maximum variation from plumb:
 - 1) Includes, but is not limited to, the following:
 - (a) External corners.
 - (b) Control and expansion joints.
 - (c) Reveals.
 - (d) Other conspicuous lines.
 - 2) Do not vary from plumb by more than:
 - (a) 1/4 inch in 20 feet.
 - (b) 1/2 in in 40 feet or more.
10. Mortar Joint Thickness: Do not vary thickness indicated by more than plus or minus 1/8 inch.

3.16 CLEANING

- A. Protect surrounding elements and finishes from damage due to cleaning procedures.
- B. Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 10 feet away, subject to Architect's approval.
- C. Remove excess mortar and mortar droppings.
- D. Clean soiled surfaces with cleaning solution.
- E. Apply masonry cleaners to masonry surfaces according to manufacturer's written instructions; use brush or spray application.
 1. Periodically during rinsing, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
 - a. Repeat rinsing until tested pH of water runoff is between 6.7 and 7.5.

END OF SECTION

SECTION 044200 - EXTERIOR STONE CLADDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Salvaged stone wall cap units.

1.2 ACTION SUBMITTALS

- A. Product Data: For each stone accessory, and manufactured product.
- B. Shop Drawings: Show installation details for stone wall cap assembly, including dimensions and profiles of stone units.
 - 1. Show locations and details of joints both within and between stone wall cap assembly and other construction.
 - 2. Show locations and details of anchors.
- C. Colored Pointing Mortar Samples: For each color required.
- D. Sealant Samples: For each type and color of joint sealant required.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups of typical exterior wall area not less than 72 inches (1800 mm) long by 48 inches (1200 mm) high.

1.4 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace stone cladding damaged by frost or freezing conditions. Comply with cold-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.
- C. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (5 deg C) or when joint substrates are wet.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Design stone anchors and anchoring systems according to ASTM C 1242.

2.2 STONE WALL CAP UNITS

- A. Varieties and Sources: Salvaged existing stone wall cap units.

2.3 ANCHORS

- A. Fabricate anchors from stainless steel, ASTM A 240/A 240M or ASTM A 666, Type 304; temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A 276, Type 304 .

2.4 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction, natural color or white as required to produce mortar color indicated.
 - 1. Low-Alkali Cement: Portland cement for use with limestone shall contain no more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207.
- C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Pigments shall have a record of satisfactory performance in mortar.
- D. Aggregate: ASTM C 144; except for joints narrower than 1/4 inch (6 mm) and pointing mortar, 100 percent shall pass No. 16 (1.18-mm) sieve.
- E. Water: Potable.

2.5 STONE ACCESSORIES

- A. Setting Shims: Strips of resilient plastic or vulcanized neoprene, Type A Shore durometer hardness of 50 to 70, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.
- B. Concealed Sheet Metal Flashing: Fabricated from zinc-tin, alloy-coated stainless steel in thicknesses indicated, but not less than 0.0156 inch (0.4 mm) thick, and complying with Section 076200 "Sheet Metal Flashing and Trim."
- C. Sealants for Joints in Stone Cladding: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and do not stain stone

2.6 MORTAR MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions. Do not use admixtures, unless otherwise indicated.
- B. Portland Cement-Lime Setting Mortar: Comply with ASTM C 270, Proportion Specification, Type S.
- C. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, Type N. Provide pointing mortar mixed to match Architect's sample and complying with the following:
 - 1. Pigmented Pointing Mortar: Do not exceed pigment-to-cement ratio of 1:10, by weight.

PART 3 - EXECUTION

3.1 STONE REMOVAL, PREPARATION AND STORAGE

- A. Remove existing stone wall caps, prep and save for reinstallation:
 - 1. Carefully remove existing stone caps from wall, avoiding damaging units or adjacent construction.

2. Manually scrape or remove residual mortar, flashing, etc. using hand tools, brushes and water. Remove sealants by cutting close to stone with utility knife and cleaning with non-staining solvents.
3. Clean stone units using non-acidic cleaner.
4. Store stone units on pallets or other raised surface and protected from weather until ready for reinstallation.

3.2 SETTING STONE UNITS, GENERAL

- A. Execute stone unit installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone.
- B. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with uniform joints of widths indicated, and with edges and faces aligned according to established relationships and indicated tolerances.

3.3 SETTING STONE UNITS WITH MORTAR

- A. Stone units will be reinstalled in mortar bed over new stainless steel through - wall flashing.
 1. Anchor horizontal wall cap units using new stainless steel dowel anchors.
- B. Clear existing holes or drill new as required in stone wall caps for new dowel anchors. Dowel holes should be over-bored 1/4".
- C. Install dowels into masonry wall, accurately coordinated with penetrations in through-wall flashing.
- D. Install through - wall flashing with dimples formed from punching dowel penetrations facing upward, to form a water dam at the dowel. Install continuous bead of butyl sealant around the dowel penetration above and below the flashing and allow to cure. Lap through-wall flashing six-inches at joints and provide three 1/4-inch beads of butyl lap sealant continuous from edge of metal to edge of metal.
- E. Set stone in a full bed of mortar with head joints filled unless otherwise indicated. Provide sealant in the dowel holes in lieu of mortar to allow for thermal movement.
- F. Tool joints with a round jointer having a diameter 1/8 inch (3 mm) larger than width of joint, when mortar is thumbprint hard.
- G. Rake out mortar from head joints and other sealant-pointed joints to depths required for sealant and sealant backing but not less than 1 inch. Rake joints to uniform depths with square bottoms and clean sides.
- H. Provide backer rod and silicone sealant in head joints and bed joints.

3.4 JOINT-SEALANT INSTALLATION

- A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.5 INSTALLATION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, corners and jambs within 20 feet (6 m) of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch in 40 feet (10 mm in 12 m) or more.

- B. Variation from Level: For horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (10 mm) maximum.
- C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (12 mm in 12 m) or more.
- D. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less. For joints within 60 inches (1500 mm) of each other, do not vary more than 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less from one to the other.
- E. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units.

3.6 ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean stone cladding as work progresses. Remove mortar fins and smears before tooling joints. Remove excess sealant and smears as sealant is installed.
- B. Final Cleaning: Clean stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION 044200

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum pipe railings.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Aluminum Pipe and Tube Railings:
 - 1. Provide handrail system complying with the following requirements:
 - a. Extruded aluminum pipe rail system with internal connectors.
 - 1) Rails and Posts: 1-1/2" diameter.
 - 2) Mechanical Connectors: Manufactured post and handrail connector fittings.
 - 3) Flanges: Solid cast flanges where required.
 - 4) Fasteners: All fasteners to be type 304 stainless steel.
 - b. Provide complete system for all parts and accessories from the same manufacturer.
 - c. Configuration as shown on Drawings and to match existing railings to remain.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design railings.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

- A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.4 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Tubing: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.
- C. Extruded Structural Pipe ASTM B 429/B 429M, Alloy 6063-T6.
- D. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.
- E. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Type 304 stainless-steel fasteners.
- B. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [Group 1 (A1)] stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

- A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for exterior applications.

2.7 FABRICATION

- A. 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.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- D. Form changes in direction by bending or by inserting prefabricated elbow fittings.
- E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing members with prefabricated end fittings.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

2.8 ALUMINUM FINISHES

- A. 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 unacceptable. 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.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Match existing railings to remain.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: Match existing railings to remain.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

3.2 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

3.3 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

3.4 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- 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.

END OF SECTION 055213

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous formed sheet metal fabrications.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Distinguish between shop- and field-assembled work.
 - 3. Include identification of finish for each item.
 - 4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.
- C. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.5 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - a. Color: As selected by Architect from Manufacturer's full range.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners:
 - 1. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- C. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- D. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Obtain field measurements for accurate fit before shop fabrication.
 - 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- F. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

PART 3 - EXECUTION

3.1 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, protective

coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 4. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
- C. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
- D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- E. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- F. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.2 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 076200

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section and following applications:
 - 1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Head joints in exterior stone wall caps.
 - b. Control and expansion joints in unit masonry.
 - c. Flashing re-bar penetrations
 - d. Flashing lap joints

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide warranted sealant installations as indicated. Provide all testing and all other requirements of the sealant manufacturer to obtain the desired warranty.

1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- D. Qualification Data: For Installer and testing agency.
- E. Preconstruction Field Test Reports: When requested by owner, indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.
- F. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backing have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- G. Field Test Report Log: For each elastomeric sealant application.
- H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of non-elastomeric sealant and joint substrate indicated.
 - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 4. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 - 5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.
- D. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
 - 1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealant materials to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As indicated under sealant types.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Silicone Sealant (Sealant A): A medium-modulus, one-part, pre-pigmented, neutral-cure, non-staining silicone joint sealant: Where joint sealants of this type are indicated, provide products complying with the following:
 - 1. Products: Provide one of the following:
 - a. 756 SMS; Dow Corning.
 - b. Sikasil WS-295; Sika Corporation
 - 2. Application: Exterior masonry joints including coping head joints, flashing penetrations, and other joints as indicated
 - 3. Primer: manufacturer's recommended primer for each substrate, if required, based on compatibility and adhesion tests.
 - 4. Color: To be selected by Owner/Architect from special and custom colors.
- E. Butyl Sealant (Sealant B): A one part non-skinning, permanently tacky butyl metal flashing sealant that allows metal lap joints to expand and contract. Where joint sealants of this type are indicated, provide products complying with the following:
 - 1. Products: Provide one of the following:
 - a. Lap Rite; Masonpro
 - b. Sikalastomer 511; Sika Corporation
 - 2. Color: Manufacturer's standard gray or beige.
 - 5. Application: Lap joints within stainless steel thru-wall flashing.

2.4 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings (Backer Rod): ASTM C 1330, Type C (closed-cell material with a surface skin), polyurethane foam rod, oversized 20 to 50 percent larger than joint width, as approved in writing by joint-sealant manufacturer for joint

application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
 - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - 1) Limestone
 - 2) Masonry
 - 2. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants or paint, if applicable. Nonporous joint substrates include the following:
 - a. Metal.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such

contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.4 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with required areas are indistinguishable from original work.

3.5 JOINT-SEALANT SCHEDULE

- A. SEALANT A: Exterior masonry joints including coping head joints, flashing penetrations, and other joints as indicated
- B. SEALANT B: Lap joints within stainless steel thru-wall flashing.

END OF SECTION - 079200

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Storefront framing.
 - 2. Manual-swing entrance doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
 - 2. Include point-to-point wiring diagrams.
- C. Samples: For each type of exposed finish required.
- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication, and assembly of entrance door hardware, as well as procedures and diagrams.

1.3 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.
- B. Field quality-control reports.
- C. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. 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.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: per Michigan Building Code.
 - 2. Other Design Loads: per Michigan Building Code.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
 - 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
 - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans of less than 11 feet 8-1/4 inches (3.6 m).
- E. Structural: Test according to ASTM E 330/E 330M as follows:
 - 1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
 - 1. Fixed Framing and Glass Area:

- a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
- 2. Entrance Doors:
 - a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
 - 1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- H. Energy Performance: Certify and label energy performance according to NFRC as follows:
 - 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
 - 2. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STOREFRONT SYSTEMS

- A. Basis-of-Design Product for Aluminum-Framed Entrances and Storefronts: Subject to compliance with requirements, provide Tubelite T14000 series for exterior. Substitutions: See Section 012500 - Product Requirements.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Exterior Framing Construction: Thermally broken.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Finish: Color anodic finish.
 - 4. Fabrication Method: Field-fabricated stick system.
 - 5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 6. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.
- E. Insulated Spandrel Panels:
 - 1. Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
 - a. Overall Panel Thickness: 1 inch (25.4 mm).
 - b. Exterior Skin: Aluminum.
 - 1) Thickness: Manufacturer's standard for finish and texture indicated.
 - 2) Finish: Match framing system.
 - c. Interior Skin: Aluminum.
 - 1) Thickness: Manufacturer's standard for finish and texture indicated.
 - 2) Finish: Matching storefront framing.
 - d. Thermal Insulation Core: Manufacturer's standard.

- e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.

2.3 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic 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: Wide stile; 5-inch (127-mm) nominal width.
 - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.4 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

2.5 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

2.6 MATERIALS

- A. Sheet and Plate: ASTM B 209 (ASTM B 209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
- C. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
- D. Structural Profiles: ASTM B 308/B 308M.
- E. Steel Reinforcement:
 - 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.
 - 4. Primer: 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.

2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.

- B. Weld in concealed locations to the greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. 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. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior.
 - 6. 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. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. 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.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 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 nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units' level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. 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.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 1. Water-Spray Test: Areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 3. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

- 1.1 Refer to "General and Special Conditions", and "Instructions to Bidders", Division 1 of Specifications. Requirements of these Sections and the project drawings shall govern work in this section.
- 1.2 Work Included:
- A. Furnish all items of Finish Hardware specified, scheduled, shown or required herein except those items specifically excluded from this section of the specification.
 - B. Related work:
 - 1. Division 00 00 00 - Procurement and Contracting Requirements
 - 2. Division 01 00 00 - General Requirements
 - 3. Division 08 00 00 - Openings
 - 4. Division 26 00 00 - Electrical
 - 5. Division 27 00 00 - Communications
 - 6. Division 28 00 00 - Electronic Safety and Security
 - C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:
 - 1. Cabinet Hardware.
 - 2. Signs, except as noted.
 - 3. Folding partitions, except cylinders where detailed.
 - 4. Sliding aluminum doors
 - 5. Chain link and wire mesh doors and gates
 - 6. Access doors and panels
 - 7. Overhead and Coiling doors
- 1.3 Quality Assurance
- A. Requirements of Regulatory Agencies:
 - 1. Furnish finish hardware to comply with the requirements of laws, codes, ordinances, and regulations of the governmental authorities having jurisdiction where such requirements exceed the requirements of the Specifications.
 - 2. Furnish finish hardware to comply with the requirements of the regulations for public building accommodations for physically handicapped persons of the governmental authority having jurisdiction and to comply with Americans with Disabilities Act.
 - 3. Provide hardware for fire-rated openings in compliance with NFPA 80 and state and local building code requirements. Provide only hardware that has

been tested and listed by UL for types and sizes of doors required and complies with requirements of door and door frame labels.

B. Hardware Supplier:

1. Shall be an established company dealing in Commercial Door Hardware. The Commercial Door Hardware company must have adequate inventory, qualified personnel on staff and be located within 100 miles of the project. The distributor must be a factory-authorized dealer for all materials required.
2. All door hardware product must be **B.H.M.A. (Builders Hardware Manufacturers Association) Certified**.

C. Electrified Door Hardware Supplier:

1. Shall be an experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.
2. Shall prepare data for electrified door hardware, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies like those indicated for this project.
3. Shall have experience in providing consulting services for electrified door hardware installations.

D. Pre-installation Meeting:

1. Before hardware installation, General Contractor/Construction Manager will request a hardware installation meeting be conducted on the installation of hardware; specifically, that of locksets, closers, exit devices, overhead stops and coordinators. Manufacturer's representatives of the above products, in conjunction with the hardware supplier for the project, shall conduct the meeting. Meeting to be held at job site and attended by installers of hardware for aluminum, hollow metal and wood doors. Meeting to address proper coordination and installation of hardware, per finish hardware schedule for this specific project, by using installation manuals, hardware schedule, templates, physical product samples and installation videos.
2. When any electrical hardware is specified, this meeting shall also include the following trades/installers: Electrical, Security, Alarm systems and Architect.
3. Convene one week or more prior to commencing work of this Section.
4. The Hardware Supplier shall include the cost of this meeting in his proposal.

E. Manufacturer:

1. Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from one manufacturer, although several may be indicated as offering products complying with requirements.
2. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

1.4 Submittals:

A. Hardware Schedule

1. Submit number of Hardware Schedules as directed in Division 1.
2. Follow guidelines established in Door & Hardware Institute Handbook (DHI) Sequence and Format for the Hardware Schedule unless noted otherwise. Schedule will include the following:
 - a. Door Index including opening numbers and the assigned Finish Hardware set.
 - b. Preface sheet listing category only and manufacturer's names of items being furnished as follows:

CATEGORY	SPECIFIED	SCHEDULED
Hinges	Manufacturer A	Manufacturer B
Lock sets	Manufacturer X	Manufacturer X
Kick Plates	Open	Manufacturer Z

- c. Hardware Locations: Refer to Article 3.1 B.2 Locations.
- d. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, door material, frame material, and UL listing.
- e. Hardware Description: Quantity, category, product number, fasteners, and finish.
- f. Headings that refer to the specified Hardware Set Numbers.
- g. Scheduling Sequence shown in Hardware Sets.
- h. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
- i. Electrified Hardware system operation description.
- j. "Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved."
- k. Typed Copy.
- l. Double-Spacing.
- m. 8-1/2 x 11-inch sheets
- n. U.S. Standard Finish symbols or BHMA Finish symbols.

B. Product Data:

1. Submit Manufacturers Catalog cut sheets of scheduled hardware.
2. Submit product data with hardware schedule.

C. Samples:

1. Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample, if required, of each type of exposed hardware unit, finished as required and tagged with full description for coordination with schedule.
2. Samples will be returned to the supplier. Units, which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

D. Key Schedule:

1. Submit detailed schedule indicating clearly how the Owner's final keying instructions have been followed.
 2. Submit as a separate schedule.
 3. The DTMB Office of Infrastructure Protection Access Control will do all the locksmith pinning off cores and install cores for the DTMB buildings. (except for MSP Forensic Labs and Hall of Justice)
- E. Electrified Hardware Drawings:
1. Submit elevation drawings showing relationship of all electrical hardware components to door and frame.
 - a. Include wiring drawing showing point to point wire hook up for all components.
 - b. Include system operations descriptions for each type of opening; describe each possible condition.
- F. Submit to General Contractor/Construction Manager, the factory order acknowledgement numbers for the various hardware items to be used on the project. The factory order acknowledgement numbers shall help to facilitate and expedite any service that may be required on a hardware item. General Contractor/Construction Manager shall keep these order acknowledgement numbers on file in the construction trailer.
- 1.5 Product Delivery, Storage, and Handling:
- A. Label each item of hardware with the appropriate door number and Hardware Schedule heading number and deliver to the installer so designated by the contractor.
- 1.6 Warranties:
- A. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work. Replace work found to be defective as defined in the General Conditions.

PART 2 - PRODUCT

- 2.1 Furnish of each category with the door hardware products can be multiple door hardware brands unless specified otherwise by DTMB Office of Infrastructure Protection, Access Control Supervisor.
- 2.2 Provide all door hardware specification of the product being used on the project.

A. Continuous Gear Hinge:

1. 6063-T6 aluminum alloy, anodized finish (cap on entire hinge painted if specified). Manufacture to template, uncut hinges non-handed, pin less assembly, three interlocking extrusions, full height of door and frame, lubricated polyacetal thrust bearing, fasteners 410 stainless steel plated and hardened. All hinge profiles to be manufactured to template bearing locations, with standard duty bearing configurations at 5-1/8" spacing with a minimum of 16 bearings; and heavy duty at 2-9/16" spacing with a minimum of 32 bearings. Anodizing of material shall be done after fabrication of components so that all bearing slots are anodized.
2. Length: 1" less than door opening height. Fastener 12-24 x 1/2" #3 Phillips keen form stainless steel self-tapping at aluminum and hollow metal doors, 12- 1/2" #3 Philips, flathead full thread at wood doors.
3. Furnish fire rated hinges "FR" at labeled openings.
 - a. For Wood and Hollow Metal frames
4. Manufactured by any B.H.M.A member.

B. Exit Devices: Allegion-Von Duprin

1. Exit devices shall be touchpad style, fabricated of brass, bronze, stainless steel, or aluminum, plated to the standard architectural finishes to match the balance of the door hardware.
2. All exit devices shall incorporate a fluid damper, which decelerates the touchpad on its return stroke and eliminates noise associated with exit device operation. Touchpad shall extend a minimum of one half of the door width. All latch bolts to be dead latching type, with a self-lubricating coating to reduce wear.
3. Endcap will be sloped to deflect any impact from carts, and they shall be flush with the external mechanism case. End caps that overlap and project above the mechanism case are unacceptable. End cap shall utilize a two-point attachment to the mounting bracket.
4. Touchpad shall match exit device finish, and shall be stainless steel for US26, US26D, US28, US32, and US32D finishes. Only compression springs will be used in devices, latches, and outside trims or controls.
5. Plastic templates shall be included with each exit device to facilitate a quick, easy and accurate installation.
6. Strikes shall be roller type and come complete with a locking plate to prevent movement.
7. All rim and vertical rod exit devices shall have passed a 5 million (5,000,000) cycle test based on ANSI A156.3, 1994, Grade 1 test standards and certified by an independent testing lab.
8. Exit devices shall be UL listed panic exit hardware. All exit devices for fire rated openings shall be UL labeled fire exit hardware.
9. Lever trim for exit devices shall be vandal-resistant type, which will travel to a 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
10. No external vertical rod on an exit device.
11. Surface mount vertical rod are acceptable.
12. Allegion-Von Duprin 98/99 and 33A/35A Series. Series and function numbers

as listed in sets.

13. Allegion-Von Duprin 98/99 and 33A/35A QELA Baseplate Conv. Kit series.
 14. Allegion-Schlage PS902 or Von Duprin PS 914 with a Von Duprin 900-2RS is a 2 Relay EL Panic Device Control Board output power supply for connection of electrified devices such Von Duprin exit devices equipped with the (QELA Baseplate Conv. Kit series.)
- C. Removable Mullion:
1. Exterior doors, mullion is removable only using building keys.
 - a. Allegion-Von Duprin KR4954
- D. Push and Pull Hardware:
1. Pull, Offset: One-inch round rod, 90-degree offset, 12-inch centers.
 2. Vandal Resistant Pulls: Stainless steel construction 0.120 inches thick.
 3. Manufactured by any B.H.M.A member.
- E. Coordinator – Frame Stop Mounted:
1. Door coordinator shall prevent the active door from closing before inactive door. Stop mounted channel 1-5/8" x 5/8" steel tubing x length to suit door opening. Coordinator shall be UL listed. Furnish filler bars to fill gap between end of coordinator and inactive door frame. Furnish mounting brackets for all stop mounted hardware such as exit device strikes, door closer PA shoes, etc. Coordinators shall be prepared (cutout) at the factory for surface applied or concealed vertical rod panic devices if required.
 2. Furnish with carry bar CB1 when required for proper operation.
 3. Manufactured by any B.H.M.A member.
- F. Electric Power Transfer:
1. Transfer power from door frame to edge of door, UL listed R4504.
 2. Allegion-Von Duprin EPT
- G. Access control wire and electrical conduits:
1. Honeywell Profusion Genesis 32951099 series cable 22/6+22/4+22/2+18/4 – Plenum or FTS.
 2. West Penn wire AQC1822GY1000 Access Control Composite Cable Indoor/Outdoor Aqua seal gray.
 3. West Penn wire AQ3283 1000-12C 18G STRD SHLD Aqua seal gray.
 4. PRO4200 Mercury Panel.
 5. HID Signo 20/40 card readers.
 6. Door Sense: Interlogix 1078W-N
 7. Request to Exit: Bosch DS150i
 8. Electrical contractors provide conduit card reader electrical single gang box, request to exit detector electrical single gang box horizontal, door sensor conduit top of door frame, electrified door hardware conduit, electric power

transfer hinge conduit.

9. All electrical conduits for the access control wire come out of electrical junction box on the secure corridor side or secure hallway side for the access control door opening. Except for (REX)request to exit detector the horizontal electrical single gang box interior side.
10. Provide electrical conduit from the electrical junction box to the power supply for the electrical exit device door hardware.
11. Provide conduits for 120 volts for low energy power operated door unit and conduit for low volt 3 extra 22-4 wire to Low Energy Power Operated Door unit to power supply and to electrical single gang boxes for the operator actuator buttons.

H. Closers:

1. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder. Cylinder body shall be 1 ½" in diameter, and double heat-treated pinion shall be 11/16" in diameter with double D slab drive arm connection.
2. Hydraulic fluid shall be of a type requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Spring power shall be continuously adjustable over the full range of closer sizes and allow for reduced opening force for the physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and backcheck.
4. All closers shall have solid forged steel main arms (and forged forearms for parallel arm closers).
5. All surface mounted mechanical closers shall be certified to exceed ten million (10,000,000) full load cycles by a recognized independent testing laboratory.
6. Closers will have Powder coating finish certified to exceed 100 hours salt spray testing by ETL, an independent testing laboratory used by BHMA for ANSI certification.
7. Refer to door and frame details and furnish accessories such as drop plates, panel adapters, spacers and supports as required to correctly install door closers. State degree of door swing in the hardware schedule.
8. Furnish closers manufactured by LCN
 - a. Allegion-Von Duprin -LCN Series 4000.

I. ADA Special Closers

1. Where "Low Energy Power Operated Door" as defined by ANSI Standard A156.19 is indicated for doors required to be accessible to the disabled, provide electrically powered operators complying with the ADA requirements for opening force and time to close standards.
2. Full closing force shall be provided when the power or assist cycle ends.
3. Modular design, adjustments easily accessible from the front, UL listed for use on labeled doors.
4. Shall have "Second Chance" function to accommodate momentary resistance, "Breakaway" function in the electronically controlled clutch, "Soft Start" motor control function and "Maintain Hold-Open Switch" to hold the door open at

- 90 degree.
5. Shall have built in 12V and 24V power supply for actuators, card readers, electric strikes and magnetic door locks, inputs for both swing and stop side sensors and available to accept either 120VAC or 220VAC input power. All wiring connections between operator modules made by easy-to-handle electrical connectors. Shall comply with both UL and NEC requirements for Class 1 and Class 2 wiring by providing separate conduits for each.
 6. Shall have seven independent electronic adjustments to tailor the operator for specific site conditions. Opening speed, holding force at 90 deg., sequential trigger and time delay, hold-open time at 90 deg., opening force, clutch "breakaway" force setting, electric strike trigger and time delay.
 7. Shall have separate and independent adjustments for back check, main speed and latch speed.
 8. Furnish actuators and other controls as shown in Hardware Sets.
 9. Furnish operators manufactured by:
 10. Provide conduits for 120 volts for low energy power operated door unit and conduit for low volt 3 extra 22-4 wire to Low Energy Power Operated Door unit to power supply and to electrical single gang boxes for the operator actuator buttons.
 11. All installers must be certified by the **American Association of Automatic Door Manufacturers (AAADM)** is a trade association of power-operated automatic door manufacturers.
 12. Accepted units:
 - a. Stanley Magic Force
 - b. Horton Automatics Easy Access Series 4100LIE or Easy Access Series 7100
 - c. Record 6100 or 8100 Heavy Duty
- J. Overhead Holders and Stops:
1. Plastic end caps hold open mechanisms and shock blocks are not allowed. End caps must be finished same as balance of unit.
 2. Manufacture products using base material of Brass/Bronze for US3, US4, & US10B finished products and 300 Stainless Steel for US32 & US32D finished products.
 3. Manufactured by any B.H.M.A member.
- K. Kick Plates:
1. Furnish .050 inches thick, beveled three sides, 10" high x door width less 2" at single doors and less 1" at pairs. Where glass or louvers prevent this height, supply with height equal to height of bottom rail less 2".
 2. Manufactured by any B.H.M.A member.
- L. Bumpers:
1. Wrought, forged, or cast, approximately 2-1/2 inch diameter, convex or concave rubber center, concealed fasteners.
 2. Manufactured by any B.H.M.A member.

M. Wall Stops:

1. Length to exceed projection of all other hardware. Provide with threaded studs and expansion shields for masonry wall construction. Install with slope at top.
2. Manufactured by any B.H.M.A member.

N. Thresholds:

1. 1/2" high - 5" wide. Cope at jambs.
2. Furnish full wall opening width when frames are recessed.
3. Cope in front of mullions if thresholds project beyond door faces.
4. Furnish with non-ferrous Stainless-Steel Screws and Lead Anchors.
5. Manufactured by any B.H.M.A member.

O. Door Sweeps:

1. Surface Sweeps
2. Manufactured by any B.H.M.A member.

P. Weather-stripping:

1. Apply to head and jamb stops.
2. Solid Bar stock all sides
3. Manufactured by any B.H.M.A member.

Q. Meeting Stile Weather-stripping:

1. 2 Pc. Nylon brush type to seal gap between pairs of doors.
2. Manufactured by any B.H.M.A member.

R. Fasteners:

1. Furnish fasteners of the proper type, size, quantity and finish. Use machine screws and expansion shields for attaching hardware to concrete or masonry, and wall grip inserts at hollow wall construction. Furnish machine screws for attachment to reinforced hollow metal doors and frames and reinforced aluminum doors and frames. Furnish full thread wood screws for attachment to solid wood doors and frames. "TEK" type screws are not acceptable.
2. Sex bolts will not be permitted on reinforced metal doors or wood doors where blocking is specified.

2.3 Finishes:

- A. Generally, Dull Chrome, US26D / BHMA 626. Provide finish for each item as indicated in sets.

2.4 Templates and Hardware Location:

- A. Furnish hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.
- B. Furnish metal template to frame/door supplier for continuous hinge.
- C. Refer to Article 3.1 B.2, Locations, and coordinate with templates.

2.5 Cylinders and Keying:

- A. Locks Cylinders and keys will be furnished with Schlage or Best Small Format Interchangeable Core (SFIC). Coordinate keying requirements with State of Michigan Department of Technology, Management and Budget, Office of Infrastructure Protection.
- B. Provide cylinders with construction cores or keying for use during the construction period.
- C. All keyway system is Schlage Everest "B"

PART 3 - EXECUTION

3.1 Installation

A. General:

- 1. Install hardware according to manufacturer's installations and template dimensions. Attach all items of finish hardware to doors, frames, walls, etc. with fasteners furnished and required by the manufacture of the item.
- 2. Provide blocking/reinforcement for all wall mounted Hardware.
- 3. Reinforced hollow metal doors and frames and reinforced aluminum door and frames will be drilled and tapped for machine screws.
- 4. Solid wood doors and frames: full thread wood screws. Drill pilot holes before inserting screws.
- 5. Continuous gear hinges attached to hollow metal doors and frames and aluminum doors and frames: 12-24 x 1/2" #3 Phillips Keen form self-tapping. Use #13 or 3/16 drill for pilot.
- 6. Continuous Gear Hinges require continuous mortar guards of foam or cardboard 1/2" thick x frame height, applied with construction adhesive.
- 7. Install weather-strip gasket prior to parallel arm closer bracket, rim exit device or any stop mounted hardware. Gasket to provide a continuous seal around perimeter of door opening. Allow for gasket when installing finish hardware. Door closers will require special templating. Exit devices will require adjustment in backset.

B. Locations:

- 1. Dimensions are from finish floor to center line of items.
- 2. Include this list in Hardware Schedule.

<u>CATEGORY</u>	<u>DIMENSION</u>
Hinges	Door Manufacturer's Standard
Flush Bolt Levers	72" and 12"
Levers	Door Manufacturer's Standard
Exit Device Touch Bar	Per Template
Dead latch Cylinder	43" unless conflicting with push-
pull.	
Deadlock MS Cylinder	43" unless conflicting with push-
pull.	
Hospital Push-Pull	Manufacturer's Template
Roller Latch	At Head
Push-Pull Units	42" to centerline of Pull
Offset Pulls	Suitable for Exit Devices
Pulls - Flush Cup	46"
Pulls (BTB)	46"
Push-Pulls	46"
Push Plates	52"
Pull Plates	42"
Wire Pulls	42"
Wall Stops/Holders	At Head
Astragals	Pull side of active leaf
Trim Protector Bars	Push side of door below lever
handle	
Lock Protectors	Pull side of door

C. Field Quality Inspection:

1. Provide the services of a representative to inspect material furnished and its installation and is adjustment, and to instruct the Owner's personnel in adjustment, care and maintenance of hardware.
2. Locksets and exit devices shall be inspected by the factory representative after installation and after the HVAC system is in operation and balanced, to insure correct installation and proper operation.
3. Closers shall be inspected by the factory representative **(and adjusted when required after a Pre-Installation meeting has been conducted)** after installation and after the HVAC system is in operation and balanced, to insure correct installation and proper operation.
4. The manufacturer's representative shall prepare a written report stating compliance and recording locations and kinds of noncompliance. The original report shall be forwarded to the Architect with copies to the Contractor, hardware distributor, hardware installer and building owner.

D. Technical and Warranty Information:

1. At the completion of the project, the technical and warranty information coalesced and kept on file by the General Contractor/Construction Manager shall be given to the Owner or Owner's Agent. In addition to both the technical and warranty information, all factory order acknowledgement numbers supplied to the General Contractor/Construction Manager during the construction period shall be given to the Owner or Owner's Agent. The warranty information and factory order acknowledgement numbers shall serve

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to both expedite and properly execute any warranty work that may be required on the various hardware items supplied on the project.

2. Submit to General Contractor/Construction Manager, two copies each of parts and service manuals and two each of any special installation or adjustment tools. Include for locksets, exit devices, door closers and any electrical products

3.2 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.3 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.4 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

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HARDWARE GROUP NO. 01

For use on Door #(s): A1.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT	710	IVE
2	EA	POWER TRANSFER	EPT10	695	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	695	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-98-NL-OP	313	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO	313	VON
1	EA	SFIC MORTISE HOUSING	80-102	643e	SCH
1	EA	SFIC RIM HOUSING	80-129	643e	SCH
2	EA	SFIC CORE	80-037	613	SCH
2	EA	OFFSET PULL	392-7	313	VON
1	EA	OH STOP	100S	643E/ 716	GLY
1	EA	OH STOP	100SE	643E/ 716	GLY
1	EA	SURFACE CLOSER	4021	695	LCN
1	EA	SURF. AUTO OPERATOR	4640	695	LCN
1	EA	MOUNTING PLATE	4020-18G	695	LCN
1	EA	ACTUATOR, TOUCH	8310-836T	630	LCN
1	EA	WALL MOUNT PUSHPLATE	8310-852T	630	LCN
1	EA	MOUNT BOX	8310-869F		LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING/ GASKETING	BY DOOR/FRAME MANUFACTURER		
2	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	655A-223	A	ZER
2	EA	DOOR CONTACT	679-05 WD/HM AS REQ'D	BLK	SCH
1	EA	ACCESS CONTROL	(BY SECURITY CONTRACTOR)		
1	EA	POWER SUPPLY	PS902 900-4RL	LGR	SCH

PRESENTING AN AUTHORIZED CREDENTIAL WILL RETRACT ONE PANIC HARDWARE LATCH BOLT AND ALLOW ACCESS. THE OUTSIDE AUTOMATIC OPERATOR ACTUATOR IS ENABLED WHEN THE PANIC HARDWARE LATCH IS RETRACTED. THE INSIDE AUTOMATIC OPERATOR ACTUATOR IS ALWAYS ENABLED. FREE EGRESS IS ALWAYS ALLOWED. BOTH PANIC HARDWARE LATCHES MAY BE RETRACTED BY THE ACCESS CONTROL SYSTEM. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

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HARDWARE GROUP NO. 02

For use on Door #(s): C1.1, C2.2

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	710	IVE
1	EA	POWER TRANSFER	EPT10	695	VON
1	EA	ELEC PANIC HARDWARE	LX-RX-QEL-98-NL-OP	313	VON
1	EA	SFIC RIM HOUSING	80-129	643e	SCH
2	EA	SFIC CORE	80-037	613	SCH
1	EA	OFFSET PULL	392-7	313	VON
1	EA	OH STOP	100SE	643E/ 716	GLY
1	EA	SURF. AUTO OPERATOR	4640	695	LCN
1	EA	ACTUATOR, TOUCH	8310-836T	630	LCN
1	EA	WALL MOUNT PUSHPLATE	8310-852T	630	LCN
1	EA	MOUNT BOX	8310-869F		LCN
1	EA	WEATHERSTRIPPING/ GASKETING	BY DOOR/FRAME MANUFACTURER		
1	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	DOOR CONTACT	679-05 WD/HM AS REQ'D	BLK	SCH
1	EA	ACCESS CONTROL	(BY SECURITY CONTRACTOR)		
1	EA	POWER SUPPLY	PS902 900-4RL	LGR	SCH

PRESENTING AN AUTHORIZED CREDENTIAL WILL RETRACT THE PANIC HARDWARE LATCH BOLT AND ALLOW ACCESS. THE OUTSIDE AUTOMATIC OPERATOR ACTUATOR IS ENABLED WHEN THE PANIC HARDWARE LATCH IS RETRACTED. THE INSIDE AUTOMATIC OPERATOR ACTUATOR IS ALWAYS ENABLED. FREE EGRESS IS ALWAYS ALLOWED. COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

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HARDWARE GROUP NO. 03

For use on Door #(s): C1.2, C2.1

Provide each opening with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	710	IVE
1	EA	PANIC HARDWARE	CD-98-NL-OP-110MD	313	VON
1	EA	SFIC MORTISE HOUSING	80-102	643e	SCH
1	EA	SFIC RIM HOUSING	80-129	643e	SCH
2	EA	SFIC CORE	80-037	613	SCH
1	EA	OFFSET PULL	392-7	313	VON
1	EA	OH STOP	100S	643E/ 716	GLY
1	EA	SURFACE CLOSER	4021	695	LCN
1	EA	MOUNTING PLATE	4020-18G	695	LCN
1	EA	WEATHERSTRIPPING/ GASKETING	BY DOOR/FRAME MANUFACTURER		
1	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	655A-223	A	ZER

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Glass for doors and storefront framing.
 - 2. Glazing sealants and accessories.

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

1.4 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for 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: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Guardian Glass; SunGuard.
 - 2. Vitro.
 - 3. Substitutions: See Section 012500 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.
 - 1. Design Wind Pressures: per Michigan Building Code.
 - 2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- B. Safety Glazing: Where safety glazing is required by the building codes, provide glazing that complies with 16 CFR 1201, Category II.
- 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.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Laminated Glazing Reference Manual" and "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."
 - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is required by the building codes, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Sealing System: Dual seals.
 - 2. Perimeter Spacer: Manufacturer's standard warm-edge spacer material and construction.

2.7 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they 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. Sealant shall have a VOC content of 250 g/L or less.
 - 4. Colors of Exposed Glazing Sealants: As selected 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.
 - 1. Available Products:
 - a. GE Silicones; Silglaze II SCS2800
 - b. Tremco; Tremsil 600
 - c. Dow Corning Corporation; 795
 - d. Substitutions: See Section 012500 - Product Requirements.

2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, where indicated.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 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.

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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. 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.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- G. 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, then to jambs. Cover horizontal framing joints by applying tapes to jambs, 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. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. 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.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

3.6 INSULATING GLASS SCHEDULE

- A. Glass Type GL-A: Low-E-coated, clear insulating laminated glass at all exterior locations unless indicated otherwise. Provide laminated glass at hazardous locations requiring safety glazing as indicated on Drawings.
 1. Basis-of-Design Product, provide one of the following:
 - a. Guardian Glass; SunGuard SNX 62/27
 - b. Vitro (PPG); Solarban 70 XL
 - c. Substitutions: See Section 012500 - Product Requirements.
 2. Overall Unit Thickness: 1 inch (25 mm).
 3. Minimum Thickness of Each Glass Lite: 6 mm.
 4. Outdoor Lite: Fully tempered float glass.
 - a. Provide clear laminated glass with two plies of tempered float glass.
 - 1) Minimum Thickness of Each Glass Ply: 3 mm.
 5. Interspace Content: Argon.
 6. Indoor Lite: Fully tempered float glass.
 7. Low-E Coating: Sputtered on second surface.
 8. Winter Nighttime U-Factor: .24 maximum.
 9. Summer Daytime U-Factor: .21 maximum.
 10. Visible Light Transmittance: 61 percent minimum.
 11. Solar Heat Gain Coefficient: .27 maximum.
 12. Safety glazing required.

END OF SECTION 088000

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 1 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. Mechanical demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.
 - 13. Equipment supports.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

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.

C. Operation and Maintenance Data: At the end of the project the contractor shall submit two paper copies of the Operation and Maintenance Data to the owner in three ring binders with the project title and contractor's contact information.

D. Project Record Documents: Throughout the project the contractor shall keep a running record of as-builts showing deviations from the plans. At the end of the project the contractor shall submit one clean hand sketch set of documents to the owner.

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 Mechanical 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.

D. Install all equipment, materials, and accessories per manufacturers written instructions.

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 mechanical 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 mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

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.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

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, BAg1, 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. ABS Piping: ASTM D 2235.
 2. CPVC Piping: ASTM F 493.
 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 2. Aboveground Pressure Piping: Pipe fitting.
- B. 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.
 1. Manufacturers:
 - a. Eslon Thermoplastics.
- C. 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.

1. Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

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 nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.
- 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.
 - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic, Carbon steel or Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless 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.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed or exposed-rivet 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 EQUIPMENT CURBS

- A. Manufacturers:
 - 1. Pate.
 - 2. RPS Corporation.
 - 3. Thy Curb, Thybar Corporation.
- B. Equipment Support Rails:
 - 1. 18 Gauge galvanized steel with integral base plate, continuous welded corner seams, pressure treated wood nailer, counter flashing with leg screws, and internally reinforced for load bearing requirements.
 - 2. Height: Minimum 18 inches high or as specified.
 - 3. Length: As required for equipment and to span structural supports.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors 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 Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated or rough-brass finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.

- I. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated or rough-brass finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
- 1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.3 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
 - B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
 - E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
 - F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. 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.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. 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.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 4. Wet Piping Systems: Install dielectric nipple fittings to connect piping materials of dissimilar metals.
 - a. For piping systems operating below ambient temperature, provide dielectric nipple and brass ball valve or dielectric coupling to separate interior and exterior dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical 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.
- E. Install equipment per the manufacturer's recommendations. If the manufacturer's recommendations are different than shown on the construction documents or as otherwise specified contact the engineer.
- F. Contractor shall provide all equipment and associated controls required to provide a complete and operable system.
- G. The scope of work for all Division 23 sections includes all miscellaneous work needed (whether or not specified or shown on the documents) to produce a complete and fully operational system.

3.6 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Architectural Section.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section Cast-in-Place.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

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

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical 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.

3.10 GROUTING

- A. Mix and install grout for mechanical 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.

3.11 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

END OF SECTION 230500

SECTION 230516 – PIPE EXPANSION FITTINGS AND LOOPS

PART 1 – GENERAL

1.1 SUMMARY

- A. The scope of work for this section includes all miscellaneous work needed to produce a complete and fully operational system.
- B. This Section includes the following pipe expansion joints and expansion compensation devices for mechanical piping systems.
 - 1. Flexible-hose expansion joints.
 - 2. Grooved-end pipe expansion joints.
 - 3. Pipe bends and loops.
 - 4. Alignment guides and anchors.

1.2 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

1.3 SUBMITTALS

- A. Product Data: For each type of pipe expansion joint and alignment guide indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems for and for selecting and designing expansion joints, loops, and bends.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size material pressure rating, end connections, and location for each expansion joint.
 - 5. Grooved joint couplings shall be shown on drawings and product submittals, and be specifically identified with the applicable Victaulic style number.
- C. Welding certificate.

1.4 QUALITY ASSURANCE

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

1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code – Steel."
 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.
- B. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by Victaulic. Grooving tools shall be supplied by the same manufacturer as the grooved components.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 EXPANSION JOINTS

- A. Expansion Compensators: Double-ply corrugated steel, stainless-steel, or copper-alloy bellows in a housing with internal guides, antitorque device, and removable end clip for positioning.
1. Manufacturers:
 - a. Adscro Manufacturing, LLC
 - b. Flexicraft Industries.
 - c. Flex-Pression, Ltd.
 - d. Flex-Weld, Inc.
 - e. Hyspan Precision Products, Inc.
 - f. Metraflex, Inc.
 - g. Senior Flexonics, Inc.; Pathway Division.
 - h. Unaflex, Inc.
 2. Configuration for Steel Piping: Two-ply stainless-steel bellows and carbon-steel shroud.
 3. End Connections for Copper Tubing: Solder joint or threaded.
 4. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
 5. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged or threaded.
 6. Provide engineered anchors for this product.
- B. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
1. Manufacturers:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex-Pression, Ltd.

- d. Metraflex.
 - 2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder-joint end connections.
 - a. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths.
 - b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths.
 - 3. Flexible-Hose Expansion Joints for Steel Pipings: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and flanged, weld end connections for NPS 2-1/2 and larger.
 - a. NPS 2 and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths.
 - b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and single-braid, stainless steel sheaths.
 - 4. Anchors as shown on the Plans.
- C. Grooved End Expansion Joints for Steel Piping: Use in water piping systems ¾" and larger that are installed within enclosures where a pipe bend or loop cannot be applied.
- 1. Manufacturers:
 - a. Victaulic
 - 2. 2" Through 6": Packless, gasketed, slip-type expansion joint with grooved end telescoping body for installation with Victaulic Style 07 rigid couplings. Provides axial end movement to 3", designed for water services up to 230°F and working pressure to 350 psi. Victaulic Style 150 Mover®.
 - 3. ¾" Through 24": Combination of short nipples and Victaulic Style 75 or 77 flexible couplings joined in tandem for increased expansion. Joint movement and expansion capabilities dependent on number of couplings/nipples used in the joint. Pressure rating dependent on size and style of flexible couplings used. Victaulic Style 155.

2.3 MISCELLANEOUS MATERIALS

- A. Alignment Guides: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
- 1. Manufacturers:
 - a. Adsko Manufacturing, LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.
 - h. Piping Technology & Products, Inc.
 - i. Senior Flexonics, Inc.; Pathway Division.

- B. Steel Shapes and Plates: ASTM A 36/A 36M.
- C. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex head.
- D. Washers: ASTM F 84, steel plain, flat washers.
- E. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Stud: Threaded, zinc-coated carbon steel.
 - 2. Expansion Plug: Zinc-coated steel.
 - 3. Washer and Nut: Zinc-coated steel.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- B. Install expansion joints of sizes matching size of piping in which they are installed.
- C. Grooved end expansion joints shall be installed in accordance with the manufacturer's (Victaulic) guidelines and recommendations. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied 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 for proper gasket sealing. A Victaulic factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.
- D. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.
- E. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- F. Install pipe bends and loops in grooved piping systems with (8) Victaulic Style 75 or 77 flexible couplings, (4) Victaulic 90° elbows, and (3) grooved end pipe spools provided in water systems to 230°F in accordance with the latest Victaulic recommendations for expansion compensation.
- G. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.
- H. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

- I. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- J. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.
- K. Install guides to pipe and secure to building structure.
- L. Attach guides to pipe and secure to building structure.
- M. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- N. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- O. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- P. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansions joints or compensators are indicated.
- Q. Use grout to form flat bearing surfaces for expansion fittings, guides and anchors installed on or in concrete.

END OF SECTION 230516

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. Thermometers.
 - 2. Gages.
 - 3. Test plugs.
 - 4. Flowmeters.
 - 5. Thermal-energy meters.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers, gages, flowmeters and thermal-energy meters indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer, gage, flowmeter and thermal-energy meter, signed by product manufacturer.
- D. Operation and Maintenance Data: For flowmeters and thermal-energy meters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

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

1. Palmer - Wahl Instruments Inc.
 2. Terice, H. O. Co.
 3. Weiss Instruments, Inc.
 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or brass, 7 inches long.
- C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 2. KOBOLD Instruments, Inc.
 3. Marsh Bellofram.
 4. Terice, H. O. Co.
 5. Weiss Instruments, Inc.
 6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Liquid-filled type, drawn steel or cast aluminum, 5-inch diameter.
- C. Element: Bourdon tube or other type of pressure element.
- D. Movement: Mechanical, connecting element and pointer.
- E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- F. Pointer: Red or other dark-color metal.
- G. Window: Glass or plastic.
- H. Ring: Metal or plastic.
- I. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

- J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.
- K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 BIMETALLIC-ACTUATED DIAL THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 2. Ernst Gage Co.
 - 3. Eugene Ernst Products Co.
 - 4. Marsh Bellofram.
 - 5. Miljoco Corp.
 - 6. NANMAC Corporation.
 - 7. Noshok, Inc.
 - 8. Palmer - Wahl Instruments Inc.
 - 9. REO TEMP Instrument Corporation.
 - 10. Tel-Tru Manufacturing Company.
 - 11. Terice, H. O. Co.
 - 12. Weiss Instruments, Inc.
 - 13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 14. WIKA Instrument Corporation.
 - 15. Winters Instruments.
- B. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.
- C. Case: Liquid-filled type, stainless steel with 5-inch diameter.
- D. Element: Bimetal coil.
- E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- F. Pointer: Red or other dark-color metal.
- G. Window: Glass or plastic.
- H. Ring: Stainless steel.
- I. Connector: Adjustable angle type.
- J. Stem: Metal, for thermowell installation and of length to suit installation.
- K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 THERMOWELLS

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

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.5 PRESSURE GAGES

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

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. KOBOLD Instruments, Inc.
6. Marsh Bellofram.
7. Miljoco Corp.
8. Noshok, Inc.
9. Palmer - Wahl Instruments Inc.
10. REO TEMP Instrument Corporation.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass or plastic.
8. Ring: Metal or plastic.

9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.6 TEST PLUGS

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

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Terice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, one thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
4. Carrying case shall have formed instrument padding.

2.7 WAFER-ORIFICE FLOWMETERS

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

1. ABB, Inc.; ABB Instrumentation.

2. Armstrong Pumps, Inc.
 3. Badger Meter, Inc.; Industrial Div.
 4. Bell & Gossett; ITT Industries.
 5. Meriam Instruments Div.; Scott Fetzer Co.
- B. Description: Differential-pressure-design orifice insert for installation between pipe flanges; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.
- C. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
- D. Pressure Rating: 300 psig.
- E. Temperature Rating: 250 deg F.
- F. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
- G. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
1. Scale: Gallons per minute.
 2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.
- H. Portable Indicators: Differential-pressure type calibrated for connected flowmeter element and having two 12-foot hoses in carrying case.
1. Scale: Gallons per minute.
 2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.
- I. Operating Instructions: Include complete instructions with each flowmeter.

2.8 TURBINE FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Badger Meter, Inc.; Industrial Div.
 2. ONICON Incorporated.
- B. Description: Dual turbine flow meter complete with installation hardware to enable insertion and removal of the meter without system shutdown.
- C. Construction: Two contra-rotating axial turbines with electronic impedance-based sensing and an averaging circuit to reduce measurement errors due to swirl and flow profile distortions.
1. Wetted metal components shall be nickel plated brass.
 - a. 316 L SS construction for hydronic applications over 250 degrees F for any non-metallic pipe.

- b. Maximum operating temperature shall be 280 degrees F, 300 F peak.
- D. Accuracy: Wet-calibrate flow meter against a primary volumetric standard accurate to within 0.1% and traceable to NIST.
 - 1. Provide manufacturer's certificate of calibration.
 - 2. Accurate to within +/- 0.5% at calibrated velocity; within +/- 1% over a 10:1 turndown; and within +/- 2% over a 50:1 turndown.
- E. Outputs: Integral analog outputs, 4-20 mA & 0-10V.

2.9 PITOT-TUBE FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Dieterich Standard Inc.
 - 2. Meriam Instruments Div.; Scott Fetzer Co.
 - 3. Preso Meters Corporation.
 - 4. Taco, Inc.
 - 5. Veris Industries.
- B. Description: Insertion-type, differential-pressure design for inserting probe into piping and measuring flow directly in gallons per minute.
- C. Construction: Stainless-steel probe of length to span inside of pipe; with integral transmitter and direct-reading scale.
- D. Pressure Rating: 150 psig minimum.
- E. Temperature Rating: 250 deg F minimum.
- F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons.
- G. Integral Transformer: For low-voltage power connection.
- H. Accuracy: Plus or minus 1 percent for liquids and gases.

2.10 FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brooks Instrument Div.; Emerson Electric Co.
 - 2. Dwyer Instruments, Inc.
 - 3. Ernst Gage Co.
 - 4. Eugene Ernst Products Co.
 - 5. McCrometer, Inc.
 - 6. OPW Engineered Systems; Dover Corp.
 - 7. Penberthy, Inc.
- B. Description: Instrument for installation in piping systems for visual verification of flow.

- C. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator, and threaded or flanged ends.
- D. Pressure Rating: 125 psig.
- E. 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.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler and chiller.
 - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
 - 4. Inlet and outlet of each hydronic heat exchanger.
 - 5. Inlet and outlet of each hydronic heat-recovery unit.
 - 6. Inlet and outlet of each thermal storage tank.
 - 7. Outside-air, return-air, and mixed-air ducts.
- B. Install direct-mounting, vapor-actuated dial thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler and chiller.
 - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
 - 4. Inlet and outlet of each hydronic heat exchanger.
 - 5. Inlet and outlet of each hydronic heat-recovery unit.
 - 6. Inlet and outlet of each thermal storage tank.
- C. Install remote-mounting, vapor-actuated dial thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler and chiller.
 - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
 - 4. Inlet and outlet of each hydronic heat exchanger.
 - 5. Inlet and outlet of each hydronic heat-recovery unit.
 - 6. Inlet and outlet of each thermal storage tank.
- D. Install bimetallic-actuated dial thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler and chiller.
 - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
 - 4. Inlet and outlet of each hydronic heat exchanger.
 - 5. Inlet and outlet of each hydronic heat-recovery unit.

6. Inlet and outlet of each thermal storage tank.

E. Install liquid-filled-case-type, bimetallic-actuated dial thermometers at suction and discharge of each pump.

F. Provide the following temperature ranges for thermometers:

1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

B. Install liquid-filled-case-type pressure gages at chilled- and condenser-water inlets and outlets of chillers.

C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.

C. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).

F. Install needle-valve and syphon fitting in piping for each pressure gage for steam.

G. Install test plugs in tees in piping.

H. Install flow indicators, in accessible positions for easy viewing, in piping systems.

I. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

J. Install flowmeter elements in accessible positions in piping systems.

K. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.

L. Install wafer-orifice flowmeter elements between pipe flanges.

M. Install permanent indicators on walls or brackets in accessible and readable positions.

- N. Install connection fittings for attachment to portable indicators in accessible locations.
- O. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.
- P. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.

3.5 ADJUSTING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 230519

SECTION 230523 – GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following general-duty valves:
 - 1. Copper-alloy ball valves.
 - 2. Ferrous-alloy butterfly valves.
 - 3. Copper-alloy Butterfly Valves
 - 4. Ferrous-alloy check valves
 - 5. Bronze check valves.
 - 6. Gate valves.
- B. See other piping Sections for general-duty and specialty valves for site construction piping.
- C. See Division 23 Section "HVAC Instrumentation and Controls for HVAC" for control valves and actuators.
- D. See Division 23 piping Sections for specialty valves applicable to those Sections only.

1.2 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; furnished specialties; and accessories.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

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 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and Smaller: Threaded ends, unless otherwise indicated.
- C. Brass Valves: NPS 2 and Smaller: Victaulic VIP Press 304™ ends, unless otherwise indicated
- D. Ferrous Valves NPS 2-1/2 and Larger: Grooved or flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- G. Valve Actuators:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
- H. Extended Valve Stems: On insulated valves.
- I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- J. Valve Grooved Ends: ASME/AWWA C606.
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - a. Caution: Use solder with melting point below 840 deg F for check, gate, and globe valves; below 421 deg F for ball valves.
 - 2. Threaded: With threads according to ASME B1.20.1.
- K. Valve Bypass and Drain Connections: MSS SP-45.

2.3 COPPER-ALLOY BALL VALVES

- A. Manufacturers:
 - 1. One-Piece, Copper-Alloy Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Jenkins Valves.
 - c. Stockham Valves.
 - d. Grinnell Corporation.
 - e. Jamesbury, Inc.
 - f. NIBCO INC.
 - g. Watts Industries, Inc.; Water Products Div.
 - 2. Two-Piece, Copper-Alloy Ball Valves:

- a. Conbraco Industries, Inc.; Apollo Div.
- b. Crane Valves.
- c. Jenkins Valves.
- d. Stockham Valves.
- e. Grinnell Corporation.
- f. Hammond Valve.
- g. Jamesbury, Inc.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Victaulic Company of America
- k. Watts Industries, Inc.; Water Products Div.

B. Hydronic:

- 1. Ball Valves – 2" and Smaller (Alternate to standard port): Ball valves shall be 300 or 600# WOG, 150# SWP, 2 piece body style, full port, CP solid brass tunneled ball, reinforced Teflon seats, hex gland follower, bronze body of ASTM B584, blowout proof stem, lever handle.
- 2. Ball valves shall be 400-psig CWP, 3 piece body style, full port, stainless steel ball and stem. PTFE seats, stainless steel body of ASTM A351, grade CF8M, blowout proof stem, lever handle. Basis of design: Victaulic Series P569.
- 3. Ball Valves – 3" and Smaller: Ball valves shall be 300 or 600# WOG, 150# SWP, 2 piece body style, STD port, CP solid brass tunneled ball, reinforced Teflon seats, hex gland follower, bronze body of ASTM B584, blowout proof stem, lever handle.

C. Low Pressure Steam (under 15 LBS):

- 1. Ball Valves – 2" and Smaller (Alternate to standard port): Ball valves shall be 600# WOG, 150# SWP, 2 piece body style, full port, stainless steel solid tunneled ball, reinforced Teflon seats, hex gland follower, bronze body of ASTM B584, blowout proof stem, lever handle.
- 2. Ball Valves – 3" and Smaller: Ball valves shall be 600# WOG, 150# SWP, 2 piece body style, STD port, stainless steel solid tunneled ball, hex gland follower, bronze body of ASTM B584, blowout proof stem, lever handle.

2.4 FERROUS-ALLOY BUTTERFLY VALVES

A. Manufacturers:

- a. Ferrous-Alloy Butterfly Valves:
- b. Crane Co.; Crane Valve Group; Center Line.
- c. Stockham Valves.
- d. Grinnell Corporation.
- e. Hammond Valve.
- f. Metraflex Co.
- g. Milwaukee Valve Company.
- h. Mueller Steam Specialty.
- i. NIBCO INC.
- j. Tyco International, Ltd.; Tyco Valves & Controls.
- k. Victaulic Company of America
- l. Watts Industries, Inc.; Water Products Div.

B. Hydronic:

1. Butterfly Valves – 3" & Larger: Butterfly valves shall be 200# WOG, full lug body of ASTM A126 Class B cast iron, aluminum bronze disc, 416 stainless steel stems, 2 piece stem design, field replaceable hard phenolic backed EPDM liner, non-metallic. stem journal, blow-out proof stem, extended neck, MSS SP-67
2. Butterfly Valves, Grooved-End: 300 psig CWP rating, ferrous alloy, ductile iron body with grooved or shouldered ends in accordance with ASME/AWWA C606. Valve seat shall be pressure responsive in sizes through 12", and the stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating. Basis of design: Victaulic Vic300 Masterseal and AGS-Vic300.

2.5 NON-FERROUS ALLOY BUTTERFLY VALVES

A. Manufacturer:

1. Victaulic Company.

B. Butterfly Valves, Grooved-end: 300 psig CWP rating, non-ferrous alloy, cast-brass body with copper-tube dimensioned grooved ends. Valve seat shall be pressure responsive, and the stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.

1. Basis of design: Victaulic Series 608N.

2.6 FERROUS-ALLOY CHECK VALVES

A. Manufacturer:

1. Victaulic Company.

B. Hydronic Water Only – Grooved end spring-assisted swing check for vertical or horizontal installation: 230 or 300 psig CWP rating, stainless steel spring and shaft, with ductile iron body and grooved ends.

1. Basis of Design: Victaulic Series 716 (300-psig) and AGS Series W715 (230-psig).

2.7 BRONZE CHECK VALVES

A. Manufacturers:

1. Type 1, Bronze, Horizontal Lift Check Valves with Metal Disc:

- a. Cincinnati Valve Co.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Stockham Div.

2. Bronze, Swing Check Valves with Metal Disc:

- a. Cincinnati Valve Co.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Div.
- e. Grinnell Corporation.

- f. Hammond Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell, Wm. Co.
- j. Victaulic Company of America (Hydronic water systems)
- k. Watts Industries, Inc.; Water Products Div.

B. Hydronic and Low Pressure Steam (under 15 PSI):

- 1. Check Valves – Up To 2½": Check valves shall be class 150# SWP, 300# WOG, horizontal swing check, body and cap shall be of ASTM B62 cast bronze, TFE disc, integral bronze seats, MSS SP-80
- 2. Check Valves – 3" and Larger: Check valves shall be class 125# SWP, 200# WOG, horizontal swing check, body and cap shall be of ASTM A 126 cast iron, bronze trim, bolted cap, flanged ends, MSS SP-71
- 3. (Hydronic only) Silent Check Valves – 2 1/2" and Larger: Silent check valves shall be 200# WOG minimum, body shall be of ASTM A126 class B cast iron, center guided, SS spring and screws, bronze disc, bronze seat.
- 4. Hydronic Only – Grooved end swing check: 175 or 300psig CWP rating Ductile Iron body with grooved or shouldered ends, ASME/AWWA C606.

2.8 GATE VALVES

A. Manufacturers:

1. Gate Valves:

- a. Cincinnati Valve Co.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Div.
- e. Grinnell Corporation.
- f. Hammond Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell, Wm. Co.
- j. Watts Industries, Inc.; Water Products Div.

B. Hydronic and Low Pressure Steam (under 15 LBS):

- 1. Gate Valves – Up To 2 ½": Gate valves shall be class 150# SWP, 300# WOG, rising stem, union bonnet, solid wedge malleable iron handwheel, body, bonnet, and union nut shall be of ASTM B62 Bronze, non-asbestos packing, MSS SP-80.
- 2. Gate Valves – 3" and larger: Gate valves shall be class 125# SWP, 200# WOG, rising stem, OS&Y, bolted bonnet, body and bonnet shall be of ASTM A126 Class B cast iron, flange ends, bronze trim, non-asbestos packing, MSS SP-70.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Throttling Service: Ball, butterfly, or globe valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Unions and flanges for servicing and disconnect are not required in installations using grooved mechanical joint couplings. (The couplings shall service as disconnect points if required.)
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above center of pipe.
- F. Install valves in position to allow full stem movement.
- G. Provide stem extensions for ball valves being installed on insulated lines.
- H. Provide memory stops for all valves to be used for balancing.
- I. Install butterfly valves with stem at the horizontal, and so that the handle points down when closed, and in the direction of flow when in the open position.
- J. Adjust all packing nuts after installation.
- K. Provide lever handles for 6" and smaller butterfly valves.
- L. Provide gear operator for 8" and larger butterfly valves.
- M. Provide chain wheel operator when above 7 feet.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.4 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.

END OF SECTION 230523

SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.4 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

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 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components.

1. Manufacturers:
 - a. AAA Technology and Specialties Co., Inc.
 - b. B-Line Systems, Inc.
 - c. Carpenter & Patterson, Inc.
 - d. Empire Tool & Manufacturing Co., Inc.
 - e. Globe Pipe Hanger Products, Inc.
 - f. Grinnell Corp.
 - g. GS Metals Corp.
 - h. Michigan Hanger Co., Inc.
 - i. National Pipe Hanger Corp.
 - j. PHD Manufacturing, Inc.
 - k. PHS Industries, Inc.
 - l. Piping Technology & Products, Inc.
 2. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
 3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
1. Manufacturers:
 - a. B-Line Systems, Inc.
 - b. Grinnell Corp.
 - c. GS Metals Corp.
 - d. Michigan Hanger Co., Inc.
 - e. National Pipe Hanger Corp.
 - f. Thomas & Betts Corp.
 - g. Unistrut Corp.
 - h. Wesanco, Inc.
 2. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
 3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
1. Manufacturers:
 - a. Carpenter & Patterson, Inc.
 - b. Michigan Hanger Co., Inc.
 - c. PHS Industries, Inc.
 - d. Pipe Shields, Inc.
 - e. Rilco Manufacturing Co., Inc.
 - f. Value Engineered Products, Inc.
 2. Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.

3. Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psi, ASTM C552, Type II cellular glass with 100-psi, or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi.
4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
6. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

- A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- C. Hanger Rods: Galvanized all-thread, ASTM A 36.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 2. Properties: Nonstaining, noncorrosive, and nongaseous.
 3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 .
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.

7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification 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.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification 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.
- F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification 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. 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.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. 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.

3.2 INSTALLATION

- A. Pipe Hanger and Support 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. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes. Support pipes of various sizes together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- E. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- J. 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 thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9.
- 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.
- 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
- 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.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor. Place grout under supports for equipment and make smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations. 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 Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching 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. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils. See Division 9 Section "Painting" for paint materials and application requirements.
- 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 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Equipment signs.
4. Access panel and door markers.
5. Pipe markers.
6. Duct markers.
7. Stencils.
8. Valve tags.
9. Valve schedules.
10. 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. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 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 location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - 1. Data: Instructions for operation of equipment and for safety procedures.
 - 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 - 3. Thickness: 1/8 inch, unless otherwise indicated.
 - 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
 - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length
 - 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 - 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 - 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, and Less Than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.3 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
 - 1. Stencil Material: Metal or fiberboard.
 - 2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch-thick brass or aluminum.
 - 2. Material: 3/32-inch-thick laminated plastic with 2 black surfaces and white inner layer.

3. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.5 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 2. Frame: Finished hardwood or Extruded aluminum.
 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 1. Size: Approximately 4 by 7 inches
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 1. Pumps, compressors and similar motor-driven units.
 2. Heat exchangers, coils and similar equipment.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 1. Letter Size: Minimum 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.
 - 2. Data: Distinguish among multiple units,
 - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Pumps, compressors and similar motor-driven units.
 - c. Heat exchangers, coils and similar equipment.
 - d. Tanks and pressure vessels.
 - C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
 - D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
 - 1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Orange: For combination cooling and heating equipment and components.
 - d. Brown: For energy-reclamation equipment and components.
 - 2. Letter Size: Minimum 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.
 - 3. Data: Distinguish among multiple units, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - E. Include signs for the following general categories of equipment:
 - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - 2. Pumps, compressors and similar motor-driven units.
 - 3. Heat exchangers, coils and similar equipment.
 - 4. Tanks and pressure vessels.
 - F. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
 - G. Install access panel markers with screws on equipment access panels.
- 3.3 PIPING IDENTIFICATION
- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe complying with ASME A13.1 on each piping system.
1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

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; plumbing fixture supply stops; 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.

3.5 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.
- B. Provide warning tags on equipment and with wording as directed by the Architect.

3.7 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. The scope of work for this section includes all miscellaneous work needed (whether or not specified or shown on the documents) to produce a complete and fully operational system.
- B. This Section includes TAB to produce design objectives for the following:
 - 1. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - b. Variable-flow systems.
 - 2. HVAC equipment quantitative-performance settings.
 - 3. Verifying that automatic control devices are functioning properly.
 - 4. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

- A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- B. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

1.4 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.5 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. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

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.
 - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. 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.
- D. Examine equipment performance data including pump curves. 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. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory.
- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- F. Examine system and equipment test reports.
- G. 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 that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- I. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

- J. Examine strainers for clean screens and proper perforations.
- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine equipment for installation and for properly operating safety interlocks and controls.
- O. Examine automatic temperature system components to verify the following:
 - 1. Valves, and other controlled devices are operated by the intended controller.
 - 2. Valves are in the position indicated by the controller.
 - 3. Integrity of valves and for free and full operation and for tightness of fully closed and fully open positions.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Sensors are located to sense only the intended conditions.
 - 6. Sequence of operation for control modes is according to the Contract Documents.
 - 7. Interlocked systems are operating.
- P. 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 system readiness 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. Isolating and balancing valves are open and control valves are operational.
 - 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 6. 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 Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.
- B. Cut insulation, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes

and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including valve position indicators, and similar controls and devices, to show final settings.

3.4 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 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 expansion tank liquid level.
 - 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.

3.5 PROCEDURES FOR 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.
 - 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.
 - 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 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. 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.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. 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.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.6 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.7 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer, model, and serial numbers.
 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 for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.8 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the 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 two successive eight-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.

3.9 TEMPERATURE-CONTROL VERIFICATION

- A. Check free travel and proper operation of control devices such as damper and valve operators.
- B. Check the interaction of interlock and lockout systems.
- C. Note operation of electric actuators using spring return for proper fail-safe operations.

3.10 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Heating-Water Flow Rate: 0 to minus 10 percent.

3.11 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
 - 1. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - a. 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. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 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 firm 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.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer, type size, and fittings.

14. Notes to explain why certain final data in the body of reports varies from indicated values.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Water and steam flow rates.
2. Pipe and valve sizes and locations.
3. Balancing stations.
4. Position of balancing devices.

3.12 ADDITIONAL TESTS

- A. After deficiencies have been corrected, rebalance system and resubmit report.
- B. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- C. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

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 mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:
 - 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Lagging adhesives.
 - 6. Sealants.
 - 7. Factory-applied jackets.
 - 8. Field-applied fabric-reinforcing mesh.
 - 9. Field-applied cloths.
 - 10. Field-applied jackets.
 - 11. Tapes.
 - 12. Securements.
 - 13. Corner angles.

1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. FSP: Foil, scrim, polyethylene.
- D. PVDC: Polyvinylidene chloride.
- E. SSL: Self-sealing lap.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings: Show details for the following:
 - 1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Insulation application at pipe expansion joints for each type of insulation.
 - 3. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Removable insulation at piping specialties, equipment connections, and access panels.
 - 5. Application of field-applied jackets.
 - 6. Field application for each equipment type.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. National Commercial and Industrial Insulation Standards: Comply with installation standards.
- D. ASHRAE Standard 90.1-2004: Comply with insulation values required by the Energy Standards.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

- A. Coordinate 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, 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.

1.8 SCHEDULING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. Paint flexible Elastomeric insulation exposed to sun light with Armaflex WB finish, white.
 - 1. Products:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

- a. CertainTeed Corp.; Duct Wrap.
- b. Johns Manville; Microlite.
- c. Knauf Insulation; Duct Wrap.
- d. Manson Insulation Inc.; Alley Wrap.
- e. Owens Corning; All-Service Duct Wrap.

- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation without factory-applied jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

- a. CertainTeed Corp.; Commercial Board.
- b. Fibrex Insulations Inc.; FBX.
- c. Johns Manville; 800 Series Spin-Glas.
- d. Knauf Insulation; Insulation Board.
- e. Manson Insulation Inc.; AK Board.
- f. Owens Corning; Fiberglas 700 Series.

- I. Mineral-Fiber, Preformed Pipe Insulation:

1. Products:

- a. Fibrex Insulations Inc.; Coreplus 1200.
- b. Johns Manville; Micro-Lok.
- c. Knauf Insulation; 1000(Pipe Insulation.
- d. Manson Insulation Inc.; Alley-K.
- e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

- J. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

1. Products:

- a. Knauf Insulation; Permawick Pipe Insulation.
- b. Owens Corning; VaporWick Pipe Insulation.

- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in. /h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

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

2.3 INSULATING CEMENTS

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

1. Products:

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

- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products:

- a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.

- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products:

- a. Insulco, Division of MFS, Inc.; SmoothKote.
- b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
- c. Rock Wool Manufacturing Company; Delta One Shot.

2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products:

- a. Aeroflex USA Inc.; Aeroseal.
- b. Armacell LCC; 520 Adhesive.
- c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- d. RBX Corporation; Rubatex Contact Adhesive.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products:

- a. Dow Chemical Company (The); 739, Dow Silicone.
- b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- c. P.I.C. Plastics, Inc.; Welding Adhesive.
- d. Red Devil, Inc.; Celulon Ultra Clear.
- e. Speedline Corporation; Speedline Vinyl Adhesive.

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

- a. Childers Products, Division of ITW; CP-35.
- b. Foster Products Corporation, H. B. Fuller Company; 30-90.
- c. ITW TACC, Division of Illinois Tool Works; CB-50.
- d. Marathon Industries, Inc.; 590.
- e. Mon-Eco Industries, Inc.; 55-40.
- f. Vimasco Corporation; 749.

- 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F.
- 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
- 5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products:
 - a. Childers Products, Division of ITW; CP-30.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-35.
 - c. ITW TACC, Division of Illinois Tool Works; CB-25.
 - d. Marathon Industries, Inc.; 501.
 - e. Mon-Eco Industries, Inc.; 55-10.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products:
 - a. Childers Products, Division of ITW; Encacel.
 - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
 - c. Marathon Industries, Inc.; 570.
 - d. Mon-Eco Industries, Inc.; 55-70.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products:

- a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.7 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic-Foam, and Polyisocyanurate Products:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
2. Joint Sealants for Polystyrene Products:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F.
6. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

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

1. Products:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Materials shall be compatible with insulation materials, jackets, and substrates.
 - c. Fire- and water-resistant, flexible, elastomeric sealant.
 - d. Service Temperature Range: Minus 40 to plus 250 deg F.
 - e. Color: White.

2.8 FACTORY-APPLIED JACKETS

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

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
6. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
8. Vinyl Jacket: UL-rated white vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.9 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz. /sq. yd.
1. Products:
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: Color-code jackets based on system. Color as selected by Architect.
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 - 5. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:
 - 1. Products:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - d. Insert manufacturer's name; product name or designation.
 - 2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.

- 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
 - E. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 1. Products:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.
 - c. MFM Building Products Corp.-Flex Clad
 - F. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
 1. Products:
 - a. Polyguard; Alumaguard 60.
 - b. MFM Building Products Corp; Flex-Clad 400
 - G. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 1. Products:
 - a. Dow Chemical Company (The), Saran 540 Vapor Retarder Film.
 - H. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 1. Products:
 - a. Dow Chemical Company (The), Saran 560 Vapor Retarder Film.
 - I. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
- 2.11 TAPES
- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
 1. Products:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.

- b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/ inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
 1. Products:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/ inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 1. Products:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/ inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/ inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
 1. Products:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/ inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/ inch in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products:
 - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/ inch in width.

2.12 SECUREMENTS

A. Bands:

1. Products:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **0.135-inch** diameter shank, length to suit depth of insulation indicated.

- a. Products:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **0.135-inch** diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - 4) Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel, aluminum, or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Manufacturers:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel, or 0.062-inch soft-annealed, galvanized steel.
 1. Manufacturers:
 - a. ACS Industries, Inc.
 - b. C & F Wire.
 - c. Childers Products.
 - d. PABCO Metals Corporation.
 - e. RPR Products, Inc.

2.13 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type **304 or 316**.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation in strict accordance with the manufacturer's installation instructions and the National Commercial and Industrial Insulation Standards.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **4 inches** o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies according to Division 7 Section "Through-Penetration Firestop Systems."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
 - 1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
 - 1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 - 2. Fabricate boxes from galvanized steel, at least 0.050 inch thick.
 - 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient

- services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.
- 3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION
- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.

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

D. Insulation Installation on Valves and Pipe Specialties:

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

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

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

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3-inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.9 FIELD-APPLIED JACKET INSTALLATION

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

3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1½-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 2. Wrap factory-presizes jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1¼ circumferences of appropriate PVDC tape around overlapped butt joint.
 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33½-inches or less. The 33½-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
 5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.
- F. Where rubberized bituminous resin jackets are installed comply with manufacturers installation instructions.

3.10 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Heating-hot-water expansion/compression tank insulation shall be any of the following:
1. Mineral-Fiber Board: 1-inch thick and 2-lb/cu. ft. nominal density.
 2. Mineral-Fiber Pipe and Tank: 1-inch thick.

D. Heating-hot-water air-separator insulation shall be any of the following:

1. Mineral-Fiber Board: 2-inches thick and 2-lb/cu. ft. nominal density.
2. Mineral-Fiber Pipe and Tank: 2-inches thick.

E. Glycol Expansion Tank shall be as follows:

1. Flexible Elastomeric: 2-inches thick.

3.11 PIPING INSULATION SCHEDULE, GENERAL

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

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Heating-Hot-Water Supply and Return, 200 Deg F and below:

1. NPS 1½ and Smaller: Insulation shall be the following:
 - a. Mineral Fiber pre-formed pipe: 1½-inches thick.
2. NPS 1½ and Larger: Insulation shall be the following:
 - a. Mineral Fiber pre-formed pipe: 2-inches thick.

B. Condensate Drain Piping:

1. NPS 12 and Smaller: Insulation shall be the following:
 - a. Flexible Elastomeric: 1/2-inch thick.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

END OF SECTION 230700

SECTION 232113 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Product Data: For each type of special-duty valve and specialty. Include flow and pressure drop curves based on manufacturer's testing for calibrated balancing valves, automatic flow-control valves, and specialty.
- B. Shop Drawings from the manufacturer detailing equipment assemblies and dimensions, weights, and required clearances, and location and size of each field connection.
- C. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Failed test results and corrective action taken to achieve requirements.
- D. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.
- E. Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable Victaulic style or series number.

1.2 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. 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 the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- C. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

1.3 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.

- C. Coordinate pipe fitting pressure classes with products specified in related Sections.
- D. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- E. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in other Divisions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grooved Mechanical-Joint Fittings and Couplings:
 - a. Victaulic Company of America.
 - 2. Calibrated Balancing Valves:
 - a. Flow Design, Inc.
 - b. Gerand Engineering Company.
 - c. Griswold Controls.
 - d. Tour and Andersson, Victaulic
 - 3. Grooved End Steel Pipe Expansion Joints:
 - a. Victaulic Company of America.
 - 4. Flexible-Hose Expansion Joints:
 - a. Metraflex, Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Senior Flexonics, Inc.
 - 5. Hose Kits:
 - a. Metraflex, Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Senior Flexonics, Inc.

2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 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 Fittings: ASME B16.22.
- E. Wrought-Copper Unions: ASME B16.22.
- F. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- G. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).
- H. Grooved Mechanical-Joint Fittings: ASME B16.22 wrought copper or ASME B16.18 bronze casting with copper tubing sized grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).
- I. Grooved Mechanical-Joint Couplings: "Installation Ready" stab-on design, for direct 'stab' installation onto roll grooved copper tube without prior field disassembly and no loose parts. Housings shall be ductile iron cast with offsetting, angle-pattern bolt pads, coated with copper-colored enamel. Gasket shall be Grade "EHP" EPDM with unique sealing design, suitable for temperatures up to 250 deg F and plated steel bolts and nuts. Victaulic Style 607 QuickVic™.

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 and Smaller: ASTM A 53/A 53M, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53/A 53M, Type E (electric-resistance welded), Grade B, Schedule 40, black steel, plain ends.
- C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.
- D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- F. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- H. 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.

- I. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept Victaulic grooved end couplings.
- J. Grooved Mechanical-Joint Couplings: Ductile-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. Comply with ASTM A 536 Grade 65-45-12, 65,000 PSI minimum tensile strength.
 - 1. Key section designed to engage fully into the groove tying the joint integrally to the pipe.
 - 2. Gaskets shall be suitable for the temperature and fluid used in the system. Use Grade "EHP" EPDM gaskets with unique sealing design, rated for continuous use at 250 deg F or Grade "E" EPDM gaskets rated for continuous use at 230 deg F unless indicated otherwise.
 - 3. Use rigid "QuickVic" or "Zero-Flex" couplings unless flex couplings are indicated for vibration isolation or to accommodate seismic movement.
 - 4. "Installation Ready" couplings, 2" through 8", shall be designed for direct 'stab' installation onto grooved end pipe without prior field disassembly and no loose parts. Gasket shall be Grade "EHP" EPDM. Victaulic Style 107H QuickVic™ (rigid) and Style 177 (flexible).
 - 5. Standard coupling design, 10" and 12" sizes, with Grade "E" EPDM gasket. Victaulic Style 07 Zero-Flex® (rigid) and Style 77 (flexible).
 - 6. AGS two-piece housing design, 14" through 60", shall fit into a deeper wedge-shaped groove, cast with a wide key profile and flat bolt pads for metal-to-metal contact. Wide-width FlushSeal® gasket (Grade "E" EPDM). Victaulic Style W07 (rigid) or Style W77 (flexible).
- K. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of ¼-inch misalignment.
 - 1. Victaulic Style 177, 77 or W77 flexible couplings may be used in lieu of flexible connectors for vibration isolation at equipment connections. Three (3) couplings, for each connector, shall be placed in close proximity to the source of vibration.
- L. Hose Kits: EPDM tube with braided stainless steel outer jacket; brass female pipe swivel, both ends with crimp stainless steel collar; 33 to 180 deg F. range; with fibrous flat washer; 255 psi working pressure at 70 deg F.
- M. Packed, Slip, Expansion Joints: 150-psig minimum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, packing ring, packing, limit rods, flanged ends, and chrome-plated finish on slip-pipe telescoping section.
- N. In Victaulic grooved piping system, expansion and contraction shall be accommodated by installing expansion loops or bends consisting of (8) Victaulic flexible couplings, (4) 90 degree elbows, and (3) grooved end pipe spools provided in water systems up to +250 degrees F in accordance with Victaulic recommendations for expansion compensation.
- O. Install Victaulic Style 150 or Style 155 in-line expansion joints in enclosures where loops or bends cannot be applied.
- P. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

- Q. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 VALVES

- A. Gate, globe, check, ball, and butterfly valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- C. Calibrated Balancing Valves, NPS 2 and Smaller:
1. Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
 2. Ametal® DZR brass body, y-pattern, globe type, 300 psig working pressure, 250 deg F maximum operating temperature and having soldered or threaded ends. Valve shall have 4-turn digital readout hand wheel and concealed memory feature with locking, tamper-proof setting. Built-in check valve provided for connecting a Series 73M portable differential pressure meter. Victaulic/Tour & Andersson Series 786, 787, or 78K.
 - a. Coil Components: Provide Victaulic Series 799 or 79V Koil-Kit™ consisting of a Series 78U union port fitting, Series 78Y strainer/ball valve or Series 78T union/ball valve combination to reduce space requirements and complete terminal hookup at coil outlet.
- D. Calibrated Balancing Valves, NPS 2-1/2 and Larger:
1. Cast-iron or steel body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.
 2. Ductile iron body, y-pattern, globe type with Ametal® DZR brass internal components, 300 psig working pressure, 250 deg F maximum operating temperature and having flanged or grooved ends. Valve shall have multiple-turn digital readout hand wheel and concealed memory feature with locking, tamper-proof setting. Built-in check valve provided for connecting a Series 73M portable differential pressure meter. Victaulic/Tour & Andersson Series 788 or 789.
- E. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.
1. Basis of Design: Bermad.
- F. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.
- G. Automatic Flow-Control Valves: Gray-iron body, factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow

meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate. Valve shall be line size and one of the following designs:

1. Gray-iron or brass body, designed for 175 psig at 200 deg F with stainless-steel piston and spring.
2. Brass or ferrous-metal body, designed for 300 psig at 250 deg F with corrosion-resistant, tamperproof, self-cleaning, piston-spring assembly easily removable for inspection or replacement.
3. Combination assemblies, including bronze ball valve, Bronze Y-strainer with 304 SS Screen, brass alloy control valve, with stainless-steel piston and spring 4-57 PSID Range, fitted with pressure and temperature test valves, and stainless steel braided hoses, 24 inches long, EPDM flame retardant EPM inner tube. and designed for 300 psig at 250 deg F.
4. Basis of Design: Victaulic Series 76.

2.6 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.
- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.
- C. Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. Include the following fittings and accessories:
 1. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Design tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
 2. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; designed to admit air to compression tank, drain water, and close off system.
 3. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch diameter gage glass, and slotted-metal glass guard.
- D. Bladder Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible bladder securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- E. Tangential-Type Air Separators: Welded black steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature; perforated stainless-steel air collector tube designed to direct released air into expansion tank; tangential inlet and outlet connections; threaded connections for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger; threaded blowdown connection. Provide units in sizes for full-system flow capacity.

- F. In-Line Air Separators: One-piece cast iron with an integral weir designed to decelerate system flow to maximize air separation at a working pressure up to 175 psig and liquid temperature up to 300 deg F.
- G. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
 - 1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
- H. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- I. Basket Strainers: 125-psig working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged-end connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- J. T-Pattern Strainers: Up to 750-psig working pressure; ductile-iron body, grooved-end connections, stainless-steel basket with 57 percent free area; removable access coupling and end cap or T-bolt hinged closure/cap for strainer maintenance. Victaulic Series 730 and W730.
- K. Grooved-End Y-Pattern Strainers: 300-psig working pressure; ductile-iron body, grooved end connections, NPS 2 through NPS 18, Type 304/304L stainless steel metal removable basket with 0.125" diameter perforations, blow-down port fitted with pipe plug. Victaulic Style 732 and W732.

2.7 EXPANSION FITTINGS AND LOOPS

- A. Flexible-Hose Expansion Joints for Copper Piping: Copper alloy fittings with solder- joint end connections. Flexible loops consist of two sections of flexible hose and braid, two 90 degree elbows and a 180 degree return assembly with center support nut.
 - 1. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - 2. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
- B. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and grooved or flanged end connections for NPS 2-1/2 and larger. Flexible loops consist of two sections of flexible hose and braid, two 90 degree elbows and a 180 degree return assembly with center support nut.
 - 1. NPS 2 and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
 - 2. NPS 2-1/2 to NPS 6: Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
 - 3. NPS 8 to NPS 12: Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
- C. In Victaulic grooved piping system, expansion and contraction shall be accommodated by installing expansion loops or bends consisting of (8) Victaulic flexible couplings, (4) 90 degree elbows, and (3) grooved end pipe spools provided in water systems up to +250 degrees F in accordance with Victaulic recommendations for expansion compensation.

- D. Install Victaulic Style 150 or Style 155 in-line expansion joints in enclosures where loops or bends cannot be applied.
 - 1. 2" through 6" Sizes: Packless, gasketed, slip-type expansion joint with PPS coated grooved end telescoping body providing up to 3" axial end movement and pressure rating up to 350 psig. Victaulic Style 150 Mover®
 - 2. ¾" and Larger: Combination of grooved end short nipples and flexible couplings joined in tandem to provide increased expansion. Expansion capabilities determined by the number of couplings/nipples used in the joint. Pressure rating dependent on size and style of flexible couplings used. Victaulic Style 155.

2.8 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Metraflex, Inc.
 - d. Senior Flexonics, Inc.; Pathway Division.

2.9 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Stud: Threaded, zinc-coated carbon steel.
 - 2. Expansion Plug: Zinc-coated steel.
 - 3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - 2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - 3. Washer and Nut: Zinc-coated steel.
- F. Concrete: Portland cement mix, 3000 psi minimum. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.

- G. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, 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 PIPING APPLICATIONS

- A. Hot and Chilled Water, NPS 2 and Smaller: Aboveground, use Type L drawn-temper copper tubing with soldered joints or Schedule 40 steel pipe with threaded joints. Belowground or within slabs, use Type K annealed-temper copper tubing with soldered joints. Use the fewest possible joints belowground and within floor slabs.
 - 1. Vic-Press stainless steel fittings and joints may be used in lieu of threaded or soldered joints for operating pressures to 500-psig CWP.
- B. Hot Water, NPS 2-1/2 and Larger: Schedule 40 steel pipe with welded, flanged, or grooved mechanical-joints.
- C. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints.

3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty: Gate, ball, and butterfly valves.
 - 2. Throttling Duty: Globe, ball, and butterfly valves.
- B. Install shutoff duty valves at supply connection to each piece of equipment and elsewhere as indicated.
- C. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

3.3 PIPING INSTALLATIONS

- A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping installation requirements.

- B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains, consisting of a tee fitting, NPS ¾ ball valve, and short NPS ¾ threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- D. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- E. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- F. Anchor piping for proper direction of expansion and contraction.
- G. Install grooved fittings in strict accordance with the manufacturer's written installation instructions.

3.4 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 requirements below for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping runs less than 20 feet long.
 - 2. Adjustable roller hangers for individual horizontal piping runs 75 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 75 feet or longer, supported on a trapeze.
 - 4. Constant support hangers for vertical heating supply and return piping extending more than two floors.
 - 5. 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 ¾ and 1: Maximum span, 7 feet; minimum rod size, ¼ inch.
 - 2. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 3. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 5. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 6. NPS 4: Maximum span, 14 feet; minimum rod size, ½ inch.
 - 7. NPS 6: Maximum span, 17 feet; minimum rod size, ½ inch.
 - 8. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
 - 9. NPS 10: Maximum span, 20 feet; minimum rod size, ¾ inch.
 - 10. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS ¾: Maximum span, 5 feet; minimum rod size, ¼ inch.
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, ¼ 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. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer have written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- F. Victaulic Style 107H, 07, and W07 rigid couplings may be used with IPS steel piping systems, which meet the support and hanging requirements of ASME B31.1 and B31.9. An adequate number of Victaulic Style 177, 77, and W77 flexible couplings shall also be used to compensate for thermal expansion/contraction of the pipe.

3.5 PIPE JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Work Results for HVAC" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.
- B. Grooved joint piping systems shall be installed in accordance with the manufacturer's (Victaulic) guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. 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 Victaulic. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A Victaulic factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.6 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 in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting.
- C. Install in-line air separators in pump suction lines. Install piping to compression tank or automatic air vent with a 2 percent upward slope toward tank. Install drain valve on units NPS 2 and larger.
- D. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above floor. Install feeder in bypass line, off main, using globe valves on each side of feeder and ball or butterfly valve in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.
- E. Install expansion tanks above air separator. Install gage glass and cocks on end of tank. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, and fittings, plus weight of a full tank of water. Do not overload building components and structural members.
- F. Install bladder type expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections. Where piping is indicated to be larger than connection size, maintain larger pipe size through isolation valves and strainers.
- B. Install control valves in accessible locations close to connected equipment.

3.8 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.
 3. Install flexible loops in accordance with manufacturer's installation instructions.

3.9 SWING CONNECTIONS

- A. Connect risers and branch connections to mains and terminals with at least four pipe fittings, including tee in main.
- B. In Victaulic grooved piping systems, seismic motion shall be accommodated by installing swing joints consisting of flexible couplings, pipe nipples and elbows that provide simultaneous movement in all directions, or other seismic movement compensation devices such as loops, offsets, or Style 155 expansion joints (when an in-line device is required) to provide flexibility to the system and help reduce pipe stresses. Refer to Victaulic design submittal #26.12.

3.10 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

3.11 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

3.12 CHEMICAL TREATMENT

- A. Perform an analysis of supply water to determine the type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling.
- B. Fill system and perform initial chemical treatment.

3.13 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 system with clean water. Clean strainers.
 - 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 trapped air. Use drains installed at low points for complete draining of liquid.
 - 3. Check expansion tanks to determine that they are not air bound and that system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."

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.

3.14 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:
 1. Open valves to fully open position. Close coil bypass valves.
 2. Check pump for proper direction of rotation.
 3. Set automatic fill valves for required system pressure.
 4. Check 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. Check operation of automatic bypass valves.
 7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
 8. Lubricate motors and bearings.

3.15 CLEANING

- A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

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. Section Includes:
 - 1. Close-coupled, in-line centrifugal pumps.

1.3 DEFINITIONS

- A. ECM: Electronically commutated motor.
- B. EPDM: Ethylene propylene diene monomer.
- C. EPR: Ethylene propylene rubber.
- D. FKM: Fluoroelastomer polymer.
- E. HI: Hydraulic Institute.
- F. NBR: Nitrile rubber or Buna-N.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of pump.
 - 1. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated.
 - 2. Indicate pump's operating point on curves.
- B. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

1.6 CLOSEOUT SUBMITTALS

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

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

- A. Acceptable Manufacturers:
 - 1. Armstrong Pumps Inc.
 - 2. Bell & Gossett; Div. of ITT Industries.
 - 3. Taco, Inc.
- B. Source Limitations: Obtain pumps from single source from single manufacturer.
- C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.
- D. Pump Construction:
 - 1. Casing: Radially split, cast iron, with threaded gauge tappings at inlet and outlet, replaceable bronze wear rings, and threaded union-end connections.
 - 2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
 - 3. Pump Shaft Sleeve: Type 304 stainless steel.
 - 4. Pump Stub Shaft: Type 304 or Type 316 stainless steel.
 - 5. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and NBR rubber bellows and gasket. Include water slinger on shaft between motor and seal.
 - 6. Seal Flushing: Flush, cool, and lubricate pump seal by directing pump discharge water to flow over the seal.

- E. Shaft Coupling: Rigid, axially-split spacer coupling to allow service of pump seal without disturbing pump or motor.
- F. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Enclosure : Totally enclosed, fan cooled.
 - 2. NEMA Premium Efficient motors as defined in NEMA MG 1.
 - 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - 5. Single or Variable-speed motor.
 - 6. Provide integral pump motor variable-speed controller.
- G. Capacities and Characteristics: Refer to Drawings.

2.2 INTEGRAL PUMP MOTOR VARIABLE-SPEED CONTROLLERS

- A. Where specified or scheduled, provide pumps with an integral pump motor speed controller.
 - 1. Motor: Operates as constant- or variable-speed pump with speed regulated by an integrated variable-speed drive.
 - 2. Integrated Pump Controller: Supports direct communication with the building management system (BMS) with built-in support for the following protocols: BACnet? MS/TP.
 - 3. Commissioning and pump set up access to pump controls via the following:
 - a. A web interface (data exchange).
 - b. A user interface located on the face of speed controller to adjust modes and mode values.
 - c. An electronic display that reads real-time mode set values, flow, head, speed, and power and that locks out unauthorized adjustment of pump.
 - 4. Provide electronics with "Auto" as factory default but slope of the proportional curve will automatically match the required system curve, constant pressure control ($\Delta p/c$), variable differential pressure control ($\Delta p/v$), constant curve duty (uncontrolled pump), and rpm regulation. RPM (speed) regulation can be accomplished by the following:
 - a. Manual (via user interface or HTML).
 - b. Remote via 0 to 10 V dc.
 - c. Data protocol communications with the BMS.
 - 5. Pump Electronics: Standard with multiple digital inputs and one external digital output to be available for additional mechanical room control and pump status monitoring.
 - 6. Controller: Mounted on or adjacent to the motor. Provide enclosure rated to UL Type 12.
 - 7. Electronically Protected Pumps: Rated for continuous duty and with built-in startup circuit. Provide overcurrent, line surge and current limit protection, thermal monitoring, heat sink status and over temperature protection.
 - 8. Pump capable of being monitored continuously via integrated Internet link.
 - 9. Integrated pump controller system to have the following features:

- a. Controller software shall be capable of sensorless control in variable-volume systems without need for pump-mounted (internal/external) or remotely mounted differential pressure sensor.
- b. Integrated Pump Controller Sensorless Control: Operates under Quadratic Pressure Control (QPC) to ensure that head reduction with reducing flow conforms to quadratic control curve.
- c. Controller:
 - 1) Minimum head of 40 percent of design duty head.
 - 2) User-adjustable control mode settings and minimum/maximum head set points using built-in programming interface.
- d. Controller Integrated Control Software:
 - 1) Capable of controlling pump performance for non-overloading power at every point of operation.
 - 2) Capable of maintaining flow rate data.

2.3 ELECTRONICALLY COMMUTATED MOTOR (ECM)

- A. Provide pumps so they are specified or scheduled with ECM.
 - 1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
 - 2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
 - 3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
 - 4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
 - 5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
 - 6. Integrated motor protection verified by UL to protect the pump against over-/undervoltage, overtemperature of motor and/or electronics, overcurrent, locked rotor, and dry run (no-load condition).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the 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 will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
- B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- C. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- D. Equipment Mounting:
 - 1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
- E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and elastomeric hangers of size required to support weight of in-line pumps.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 ALIGNMENT

- A. Perform alignment service. When required by manufacturer to maintain warranty coverage, engage a factory-authorized service representative to perform it.
- B. Comply with requirements in HI standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 PIPING CONNECTIONS

- A. Where installing piping adjacent to pump, allow space for service and maintenance.
- B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- D. Install check, shutoff, and throttling valves on discharge side of pumps.
- E. Install Y-type strainer and suction diffuser and shutoff valve on suction side of pumps.

1. Use startup strainer for initial system startup. Install permanent strainer element before turnover of system to Owner.
- F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- G. Install pressure gauges on pump suction and discharge or at integral pressure-gauge tapping, or install single gauge with multiple-input selector valve.

3.5 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.6 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 2. Check piping connections for tightness.
 3. Clean strainers on suction piping. Use startup strainer for initial startup.
 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 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.

3.8 DEMONSTRATION

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

EXTERIOR ENTRANCE REPLACEMENT FOR:
JEROME T. HART STATE OFFICE BUILDING
SAGINAW, MICHIGAN

FILE NO. 171/25046.CTS

PROJECT NO. 2025009

END OF SECTION 232123

SECTION 235700 - HEAT EXCHANGERS 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 shell-and-tube and plate heat exchangers.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, performance, and dimensional requirements of heat exchangers and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."
- B. ASME Compliance: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
- C. Registration: Fabricate and label shell-and-tube heat exchangers to comply with the Tubular Exchanger Manufacturers Association's standards.

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 GASKETED PLATE HEAT EXCHANGERS

- A. Manufacturers:
1. Alfa Laval Thermal, Inc.
 2. API Heat Transfer Inc.
 3. Armstrong Pumps, Inc.
 4. Invensys APV, Inc.
 5. ITT Industries; Bell & Gossett.
 6. Mueller, Paul Company.
 7. Polaris Plate Heat Exchangers.
 8. Tranter PHE, Inc.
- B. Configuration: Freestanding assembly consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets.
- C. Frame:
1. Capacity to accommodate 20 percent additional plates.
 2. Painted carbon steel with provisions for anchoring to support.
- D. Top and Bottom Carrying and Guide Bars: Painted carbon steel, aluminum, or stainless steel.
1. Fabricate attachment of heat-exchanger carrying and guide bars with reinforcement strong enough to resist heat-exchanger movement during a seismic event when heat-exchanger carrying and guide bars are anchored to building structure.
- E. End-Plate Material: Painted carbon steel.
- F. Tie Rods and Nuts: Steel or stainless steel.
- G. Plate Material: 0.031 inch thick before stamping; Type 304 stainless steel.
- H. Gasket Material: EPDM.
- I. Piping Connections:

1. Threaded port for NPS 2 and smaller. For larger sizes, furnish end-plate port with threaded studs suitable for flanged connection.
 2. End plate with welded carbon-steel nozzles. Threaded pipe connection for NPS 2 and smaller; carbon-steel flanged pipe connection for larger sizes.
 3. Line wetted surfaces with same material as plates.
- J. Capacity and Characteristics: As scheduled on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HEAT-EXCHANGER INSTALLATION

- A. Concrete Bases: Anchor heat exchanger to concrete base.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Maintain manufacturer's recommended clearances for service and maintenance. Install piping connections to allow service and maintenance of heat exchangers.
- C. Install shutoff valves at heat-exchanger inlet and outlet connections.
- D. Install relief valves on heat-exchanger heated-fluid connection and install pipe relief valves, full size of valve connection, to floor drain.
- E. Install vacuum breaker at heat-exchanger steam inlet connection.
- F. Install hose end valve to drain shell.

3.4 FIELD QUALITY CONTROL

- A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

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3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain heat exchangers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 235700

SECTION 238316 - RADIANT-HEATING 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. Section includes radiant-heating piping, including pipes, fittings, and piping specialties.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PEX: Crosslinked polyethylene.
- C. PEX/AL/PEX: Crosslinked polyethylene/aluminum/crosslinked polyethylene.
- D. PTFE: Polytetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data for piping, fittings, manifolds, specialties, and controls; include pressure and temperature ratings, oxygen-barrier performance, fire-performance characteristics, and water-flow and pressure-drop characteristics.
- B. Shop Drawings: Show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.
 - 1. Shop Drawing Scale: 1/4 inch = 1 foot.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For radiant-heating piping valves and equipment to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PEX PIPE AND FITTINGS

Retain "Manufacturers" Paragraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following or pre-approved equivalent:
 - 1. HeatLink Group Inc.
 - 2. REHAU Incorporated.
 - 3. Uponor.
 - 4. Viega.
 - 5. Watts Radiant, inc.; a Watts Water Technologies company.
 - 6. Legend Valve & Fitting
 - 7. MrPex Systems
- B. Pipe Material: PEX-A cross-linked polyethylene as manufactured by the Engel method, according to ASTM F 876. Provide nominal pipe size as indicated on plans.
- C. Oxygen Barrier / UV Protection: Radiant floor heating pipe shall include an oxygen barrier to limit oxygen diffusion through the tube to maximum 0.10 mg per cu. m/day at 104 deg F according to DIN 4726. Snowmelt pipe shall include a UV shield to protect pipe from exposure to sunlight for up to 12 months without damaging pipe or voiding the pipe warranty.
- D. Fittings: ASTM F 1807, metal insert and copper crimp rings.
- E. Pressure/Temperature Rating: Minimum 100 psig and 180 deg F.

2.2 INSULATION

- A. Snowmelt tubing in concrete: 2" inch thick high density insulation. Minimum R10.

2.3 DISTRIBUTION MANIFOLDS

- A. Radiant Heating Manifold: Minimum NPS 1-1/2", stainless steel.
- B. Main Shutoff Valves:
 - 1. Factory installed on supply and return connections.
 - 2. Two-piece body.
 - 3. Body: Brass or bronze.
 - 4. Ball: Chrome-plated bronze.
 - 5. Seals: PTFE.

6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 225 deg F.
- C. Manual Air Vents:
1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Key furnished with valve, or screwdriver bit.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/8.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 225 deg F.
- D. Balancing Valves:
1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
 2. Ball or Plug: Brass or stainless steel.
 3. Globe Cartridge and Washer: Brass with EPDM composition washer.
 4. Seat: PTFE.
 5. Visual Flow Indicator: Flowmeter with visible indication in a clear plastic cap at top of valve.
 6. Differential Pressure Gage Connections: Integral seals for portable meter to measure loss across calibrated orifice.
 7. Handle Style: Lever or knob, with memory stop to retain set position if used for shutoff.
 8. CWP Rating: Minimum 125 psig.
 9. Maximum Operating Temperature: 250 deg F.
- E. Zone Control Valves:
1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
 2. Ball or Plug: Brass or stainless steel.
 3. Globe Cartridge and Washer: Brass with EPDM composition washer.
 4. Seat: PTFE.
 5. Actuator: Replaceable electric motor.
 6. CWP Rating: Minimum 125 psig.
 7. Maximum Operating Temperature: 250 deg F.
- F. Thermometers:
1. Mount on supply and return connections.
 2. Case: Dry type, metal or plastic, 2-inch diameter.
 3. Element: Bourdon tube or other type of pressure element.
 4. Movement: Mechanical, connecting element and pointer.
 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 6. Pointer: Black metal.
 7. Window: Plastic.
 8. Connector: Rigid, back type.
 9. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem.
 10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.
- G. Mounting Brackets: Copper, or plastic- or copper-clad steel, where in contact with manifold.

2.4 PIPING SPECIALTIES

A. Cable Ties:

1. Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
2. Minimum Width: 1/8 inch.
3. Tensile Strength: 20 lb, minimum.
4. Temperature Range: Minus 40 to plus 185 deg F.

2.5 CONTROLS

- ### A.
- Temperature-control devices and sequence of operations are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls."

PART 3 - EXECUTION

3.1 EXAMINATION

- ### A.
- Examine surfaces and substrates to receive radiant-heating piping for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Ensure that surfaces and pipes in contact with radiant-heating piping are free of burrs and sharp protrusions.
 2. Ensure that surfaces and substrates are level and plumb.
- ### B.
- Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- ### A.
- Install the following types of radiant-heating piping for the applications described:
1. Piping in Exterior Pavement: PEX.
 2. Piping in Interior Reinforced-Concrete Floors: PEX.
 3. Piping in Subfloors: PEX.

3.3 INSTALLATION

- ### 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 Shop Drawings or coordination drawings.
- ### B.
- Install radiant-heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.
- ### C.
- Connect radiant piping to manifold in a reverse-return arrangement.

- D. Do not bend pipes in radius smaller than manufacturer's minimum bend radius dimensions.
- E. Install manifolds in accessible locations, or install access panels to provide maintenance access as required in Section 083113 "Access Doors and Frames."
- F. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties" for pipes and connections to hydronic systems and for glycol-solution fill requirements.
- G. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials according to Section 078413 "Penetration Firestopping."
- H. Piping in Exterior Pavement:
 - 1. Secure piping in concrete by attaching pipes to reinforcement using cable ties.
 - 2. Space cable ties a maximum of 9 inches (457 mm) o.c. and at center of turns or bends.
 - 3. Maintain 2-inch (75-mm) minimum cover.
 - 4. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches (250 mm) on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - 5. Maintain minimum 40-psig (275-kPa) pressure in piping during concrete placement and continue for 24 hours after placement.
- I. Piping in Interior Reinforced-Concrete Floors:
 - 1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
 - 2. Space cable ties a maximum of 18 inches (457 mm) o.c. and at center of turns or bends.
 - 3. Maintain 2-inch (50-mm) minimum cover.
 - 4. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches (250 mm) on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - 5. Maintain minimum 40-psig (275-kPa) pressure in piping during concrete placement and continue for 24 hours after placement.
- J. Piping in Level Fill Concrete Floors (Not Reinforced):
 - 1. Secure piping in concrete floors by attaching pipes to subfloor using tracks, clamps, or staples.
 - 2. Space tracks, clamps, or staples a maximum of 18 inches (457 mm) o.c. and at center of turns or bends.
 - 3. Maintain 3/4-inch (19-mm) minimum cover.
 - 4. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches (250 mm) on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - 5. Maintain minimum 40-psig (275-kPa) pressure in piping during the concrete pour and continue for 24 hours during curing.
- K. Piping in Subfloor:
 - 1. Secure piping by laying in subfloor channels or modular interlocking blocks.

2. Use straight channel panels or blocks in the center and curved channel panels or blocks at the ends.
 3. Finish floor with mineralboard panel cover or finished floor surface.
- L. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Architect.
- M. After system balancing has been completed, mark balancing valves to permanently indicate final position.
- N. Perform the following adjustments before operating the system:
1. Open valves to fully open position.
 2. Check operation of automatic valves.
 3. Set temperature controls so all zones call for full flow.
 4. Purge air from piping.
- O. After concrete or plaster heating panel has cured as recommended by concrete or plaster supplier, operate radiant-heating system as follows:
1. Start system heating at a maximum of 10 deg F (6 deg C) above the ambient radiant-panel temperature and increase 10 deg F (6 deg C) each following day until design temperature is achieved.
 2. For freeze protection, operate at a minimum of 60 deg F (16 deg C) supply-water temperature.

3.4 FIELD QUALITY CONTROL

- A. Prepare radiant-heating piping for testing as follows:
1. Open all isolation valves and close bypass valves.
 2. Open and verify operation of zone control valves.
 3. Flush with clean water and clean strainers.
- B. Perform the following tests and inspections:
1. Leak Test: After installation, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig (690 kPa). Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Radiant-heating piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Protect hydronic piping system from damage during construction.

END OF SECTION

SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work includes all electrical items and systems shown on the contract drawings and specified herein.
- B. Unless specifically dimensioned, the work shown on the drawings is diagrammatic, and is intended only to show general arrangement.
- C. Include in the work all accessories and devices necessary for the intended operation of any system, whether or not specifically shown or specified.

1.2 STANDARDS OF QUALITY

- A. The specifications establish the standard of quality required, either by description or by references to brand name, name of manufacturers or manufacturer's model number.
- B. Where one product only is specifically identified by name of manufacturer's model number, the Contractor shall base his bid on the use of the name product. Where multiple names are used, the Contractor shall base his bid on the use of any of those products named.
- C. The Contractor may submit with his bid, the names of products which are proposed as substitutions for products named in specifications. Each proposed substitution shall be accompanied by a written sum of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause.
- D. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the Contractor shall provide complete data adequate for the Engineer's evaluation of the proposed substitution.
- E. When the equipment other than that specified is used, the Contractor shall be responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, etc. Such additional costs shall be identified at the time such substitutions are proposed.

1.3 SUMMARY

- A. This Section includes general administrative and procedural requirements for electrical installations.
 - 1. Submittals
 - 2. Maintenance Manuals
 - 3. Rough-ins
 - 4. Electrical Installations

1.4 SUBMITTALS

- A. The Contractor shall review, approve and submit shop drawings, with promptness so as to cause no delay in his work or in that of others. No submissions will be accepted by the Engineer without the signed review and approval of the Contractor.
- B. The Contractor shall check and verify pertinent field measurements, quantities of equipment and materials required.
- C. Submittals shall be identified by reference to the drawings, sections of specifications, or equipment symbols to which they relate.
- D. Shop drawings, when required, shall include:
 - 1. Verification of information given in Contract Documents such as performance, dimensions, weight, materials, construction, types, models, manufacturer, etc.
 - 2. Equipment layouts drawn to scale as may be required.
 - 3. Wiring diagrams and schematics for equipment.
 - 4. Any special construction conditions.
 - 5. Other information/data as may be requested.
- E. All submittals shall identify the specific details of the product or assembly. All optional features being proposed shall be so noted, or the submittal will be rejected.
- F. Review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specification. Contractor is responsible for dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.
- G. For items being resubmitted, clearly identify changes made from the initial submittal requested by the Engineer. The Engineer will review only those changes requested and identified by the Contractor.

1.5 MAINTENANCE MANUALS

- A. Prepare maintenance manuals including the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.7 PERMITS, FEES, AND CERTIFICATES OF APPROVAL

- A. Contractor shall acquire all permits and certificates.
- B. Contractor shall provide all labor and instruments required for tests and cleaning of systems.
- C. Whenever tests are required, three (3) copies of the test reports shall be submitted to the Engineer.
- D. Tests may be observed by the Engineer or his representative. Notify the Engineer a minimum of three weeks in advance of the test dates.

1.8 COMPLIANCE WITH CODES, STANDARDS AND REGULATIONS

- A. In the absence of specific instruction in the technical specifications, equipment and installation shall conform to the following applicable codes, standards and regulations, latest editions:
 - 1. American Society for Testing Materials (ASTM).
 - 2. American National Standard Institute (ANSI).
 - 3. Underwriter's Laboratories, Inc. (UL).
 - 4. American Welding Society Code (AWSC).
 - 5. Local Building, Electrical, and Fire Codes.
 - 6. National Electrical Code (NEC).
 - 7. Service Rules and Regulations of Local Electrical Utility Company.
 - 8. National Electrical Manufacturer's Association (NEMA).
 - 9. U.S. Department of Health & Human Services "HRS-M-HF" 84-1.
 - 10. Occupational Safety and Health Act (OSHA).
 - 11. National Fire Protection Association (NFPA).
 - 12. Americans with Disabilities Act (ADA).

PART 2 - PRODUCTS - Not Used.

PART 3 - EXECUTION

3.1 ROUGH-IN

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

3.2 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
1. Coordinate electrical systems, equipment, and materials installation with other building components.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 7. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
 8. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 9. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 10. Install access panel or doors where units are concealed behind finished surfaces.
 11. Install systems, material, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 12. Coordinate all electrical requirements with other trades and their shop drawings prior to installing conduit, wire, switches and breakers. Notify engineer of any discrepancies between document and actual supplied equipment.

3.3 CUTTING AND PATCHING

- A. General: Performing cutting and patching in accordance with the following requirements:
1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover work to provide for installation of ill-timed work.
 - b. Remove and replace defective work.
 - c. Remove and replace work not conforming to requirements of the contract documents.
 - d. Upon written instruction from the Engineer, uncover and restore work to provide for Engineer observation of concealed work.

END OF SECTION 260010

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

1.2 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So, connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

PART 2 - PRODUCTS – Not Used.

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.

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- 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 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Branch Circuits: Copper. Stranded for No. 12 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- B. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test 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.
- B. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.2 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 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.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Flexible raceway 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.

3.4 FIELD QUALITY CONTROL

A. 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.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- B. 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.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

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. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

1. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 2. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 3. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. 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.
 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.
 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.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

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. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

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 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: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

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END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Boxes, enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. EMT: Comply with ANSI C80.3 and UL 797.
- C. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- D. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- E. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- F. Gangable boxes are prohibited.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 4. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- B. Minimum Raceway Size: 3/4-inch trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. EMT: Use setscrew, fittings. Comply with NEMA FB 2.10.
 - 2. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- D. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches of enclosures to which attached.
- H. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- I. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- J. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- K. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- L. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- N. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- O. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed 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.
- P. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

- Q. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- R. Locate boxes so that cover or plate will not span different building finishes.
- S. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- T. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078400 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.3 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Equipment identification labels.

1.2 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.3 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 POWER AND CONTROL 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 cable size.
- B. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- C. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.3 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.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-

resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

- C. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- E. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. 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.
- E. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at

penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, 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 branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Colors for 240/120-V Three Phase Circuits:

- 1) Phase A: Black.
 - 2) Phase B (Hi leg): Orange.
 - 3) Phase C: Blue.
- e. Colors for 240/120-V Single Phase Circuits:
- 1) Phase A: Black.
 - 2) Phase C: Red.
- f. 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.
- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. 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: Self-adhesive, engraved, laminated acrylic or melamine label. 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.

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2. Equipment to Be Labeled:
 - a. Enclosures and electrical cabinets.
 - b. Access doors and panels for concealed electrical items.
 - c. Enclosed switches.

END OF SECTION 260553

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches, switchboards, controllers and motor-control centers.

1.2 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Time-current curves, coordination charts and tables, and related data.
4. Fuse size for elevator feeders and elevator disconnect switches.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.
 - c. Ambient temperature adjustment information.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single manufacturer.

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 NEMA FU 1.
- D. Comply with NFPA 70.

1.4 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.5 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

1.6 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. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than three of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussman, Inc.
 - 2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Motor Branch Circuits: Class RK5, time delay.

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 indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Non-fusible switches.
3. Enclosures.

1.2 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, and finishes.
1. Enclosure types and details for types other than NEMA 250, Type 1.
 2. Current and voltage ratings.
 3. Short-circuit current rating.
 4. UL listing for series rating of installed devices.
 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports including the following:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Manufacturer's field service report.
- E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. Include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.3 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.

1.4 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Available Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D/Group Schneider.
- B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
 - 3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.2 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.

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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.

3.3 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.
 - 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

3.6 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Exterior luminaires with LEDs light source and drivers.
 - 2. Poles.
 - 3. Utility company rebate forms.

1.2 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.
- C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4.
- D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
 - 1. Wind speed for calculating wind load for poles 50 feet or less in height is 70 mph.

1.3 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaires and accessories.
 - 3. Details of installation and construction.
 - 4. Luminaire materials.
 - 5. Drivers, including energy-efficiency data.
 - 6. LEDs, including life, output, and energy-efficiency data.
 - 7. Materials, dimensions, and finishes of poles.
 - 8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 - 9. Anchor bolts and bolt circle pattern for poles.
- B. Shop Drawings:
 - 1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 - 2. Wiring Diagrams: Power wiring.

- C. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.
- D. Qualification Data: For agencies providing photometric data for lighting fixtures.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.4 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 IEEE C2, "National Electrical Safety Code."
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 - 2. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

1.7 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. Two complete luminaires, identical to the installed perimeter luminaires.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Refer to Lighting Schedule on Sheet E-100.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. The Luminaire shall be designed and manufactured in the United States. Global components will be allowed provided greater than 50 percent of the parts and labor are sourced in the United States.
- B. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- C. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- H. Exposed Hardware Material: Stainless steel.
- I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- K. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.3 OPTICAL REQUIREMENTS

A. Luminaires shall meet or exceed the following:

1. Impact resistant polycarbonate remote phosphor plate with a thickness of at least 0.08 inches.
2. The remote phosphor plate shall meet or exceed the EN 62262 impact test with a rating of IK07 or better.
3. The polycarbonate remote phosphor shall meet or exceed the ASTM G154 Cycle 1 UV stability tests.
4. A diffuse, highly reflective mixing chamber with a reflectivity of $\geq 97\%$.
5. The optical system shall meet or exceed an IP65 rating.

2.4 PHOTOMETRIC REQUIREMENTS

A. Luminaires shall meet or exceed the following:

1. Nominal CCT of 5000K, adjustable with different remote phosphor plates.
2. Typical CRI of ≥ 70 , adjustable with different remote phosphor plates
3. Minimum initial luminaire efficacy of 90 lm/W (5000K 70CRI)
4. Two adjustable light arrays from 0 to 30 degrees
5. Lumen output $> 20,000$ (5000K, 70CRI)
6. The luminaire shall be registered with the US Department of Energy Lighting Facts program.

2.5 ELECTRICAL SYSTEM REQUIREMENTS

A. Luminaires shall meet or exceed the following:

1. Power supply rated at IP65 or better.
2. Luminaire shall have an integrated universal 480 VAC input.
3. Operating temperature of -40°C to $+45^{\circ}\text{C}$ or wider.
4. UL certified power supply providing constant current with a voltage below 60 volts DC.
5. THD (Total Harmonic Distortion) from the power supply shall be 10% or lower.

2.6 LIGHT ENGINE REQUIREMENTS

A. Luminaires shall meet or exceed the following:

1. L70 lumen maintenance shall exceed 96,000 hours.
2. LED LM-80 data must show $< 0.1\%$ decrease in output after 10,000 hours.
3. The light output shall have 5 or lower SDCM (Standard Deviation of Color Matching) consistency from fixture to fixture and over the L70 life of the product.
4. Polycarbonate based remote phosphor plate with a typical lm/Wrad efficacy of 230 or better.
5. Highly reflective, diffuse mixing chamber with a diffuse reflectivity rating of 97% or greater.
6. Metal core LED circuit board.

2.7 MECHANICAL REQUIREMENTS

- A. Luminaires shall meet or exceed the following:
1. Effective Projected Area (EPA) not to exceed 3.50.
 2. A weight $\leq$ 50 pounds (not including additional controls or 480VAC option).
 3. Normal operation range from -40 C to +45C or wider.
 4. Housing constructed of die cast aluminum, extruded aluminum and stainless steel.
 5. Cast parts shall be finished in a corrosion resistant polyester powder paint.
 6. Internally mounted drivers.
 7. Corrosion resistant fasteners.
 8. Integrated heat sink fins designed to reduce water and debris collection.
 9. Support for both vertical and horizontal pipe mounting, including adjustment from -5 to +95 degrees.
 10. A bolt-type slip fit mount should accept 2.5 to 2.0 inch OD pipes.
 11. Optional custom paint colors.

2.8 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
 3. Anchor-Bolt Template: Plywood or steel.

2.9 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.
1. Shape: Round, tapered.
 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

- B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- C. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.
- D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- G. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- H. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: Match existing.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Fasten luminaire to structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- B. Adjust luminaires that require field adjustment or aiming.
 - 1. Contractor shall coordinate aiming of the newly installed luminaires during construction with MDOC and MDTMB staff. Contractor shall include up to three aiming iterations.
 - 2. Preliminary aiming of fixtures will occur on the day of installation.
 - 3. Final aiming of fixtures shall occur after normal working hours during a period of darkness. The aiming shall be scheduled one week in advance with MDOC and

MDTMB staff. MDOC and MDTMB staff will be present during aiming operations to confirm proper aiming of each fixture.

4. Corrective aiming of fixtures as required to ensure proper coordination with newly installed cameras shall occur after installation and start-up of camera equipment.

3.2 CORROSION PREVENTION

- A. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 POLE INSTALLATION

- A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
 3. Trees: 15 feet.
- C. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
 1. Dig holes large enough to permit use of tampers in the full depth of hole.
 2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
- D. Raise and set poles using web fabric slings (not chain or cable).

3.4 CORROSION PREVENTION

- A. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 1. Install grounding electrode for each pole, unless otherwise indicated.
 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole.
 - 2. Install grounding conductor and conductor protector.
 - 3. Ground metallic components of pole accessories and foundations.

3.6 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
- C. Contractor shall provide (2) night aiming sessions.
- D. Contractor shall provide (1) aiming session after CCTV camera installation.
- E. Verify that new system is fully operational and compatible with the existing photocell and/or time clock controls.

3.7 UTILITY COMPANY LIGHTING REBATES

- A. Contractor shall coordinate with the local Electric Utility Company for all available rebates, to be paid to the Owner, for the replacement of HID luminaires with LED luminaires as part of this project.
- B. Provide the utility company with all required documentation including wattage reduction, luminaire specification sheets, purchase invoices, sample Owner utility bill and W-9 forms.
- C. Contractor shall complete rebate application forms and submit them along with all required documentation to utility company upon project completion.

END OF SECTION

FILE NO. 171/25046.CTS
PROJECT NO. 2025009

CONTRACTOR

PROJECT

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SECTION 281300 - ACCESS CONTROL DATA ROUGH IN

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes empty boxes and conduit for access control devices.

1.2 COORDINATION

- A. Coordinate box and conduit requirements with equipment supplier. (Owner)

PART 2 - PARTS

2.1 RACEWAY

- A. Comply with Division 26 Section "Raceway and Boxes for Electrical Systems."

2.2 MISCELLANEOUS HARDWARE

- A. General: System includes supports, mounting brackets, and installation hardware for components. Metal hardware is of corrosion-resistant material.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install system according to NFPA 70, applicable codes, and manufacturer's printed instructions.
- B. Install boxes. Boxes shall be single gang, 3½-inch deep.
- C. Recess mount raceway, except in unfinished spaces and new walls as indicated.
- D. All conduit shall be minimum of 1-inch.
- E. Stub all conduit to above accessible ceilings.

END OF SECTION 281300

SECTION 311000 - SITE CLEARING

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. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping or sealing, and removing site utilities or abandoning site utilities in place.
 - 7. Temporary erosion and sedimentation control if permanent project measures have not already been put in place.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated according to requirements in Section 015639 "Temporary Tree and Plant Protection."

- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures, if permanent project measures are not already in place, to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015000 "Temporary Facilities and Controls."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015000 "Temporary Facilities and Controls."

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.

- B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- D. Excavate for and remove underground utilities indicated to be removed.
- E. Removal of underground utilities is included in earthwork sections; and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Push down and grub out trees and vegetation that can be removed in this manner without damage to surrounding areas.
 - 3. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 24 inches below exposed subgrade.
 - 4. Use only hand methods or air spade for grubbing within protection zones.
 - 5. Chip removed tree branches and stockpile in areas approved by Owner or dispose of if requested and approved by Owner.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.
- C. Flag clearing limits for inspection by Landscape Architect. If clearing limits are associated with a trail or roadway corridor, use a continuous flagging line between clearing points. No clearing shall take place until limits have been inspected and approved by the Landscape Architect. Landscape Architect may make minor adjustments to clearing limits to protect trees and/or better fit with existing topographic conditions.
- D. When working immediately adjacent to trees to be preserved, do not push trees down with equipment. Individually cut trees and direct their fall so to avoid damage to trees to remain.
- E. During cleaning operations, carefully operate equipment to avoid bumping, skinning, gouging, or otherwise damaging trees to be preserved. Any limbs on trees to be

saved damaged by clearing operations shall be pruned as directed by the Landscape Architect.

- F. Do not grub stumps along clearing limit lines that are within 10 feet of trees to be preserved. These stumps shall be ground to 24 inches below existing grade.
- G. At the conclusion of construction operations, further prune or remove any trees that have been damaged during construction operations, as determined by the Landscape Architect.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Do not stockpile topsoil within protection zones.
 - 2. Stockpile surplus topsoil to allow for respreading deeper topsoil in areas directed by Architect and/or Owner.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove soil material, unsuitable as fill, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning tree, shrub, and other vegetation waste is not permitted.

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SAGINAW, MICHIGAN

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- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for walks, pavements, turf and grasses, and plants.
3. Base course for concrete walks and pavements.
4. Subsurface drainage backfill for walls and trenches.
5. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
3. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized

additional excavation and replacement material will be paid for according to Contract provisions for unit prices changes in the Work.

2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock:

1. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - a. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.
 - b. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.
2. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at Project site

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
 - a. Personnel and equipment needed to make progress and avoid delays.
 - b. Coordination of Work with utility locator service.
 - c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
 - d. Extent of trenching by hand or with air spade.
 - e. Field quality control.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required or necessitated later in the construction process:
 1. Geotextiles.
 2. Controlled low-strength material, including design mixture.
 3. Warning tapes.
- B. Samples for Verification: For the following products, in sizes indicated below:
 1. Geotextile: 12 by 12 inches
 2. Warning Tape: 12 inches long; of each color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 1. Classification according to ASTM D2487.
 2. Laboratory compaction curve according to ASTM D698.

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.7 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

- B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.
- C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.
- D. Do not commence earth-moving operations until plant-protection measures specified in Section 015000 "Temporary Facilities and Controls" are in place.
- E. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487 and Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487 and Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of [washed]crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C33/C33M; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- L. Drainage and base courses for specific situation as detailed in the plans and in plans provided by ROWE Engineering.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability:
 - a. Class 2; AASHTO M 288.
 - b. As follows:
 - 1) Grab Tensile Strength: 157 lbf; ASTM D4632.
 - 2) Sewn Seam Strength: 142 lbf; ASTM D4632.
 - 3) Tear Strength: 56 lbf; ASTM D4533.
 - 4) Puncture Strength: 56 lbf; ASTM D4833.
 - c. Apparent Opening Size: No. 40 sieve, maximum; ASTM D4751.
 - d. Permittivity: 0.2 per second, minimum; ASTM D4491.
 - e. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability:

- a. Class 2; AASHTO M 288.
- b. As follows:
 - 1) Grab Tensile Strength: 247 lbf; ASTM D4632.
 - 2) Sewn Seam Strength: 222 lbf; ASTM D4632.
 - 3) Tear Strength: 90 lbf; ASTM D4533.
 - 4) Puncture Strength: 90 lbf; ASTM D4833.
- c. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751.
- d. Permittivity: 0.02 per second, minimum; ASTM D4491.
- e. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:
- 1. Portland Cement: ASTM C150/C150M, Type I.
 - 2. Fly Ash: ASTM C618, Class C or F.
 - 3. Normal-Weight Aggregate: ASTM C33/C33M, 3/4-inch nominal maximum aggregate size.
 - 4. Foaming Agent: ASTM C869/C869M.
 - 5. Water: ASTM C94/C94M.
 - 6. Air-Entraining Admixture: ASTM C260/C260M.
- B. Produce low-density, controlled low-strength material with the following physical properties:
- 1. As-Cast Unit Weight: 30 to 36 lb/cu. ft. at point of placement, when tested according to ASTM C138/C138M.
 - 2. Compressive Strength: 140 psi, when tested according to ASTM C495/C495M.
- C. Produce conventional-weight, controlled low-strength material with 140-psi compressive strength when tested according to ASTM C495/C495M.

2.4 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.
6. Verify color with local jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

- A. Explosives:
 1. Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 - 1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms:
 - 1. Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - a. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - b. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 - c. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 - d. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
 - 2. Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 - a. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trenches in Tree- and Plant-Protection Zones:
 - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
 - 3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.

- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.

5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- D. Trenches under Roadways: Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Initial Backfill:
1. Soil Backfill: Place and compact initial backfill of subbase material or satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- G. Final Backfill:
1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
- H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory topsoil material.
 - 2. Under walks and pavements. See Plan Details.
 - 3. Under steps and ramps. See Plan Details.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 6 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698.
 - 1. Under structures, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 100 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 100 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus 1 inch, minus ¼".
 - 3. Pavements: Plus 1/2 inch minus 0".

3.17 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Prepare subsurface drainage lines or systems per details in Plans.
 - 1. Compact each filter material layer to 95 percent of maximum dry unit weight according to ASTM D698.

3.18 BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends, if indicated in Plan details in WTA or Civil engineering plans.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape base course to required crown elevations and cross-slope grades.
 - 4. Place base course 6 inches or less in compacted thickness in a single layer.
 - 5. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 6. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 100 percent of maximum dry unit weight according to ASTM D698.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 100 percent of maximum dry unit weight according to ASTM D698.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade if and as detailed in WTA or Civil Engineering Plans.
 - 1. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.20 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 - 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 50 feet or less of wall length but no fewer than two tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 100 feet or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Stock pile and reuse all topsoil in the final 6-12 inches of landfill for landscaped areas.
- B. Stockpile and reuse all satisfactory non-topsoil soils for berm building.
- C. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321723 - PAVEMENT MARKINGS

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. Painted markings applied to asphalt paving.
 - 2. Painted markings applied to concrete surfaces.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to marking asphalt paving or concrete surfaces including, but not limited to, the following:
 - a. Asphalt-paving or concrete-surface aging period before application of pavement markings.
 - b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

- A. Product Data: Include technical data and tested physical and performance properties.
- B. Shop Drawings:
 - 1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
 - 2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches square.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of City of Saginaw or Michigan DOT, wherever is the appropriate regulatory agency, for pavement-marking work.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for alkyd materials 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain pavement-marking paints from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" jurisdiction and ICC A117.1.

2.3 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint water-based / water-borne / zero VOC traffic - rated paint.
 - 1. Color: White, Yellow, or Blue as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

- B. Allow asphalt paving or concrete surfaces to age for a minimum of 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 321726 - TACTILE WARNING SURFACING

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. Surface-applied detectable warning metal tiles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Mortar and Grout:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade

and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering and wear.
 - b. Separation or delamination of materials and components.
 - 2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

- A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for tactile warning surfaces.
 - 1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.
- B. Source Limitations: Obtain each type of tactile warning surfacing, joint material, setting material, anchor, and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
 - 1. Material – Duralast Detectable Warning Plate as provided by FJ.
 - a. Cast Iron: Gray iron, ASTM A 48/A 48M, CL 35.
 - 2. Shapes and Sizes:
 - a. Rectangular panel, 18 by 24 inches, 24 by 24 inches, 24 by 36 inches, 24 by 48 inches, 24 by 60 inches as appropriate for each situation.
 - b. Radius panel, nominal 24 inches deep by 6 outside radius indicated on Drawings.

3. Dome Spacing and Configuration: Manufacturer's standard compliant spacing.
4. Mounting:
 - a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

- A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles:
 1. Concrete Paving Installation: Comply with installation requirements in Section 033000 "Cast-In-Place Concrete." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.
 2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
 3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.
 4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
 5. Clean tiles using methods recommended in writing by manufacturer.

3.4 CLEANING AND PROTECTION

- A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.
- B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 321726

SECTION 329113 - SOIL PREPARATION

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 planting soils specified by composition of the mixes.
- B. Related Requirements:
 - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
 - 2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
 - 3. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- M. SSSA: Soil Science Society of America.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for application and use.
 - 2. Include test data substantiating that products comply with requirements.
 - 3. Include sieve analyses for aggregate materials.
 - 4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
 - a. Manufacturer's qualified testing agency's certified analysis of standard products.
 - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.

- c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.
- B. Samples: For each bulk-supplied material, 1-gal. (4-L) volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For each testing agency.
- B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
- C. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
 - 1. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil.
 - 1. Notify Landscape Architect seven days in advance of the dates and times when laboratory samples will be taken.
- B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
 - 1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

- A. General: Extract soil samples according to requirements in this article.

- B. Sample Collection and Labeling: Have samples taken and labeled by state-certified, -licensed, or -registered soil scientist under the direction of the testing agency.
 - 1. Number and Location of Samples: Representative soil samples where indicated on Drawings and where directed by Landscape Architect for each soil to be used or amended for landscaping purposes.
 - 2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
 - 3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
 - 4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:
 - 1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
 - a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
 - b. Hydrometer Method: Report percentages of sand, silt, and clay.
 - 2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 - 3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 - 4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).
- C. Chemical Testing:
 - 1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
 - 2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
 - 3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
 - 4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt,

copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

- D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13, including the following:
1. Percentage of organic matter.
 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
 3. Soil reaction (acidity/alkalinity pH value).
 4. Buffered acidity or alkalinity.
 5. Nitrogen ppm.
 6. Phosphorous ppm.
 7. Potassium ppm.
 8. Manganese ppm.
 9. Manganese-availability ppm.
 10. Zinc ppm.
 11. Zinc availability ppm.
 12. Copper ppm.
 13. Sodium ppm and sodium absorption ratio.
 14. Soluble-salts ppm.
 15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
 16. Other deleterious materials, including their characteristics and content of each.
- E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
- F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
 2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.
- B. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
 1. Ratio of Loose Compost to Soil: 1:2 by volume.
 2. Ratio of Loose Wood Derivatives Soil: Weight per 1000 sq. ft. as determined by soil test.
 3. Weight of Lime: Weight per 1000 sq. ft. as determined by soil test.
 4. Weight of Sulfur Iron Sulfate: Weight per 1000 sq. ft. as determined by soil test.
 5. Weight of Agricultural Gypsum: Weight per 1000 sq. ft. as determined by soil test.
 6. Weight of Superphosphate: Weight per 1000 sq. ft. as determined by soil test.
 7. Weight of Commercial Fertilizer: Weight per 1000 sq. ft. as determined by soil test.
 8. Weight of Slow-Release Fertilizer: Weight per 1000 sq. ft. as determined by soil test.
- C. Planting-Soil Type: Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures, blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce viable planting soil.
 1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 6 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
 2. Unacceptable Properties: Manufactured soil shall not contain the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.

- c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches 2 inches in any dimension.
3. Blend manufacturer's basic soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
 - a. Ratio of Loose Compost to Soil: 1:2 by volume.
 - b. Volume of Sand: Weight per 1000 sq. ft. as determined by soil test.
 - c. Volume of Perlite: Weight per 1000 sq. ft. as determined by soil test.
 - d. Weight of Lime: Weight per 1000 sq. ft. as determined by soil test.
 - e. Weight of Sulfur Iron Sulfate: Weight per 1000 sq. ft. as determined by soil test.
 - f. Weight of Agricultural Gypsum: Weight per 1000 sq. ft. as determined by soil test.
 - g. Weight of Superphosphate: Weight per 1000 sq. ft. as determined by soil test.
 - h. Weight of Commercial Fertilizer: Weight per 1000 sq. ft. as determined by soil test.
 - i. Weight of Slow-Release Fertilizer: Weight per 1000 sq. ft. as determined by soil test.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
 2. Form: Provide lime in form of ground dolomitic limestone.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.
- F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to leaves May include animal waste.
 2. Reaction: pH of 5.5 to 8.
 3. Soluble-Salt Concentration: Less than 4 dS/m.
 4. Moisture Content: 35 to 55 percent by weight.
 5. Organic-Matter Content: 50 to 60 percent of dry weight.
 6. Particle Size: Minimum of 98 percent passing through a 1/2-inch sieve.
- B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 50 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.
- B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.
- D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches. Remove stones larger than 2 inches (50 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth of 6 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
 - a. Mix lime and sulfur with dry soil before mixing fertilizer.
 - b. Mix fertilizer with planting soil no more than seven days before planting.
 - 2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each blended lift of planting soil to 85 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place except where a different compaction value is indicated on Drawings.

- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- C. Application: Spread planting soil to total depth of 6 inches, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Lifts: Apply planting soil in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each lift of planting soil to 85 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 BLENDING PLANTING SOIL IN PLACE

- A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Mixing: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.
 - 1. Mix lime and sulfur with dry soil before mixing fertilizer.
 - 2. Mix fertilizer with planting soil no more than seven days before planting.

- D. Compaction: Compact blended planting soil to 85 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Test planting soil compaction according to ASTM D698. Space tests at no less than one for each 1000 sq. ft.
- B. Soil will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.7 PROTECTION

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Landscape Architect and replace contaminated planting soil with new planting soil.

3.8 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION 329113

SECTION 329200 - TURF AND GRASSES

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. Seeding.
 - 2. Sodding.
 - 3. Turf renovation.
- B. Related Requirements:
 - 1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
 - 1. Experience: Five years' experience in turf installation.
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 3. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
 1. Spring Planting: April 15 - June 1.
 2. Fall Planting: August 15 - October 1.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species:
 1. Quality, Seed of grass species as listed below with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
 2. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 40 percent creeping red fescue - composed of 2 variables.
 - b. 20 percent perennial ryegrass - composed of 2 variables.
 - c. 20 percent hard fescue.
 - d. 20 percent Chewing's fescue.

2.2 TURFGRASS SOD

- A. Turfgrass Sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

- B. Turfgrass Species, Cool-Season Grass: Sod of grass species as follows, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

- 1. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.

2.3 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

- 1. Composition:
 - a. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.4 MULCHES

- A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.5 HERBICIDES

- A. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- B. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from seeding and mulching operations.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."
- B. Placing Planting Soil: All planting soil and soil preparations shall be in place prior to initiating seeding or sodding operations.
 - 1. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moistened prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- B. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
 - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 5 to 8 lb/1000 sq. ft.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
- F. Alternatively, mulch newly seeded areas with fiber mulch if equipment can access newly seeded areas.

3.6 SODDING

- A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
 2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.7 TURF RENOVATION

- A. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 2. Install new planting soil as required.
- B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- C. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- D. Mow, dethatch, core aerate, and rake existing turf.
- E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.
- H. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
1. Soil Amendment(s): according to requirements of Section 329113 "Soil Preparation."
 2. Initial Fertilizer: Commercial fertilizer applied according to manufacturer's recommendations.
- I. Apply seed and protect with mulch or sod as required for new turf.
- J. Water newly planted areas and keep moist until new turf is established.

3.8 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Operate and manage newly installed irrigation systems to keep turf uniformly moist to a depth of 4 inches.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - 1. Mow Kentucky bluegrass, buffalograss, annual ryegrass, chewings red fescue to a height of 1-1/2 to 2 inches.
- D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.9 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
 - 2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.10 HERBICIDE APPLICATION

- A. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

3.12 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
 - 1. Seeded Turf: 60 days from date of Substantial Completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
 - 2. Sodded Turf: 30 days from date of Substantial Completion.

END OF SECTION 329200

SECTION 329300 - PLANTS

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. Plants.
 - 2. Fertilizers
 - 3. Mulches.
 - 4. Herbicides and pesticides.
 - 5. Tree stabilization.
 - 6. Tree-watering devices.

- B. Related Requirements:

- 1. Section 015000 "Temporary Facilities and Controls" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
 - 2. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

- E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- G. Finish Grade: Elevation of finished surface of planting soil.
- H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- J. Planting Area: Areas to be planted.
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.
- L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

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

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
3. Mycorrhizal Fungi: Submit product to be used and application rate.

- B. Samples for Verification: For each of the following:

1. Organic Compost Mulch: 1-quart (1-L) volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Mineral Mulch: 2 lb (1.0 kg) of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
3. Proprietary Root-Ball-Stabilization Device: One unit.
4. Slow-Release, Tree-Watering Device: One unit of each size required.
5. Herbicides and pesticides.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
1. Experience: 10 years' experience in landscape installation.
 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 3. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Notify Landscape Architect of sources of planting materials 30 days in advance of delivery to site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- F. Apply antidesiccant, if conditions warrant use, to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation. Damage to branches from wrapping and handling can result in rejection of the plant if such damage is determined to be excessive by the Landscape Architect.
- H. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 2. Do not remove container-grown stock from containers before time of planting.
 3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.
- 1.10 FIELD CONDITIONS
- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 15 – June 1.
2. Fall Planting: September 1 – October 15.

- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization.
 2. Warranty Periods: From date of Substantial Completion.
 - a. Trees and Shrubs; 24 months.
 - b. Ground Covers, Vines, Ornamental Grasses, Biennials, Perennials, and Other Plants; 12 months.
 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 10 percent dead or in an unhealthy condition at end of warranty period.
 - c. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk

- ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting. If root flare is more than 2 inches below the top of the root ball, the tree or shrub can be rejected for this reason alone.
- D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
- E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

- A. Amend soil into which trees, shrubs, grasses, and perennials are planted per Soil Preparation Plans and associated details.
- B. Planting Tablets: Planting Tablets shall be used in addition to soil amendments and shall be tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Size: 10-gram tablets.
 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
- C. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5,300 spores per lb. of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb. of ectomycorrhizal fungi, 33% hydrogel, and maximum of 5% inert material.

2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
1. Type: Double - Shredded bark.
 2. Size Range: 2 inches maximum, 1/2 inch minimum.

3. Color: Natural.

- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:
 - 1. Type: Rounded riverbed gravel or smooth-faced stone as acceptable to Landscape Architect.
 - 2. Size Range: 1-1/2 inches (38 mm) maximum, 3/4 inch (19 mm) minimum.
 - 3. Color: Uniform tan-beige color range acceptable to Landscape Architect.

2.4 HERBICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:
 - 1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
 - 2. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
 - 3. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.
 - 4. Proprietary Staking-and-Guying Devices: Proprietary stake or anchor and adjustable tie systems to secure each new planting by plant stem; sized as indicated and according to manufacturer's written recommendations.

2.6 TREE-WATERING DEVICES

- A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

2.7 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Burlap: Non-synthetic, biodegradable.
- C. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb (0.45 kg) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb (0.45 kg) of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
 - 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Phillips Environmental Consulting Services, Inc. and the Landscape Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation" and according to Soil Preparation Plans.
- B. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- C. Application of Mycorrhizal Fungi: Broadcast dry product uniformly over prepared soil at application rate according to manufacturer's written recommendations.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
 - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 2. Excavate approximately three times as wide as ball diameter for balled and burlapped, balled and potted, container-grown and fabric bag-grown stock.
 - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 - 5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 - 6. Maintain supervision of excavations during working hours.
 - 7. Keep excavations covered or otherwise protected overnight and after working hours.
 - 8. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.

- C. Obstructions: Notify Landscape Architect if unexpected rock, demolition debris, pipes, or other obstructions detrimental to trees or shrubs are encountered in excavations.
- D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements. If it does not, tree or shrub will be rejected.
- B. Roots: Remove stem girdling roots and kinked roots as directed by the Landscape Architect. Girdling roots, if judged to be too excessive by the Landscape Architect, shall result in rejection of the tree or shrub. Remove injured roots by cutting cleanly; do not break.
- C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 - 1. Backfill: Planting soil. For trees, use excavated soil for backfill.
 - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 - a. Quantity: Three for each caliper inch of plant; minimum of three for each shrub.
 - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 - 1. Backfill: Planting soil. For trees, use excavated soil for backfill.
 - 2. Carefully remove root ball from container without damaging root ball or plant.

3. Thoroughly loosen circling roots or root-bound plants. Extremely root-bound plants will be rejected by the Landscape Architect if the root mass cannot be spread within the planting excavation.
 4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 - a. Quantity: Three for each caliper inch of plant; minimum of three for each shrub.
 6. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 MECHANIZED TREE-SPADE PLANTING

- A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.
- B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.
- C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.
- D. Cut exposed roots cleanly during transplanting operations.
- E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.
- F. Where possible, orient the tree in the same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches after inspection by Landscape Architect. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.

- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
 - 1. Upright Staking and Tying: Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
 - 2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree; or
 - 3. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 - 4. Proprietary Staking and Guying Device: If used, install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.
- B. Root-Ball Stabilization: If used, install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.
 - 1. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.9 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.
- H. Set plants firmly in soil so that soil does not settle after watering and expose root ball.

3.10 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Treelike Shrubs in Turf Areas: Apply organic mineral mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
 - 2. Mineral Mulch in Planting Areas: Apply 2-inch average thickness of mineral mulch extending over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.11 INSTALLING SLOW-RELEASE WATERING DEVICE

- A. Provide two devices for each tree.
- B. Place devices on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.12 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.13 HERBICIDE APPLICATION

- A. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.14 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Landscape Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.
- B. Remove and replace trees that are more than 10 percent dead or in an unhealthy condition, or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern.
 - 1. Provide new trees of same size as those being replaced for each tree of 6 inches or smaller in caliper size.
 - 2. Species of Replacement Trees: Species selected by Landscape Architect.

3.15 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.16 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Coordinate with Dow Gardens horticulturists. Begin maintenance immediately after plants are installed and continue until plantings are

acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 12 months from date of Substantial Completion.
- B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
1. Maintenance Period: 12 months from date of Substantial Completion.

END OF SECTION 329300