DOCUMENT 009113 – ADDENDUM No. 2

1.1 PROJECT INFORMATION

A. Project Name: Showers West Renovation

B. Project Location: 320 W 8th Street, Bloomington, Indiana 47404.

C. Owner: City of Bloomington.

D. Architect: StudioAXIS.

E. Architect Project Number: 2023-016.

F. Date of Addendum: November 22, 2023.

1.2 NOTICE TO BIDDERS

A. This Addendum is issued to all registered plan holders pursuant to the Instructions to Bidders and Conditions of the Contract. This Addendum serves to clarify, revise, and supersede information in the Project Manual, Drawings, and previously issued Addenda. Portions of the Addendum affecting the Contract Documents will be incorporated into the Contract by enumeration of the Addendum in the Owner/Contractor Agreement.

B. The Bidder shall acknowledge receipt of this Addendum in the appropriate space on the Bid Form.

C. The date for receipt of bids is unchanged by this Addendum at the same time and location.

1.3 ATTACHMENTS

A. This Addendum includes the following attached Documents:
   1. Showers West Renovation Addendum No. 2 – MEP Attachment

B. This Addendum includes the following attached Specifications Sections:
   1. Section 00 01 10 dated 11/06/2023 (reissued).
   2. Section 08 11 13 dated 11/06/2023 (reissued).
   3. Section 08 71 00 dated 11/22/2023 (new).
   4. Section 10 21 13.17 dated 11/22/2023 (new).
   5. Section 22 11 23.13 dated 11/22/2023 (new).
   6. Section 23 09 23 dated 11/06/2023 (reissued).
   7. Section 23 72 23.13 dated 11/06/2023 (reissued).
   8. Section 23 81 46.13 dated 11/06/2023 (reissued).
   9. Section 28 15 00 dated 11/22/2023 (new).

C. This Addendum includes the following attached Sheets:
   1. General Sheet G-001 dated 11/06/2023 (reissued).
   2. Architectural Sheet A-002 dated 11/06/2023 (reissued).

Showers West Renovation
ADDENDUM #2
Wednesday, November 22, 2023

TO ALL BIDDERS:

This Addendum is issued in accordance with the provisions of Contract Documents and becomes a part of the Contract Documents as provided therein. The information contained herein modifies the original Bidding Documents dated November 6, 2023, and all prior Addenda as applicable. Requirements of the original Bidding Documents and previous Addenda remain in effect except as modified by this Addendum. Acknowledge receipt of this Addendum on all bids.

PART 1- GENERAL ITEMS

New and revised specifications, new and revised plan sheets, updated pre-bid RFI log.

PART 2- BID PACKAGE CLARIFICATIONS

Summary of work

– Prime contractors are responsible for saw cutting, trenching, excavation, backfilling and patching for work within their scope of work and bid package.

– Bid package 01 – is responsible for coordinating and installing any required equipment pads required for the project including equipment pads for the emergency generators.

– Bid package 01 – Add section 08 71 00 & 10 21 13.17 to scope of work.

– Bid package 03 – Add section 22 11 23.13 to scope of work.

– Bid package 04 – Add section 28 15 00 to scope of work.

PART 3- REQUESTS FOR INFORMATION

A. Responses to questions received to date are included on 00 91 13.

PART 4- ATTACHMENTS

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Section 08 11 13 dated 11/06/2023 (reissued). 3.
Section 08 71 00 dated 11/22/2023 (new).
4. Section 10 21 13.17 dated 11/22/2023 (new).
5. Section 22 11 23.13 dated 11/22/2023 (new).
6. Section 23 09 23 dated 11/06/2023 (reissued).
7. Section 23 72 23.13 dated 11/06/2023 (reissued).
8. Section 23 81 46.13 dated 11/06/2023 (reissued).
9. Section 28 15 00 dated 11/22/2023 (new).

C. This Addendum includes the following attached Sheets:
1. General Sheet G-001 dated 11/06/2023 (reissued).
2. Architectural Sheet A-002 dated 11/06/2023 (reissued).
3. Architectural Sheet AD101B dated 11/06/2023 (reissued).
4. Architectural Sheet AD102B dated 11/06/2023 (reissued).
5. Architectural Sheet AD401A dated 11/06/2023 (reissued).
6. Architectural Sheet AD401B dated 11/06/2023 (reissued).
7. Architectural Sheet A-101A dated 11/06/2023 (reissued).
8. Architectural Sheet A-102B dated 11/06/2023 (reissued).
9. Architectural Sheet A-102A dated 11/06/2023 (reissued).
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13. Architectural Sheet A-112 dated 11/22/2023 (new).
14. Architectural Sheet A-130 dated 11/06/2023 (reissued).
15. Architectural Sheet A-401A dated 11/06/2023 (reissued).
16. Architectural Sheet A-401B dated 11/06/2023 (reissued).
17. Architectural Sheet A-401C dated 11/22/2023 (new).
18. Architectural Sheet A-401D dated 11/22/2023 (new).
19. Architectural Sheet A-402A dated 11/06/2023 (reissued).
20. Architectural Sheet A-402B dated 11/06/2023 (reissued).
21. Architectural Sheet A-402C dated 11/22/2023 (new).
22. Architectural Sheet A-402D dated 11/22/2023 (new).
23. Architectural Sheet A-420 dated 11/06/2023 (reissued).
24. Architectural Sheet A-421 dated 11/06/2023 (reissued).
25. Architectural Sheet A-501 dated 11/06/2023 (reissued).
26. Architectural Sheet A-505 dated 11/06/2023 (reissued).
27. Architectural Sheet A-601 dated 11/06/2023 (reissued).
28. Architectural Sheet A-602 dated 11/06/2023 (reissued).
29. Architectural Sheet A-603 dated 11/06/2023 (reissued).
30. Architectural Sheet A-604 dated 11/06/2023 (reissued).
31. Architectural Sheet A-607 dated 11/22/2023 (new).
32. Architectural Sheet A-610 dated 11/22/2023 (new).
33. Architectural Sheet A-700A dated 11/06/2023 (reissued).
34. Architectural Sheet A-700B dated 11/06/2023 (reissued).
35. Architectural Sheet A-701A dated 11/06/2023 (reissued).
36. Architectural Sheet A-701B dated 11/06/2023 (reissued).
37. Architectural Sheet A-702A dated 11/06/2023 (reissued).
38. Architectural Sheet A-702B dated 11/06/2023 (reissued).
39. Architectural Sheet A-710 dated 11/06/2023 (reissued).
40. Architectural Sheet A-711 dated 11/06/2023 (reissued).

41. Architectural Sheet A-801A dated 11/06/2023 (reissued).
42. Mechanical Sheet M-201A dated 11/06/2023 (reissued).
43. Mechanical Sheet M-201B dated 11/06/2023 (reissued).
44. Mechanical Sheet M-202A dated 11/06/2023 (reissued).
45. Mechanical Sheet M-202B dated 11/06/2023 (reissued).
46. Mechanical Sheet M-301A dated 11/06/2023 (reissued).
47. Mechanical Sheet M-301B dated 11/06/2023 (reissued).
48. Mechanical Sheet M-302A dated 11/06/2023 (reissued).
49. Mechanical Sheet M-302B dated 11/06/2023 (reissued).
50. Mechanical Sheet M-402 dated 11/06/2023 (reissued).
51. Mechanical Sheet M-601 dated 11/06/2023 (reissued).
52. Mechanical Sheet M-602 dated 11/06/2023 (reissued).
53. Mechanical Sheet M-901 dated 11/06/2023 (reissued).
54. Mechanical Sheet M-902 dated 11/06/2023 (reissued).
55. Plumbing Sheet P-000 dated 11/06/2023 (reissued).
56. Plumbing Sheet PD100A dated 11/06/2023 (reissued).
57. Plumbing Sheet P-100A dated 11/06/2023 (reissued).
58. Plumbing Sheet P-100B dated 11/06/2023 (reissued).
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60. Plumbing Sheet P-101B dated 11/06/2023 (reissued).
61. Plumbing Sheet P-102B dated 11/06/2023 (reissued).
62. Plumbing Sheet P-401 dated 11/06/2023 (reissued).
63. Plumbing Sheet P-501 dated 11/06/2023 (reissued).
64. Plumbing Sheet P-601 dated 11/06/2023 (reissued).
65. Electrical Sheet EL-101A dated 11/06/2023 (reissued).
66. Electrical Sheet EL-101B dated 11/06/2023 (reissued).
67. Electrical Sheet EL-102A dated 11/06/2023 (reissued).
68. Electrical Sheet EL-102B dated 11/06/2023 (reissued).
69. Electrical Sheet EP-101A dated 11/06/2023 (reissued).
70. Electrical Sheet EP-101B dated 11/06/2023 (reissued).
71. Electrical Sheet EP-102A dated 11/06/2023 (reissued).
72. Electrical Sheet EP-102B dated 11/06/2023 (reissued).
73. Electrical Sheet E-402 dated 11/06/2023 (reissued).
74. Electrical Sheet E-601 dated 11/06/2023 (reissued).
75. Technology Sheet T-000 dated 11/06/2023 (reissued).
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84. Technology Sheet T-501 dated 11/06/2023 (reissued).
85. Technology Sheet T-502 dated 11/06/2023 (reissued).
86.

END OF ADDENDUM #2

Addenda Revisions

1. Summary of work – Bid Package 01 General Trades is responsible for all demolition except for utility demolition underneath the slab on grade. All sub grade or below slab demolition is the responsibility of the bid package where the scope of work is assigned (example BP-03 is responsible for sanitary sewer lines). Additionally, Bid Package2, Bid Package 3 and Bid Package 4 must make systems safe and ready for demolition.

2. Revised Bid Form to include option for single bid of all packages and added alternates 5 and 6.

3. Revised specification Section 01 23 00 to add alternates 5 and 6.

4. BP-01 - to add Section 10 21 13.17 will be added in Addendum No. 2 for phenolic-core toilet compartments.

BID FORM (Page 1 of 3)

Submitting Contractor Name: _____

This BID Summary Sheet shall be completed and submitted with all other BID Documents.

Bid Package # _____

The Lump Sum Base BID amount to complete the 2023 Redevelopment Commission Project including all associated work per plans and specifications is:

1. _____, _____

***Optional combination Bid* – Bid Packages _____ & _____**

The Lump Sum Base BID amount to complete the 2023 Redevelopment Commission Project all associated work per plans and specifications is for combination bid packages:

2. _____, _____

The Lump Sum Base BID amount to complete the 2023 Redevelopment Commission Project all associated work per plans and specifications is for single bid for all packages:

***Optional Combination Bid* for <u>all</u> packages as a single Prime**

3. _____, _____

The contractor will (check one): invoice a single lump sum at the conclusion of the project.
submit invoices based on project progress.

Proposed start date for this project is_____(date) and total of calendar days for completion of base bid. is_____.
(Of days)

For projects requiring submission of a Trench Safety Systems Affidavit, the portion of the Lump Sum cost provided above which is attributable to trench safety systems is: $_____.

BID FORM (Page 2 of 3)

Alternate 1: Generator (Deduct): $ _____

Alternate 2: Council Chamber (Add) $ _____

Alternate 3: IT Room (Add) $ _____

Alternate 4: Restroom (Deduct) $ _____

Alternate 5: Concealed Sprinkler Heads $ _____

Alternate 6: phenolic-foam ducts and fittings $ _____

BID FORM (page 3 of 3)

The project in its entirety shall be completed as specified in the Agreement by February 1, 2025.

Any and all Subcontractors performing work valued over 10,000 shall be listed below. Any Subcontractor not listed below at the time of the bid must be approved by the City of Bloomington prior to performing any work on this contract. Subcontractors not listed or approved will not be paid for work under this contract. In accordance with Indiana Code 5-16-13 *et seq.,* incorporated herein by reference, any Subcontractor performing work on this contract is a Tier 2 contractor.

SUBCONTRACTORS	ADDRESS	TYPE OF WORK

In submitting this Bid, Bidder represents that:

A. Bidder has visited the Site and become familiar with and is satisfied as to the general, local,and State conditions that may affect cost, progress, performance, and furnishing of the Work.

B. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged.

No._____ Dated_____
No._____ Dated_____
No._____ Dated_____
No._____ Dated _____

SIGNATURE OF BIDDER

Name of Bidder:_____ Date:_

By: _____

Name Title Printed: _____

Bidder Address:

Telephone:_____

SECTION 01 2300
ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

B. Procedures for pricing Alternates.

1.02 ACCEPTANCE OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

1.03 SCHEDULE OF ALTERNATES

Alternate 1 (BP-04): Provide a deduct alternate value to exclude the three (3) 500kw generator units from BP-04 scope of work. All other components associated with the system shall be included in the base bid. Base bid to provide a fully equipped emergency backup generation system is detailed in the contract documents allowing generators to be set and connected to the facility.

Alternate 2 - Added cost to complete All work associated with the City Council office addition in rooms (C117 and C118)

Alternate 3 – Added cost to complete full scope of work associated with the Additional IT room expansion and cut through at office space C116.

Alternate 4 – Deduct eliminate the scope of work associated with second-floor restrooms in the police captain's rooms (P225 and P227.

Alternate 5: - Sprinkler heads

1. Base bid: Semi-recessed sprinkler heads in finished spaces with lay-in or hard ceilings per P-000.
2. Alternate: Provide concealed sprinkler heads with painted cover plates for all finished spaces with lay-in or hard ceilings in lieu of semi-recessed sprinkler heads.

Alternate 6: Metal Ducts

1. Base bid: Sheet metal ductwork and insulation per specification sections 233113 and 230713.
2. Alternate: Utilize phenolic-foam ducts and fittings per specification section 233116 in lieu of externally insulated or lined sheet metal throughout the project with the exception of the supply & return ductwork associated with HP-225 (2 story lobby). Phenolic-foam duct systems shall meet or exceed pressure class, seal class, and leakage as defined per 233113 and R-value ratings per 230713. The system shall contain all ductwork accessories and components per construction documents.

PART 3 EXECUTION - NOT USED

END OF SECTION 01 2300

3. Architectural Sheet AD101B dated 11/06/2023 (reissued).
4. Architectural Sheet AD102B dated 11/06/2023 (reissued).
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84. Technology Sheet T-501 dated 11/06/2023 (reissued).
85. Technology Sheet T-502 dated 11/06/2023 (reissued).

1.4 BIDDING RFI RESPONSES

A. Question 1: Section 08 71 00 is missing from spec book.
   1. Answer 1: Section 08 71 00 will be added to Addendum No. 2.

B. Question 2: To what extent do the exterior perimeter windows paint, only the interior surface or both the interior and exterior? Also, do windows stay the same color as existing?
   1. Answer 2: Only the interior surface of the windows will be painted. Refer to the General Finish Notes on the A-700 series for the paint colors.

C. Question 3: Want to verify: Does BP-01 remove all demolition items? If so, does this include all HVAC, plumbing, electrical, and sprinkler piping after it is made safe?

1. Answer 3: Summary of work – Bid Package 01 General Trades is responsible for all demolition except for utility demolition underneath the slab on grade. All sub grade or below slab demolition is the responsibility of the bid package where the scope of work is assigned (example BP-03 is responsible for sanitary sewer lines). Additionally, Bid Package 2, Bid Package 3 and Bid Package 4 must make systems safe and ready for demolition.

D. Question 4: Do all new interior CMU walls get thickened slab per 5/S300? If so, can dowels that are shown be turned up into block and drilled and epoxy in place after thickened slab is poured?
   1. Answer 4: The new CMU walls are to receive a thickened slab. The bars in the wall can be post installed if desired. The bar size and spacing shall match what is called out in the wall details, and they shall be drilled and epoxied into the slab with a 4" embed.

E. Question 5: There are no specs for the toilet partitions; but plan notes call out for Bradley Powder Coat steel partitions. Bradley no longer offers steel partitions. What do you want me to do?
   1. Question 5: Section 10 21 13.17 will be added in Addendum No. 2 for phenolic-core toilet compartments.

END OF DOCUMENT 009113

Addendum #: 2

KBSO Project #: 23037
Project Name: Showers West Renovation
Issue Date: 11/22/2023

This Addendum number 2 to the drawings and specifications shall supplement, amend, and become a part of the bidding documents, plans, and specifications. All bids and construction contracts shall be based on these modifications to the original contract documents.

CHANGES TO THE SPECIFICATIONS

1. SECTION 221123.13 – DOMESTIC WATER BOOSTER PUMPS
    a. Added section in its entirety.
2. SECTION 230923 – DIRECT DIGITAL CONTROL (DDC) SYSTEMS FOR HVAC
    a. 2.20.H.1.a: Added verbiage to Differential Pressure Transmitter to be diaphragm type.
    b. 2.20.I: Removed airflow measuring stations.
    c. 2.20.J: Removed thermal dispersion airflow measurement.
    d. 2.20.K: Modified verbiage for DDC control components for heat pumps.
3. SECTION 237223.13 – PACKAGED INDOOR HEAT WHEEL ENERGY RECOVERY UNITS
    a. 1.3.D.3: Removed seismic reference.
    b. 2.1.F: Removed seismic reference.
    c. 2.1.G: Removed seismic performance.
    d. 2.2.H.3: Added heat exchanger requirements.
    e. 2.2.K: Added refrigerant circuit components.
4. SECTION 238146.13 – WATER-TO-AIR HEAT PUMPS
    a. 2.1.G.5: Added verbiage regarding variable speed scroll compressors.
    b. 2.1.L: Remove factory installed smoke detector.

CHANGES TO THE DRAWINGS

1. P000:
    a. Added verbiage for Alternate ALT-5.
2. PD100A:
    a. Added disconnection call out to sanitary.
3. P-100A:
    a. Added piping for new floor drains.
4. P-100B:
    a. Added piping for new floor drain.
5. P-101A:
    a. Modify routing of HWR system at Evidence Transfer.
    b. Water mains shifted to coordinate with other MEP in corridors.
    c. Access panels were added in Janitor Room and Wellness Room.

d. Vent routing shifted at EWC-1.
e. Added keynote for CDB-1 in Physical Therapy.
f. Added floor drain to Bike Storage Room.

6. P-101B:
    a. Routing of HW system changed at Men's Lockers restroom.
    b. Vent routing changed in Women's Locker restroom.
    c. Modify routing of CW main near Social Worker offices.
    d. Correct size and routing of CW to 2nd floor near Council Antechamber.
    e. Water main shifted to coordinate with other MEP in Fire Department.
    f. Water mains shifted to coordinate with other MEP in Police Station.
    g. Added notation for Alternate ALT-4.
7. P-102B:
    a. Revised Sheet Keynote for clarity on Alternate ALT-4.
8. P-401:
    a. Added domestic booster pump (DBP-1) and revised piping to accommodate.
    b. Added floor drain at booster pump.
9. P-501:
    a. Removed pressure reducing station from Water Entrance Piping Diagrams.
10. P-601:
    a. Updated Plumbing Equipment Schedule to include DBP-1.
11. MD102A:
    a. Defined ductwork demolition scope for 2nd floor MDF room.
12. M-201A:
    a. Added general note for exposed diffuser height.
    b. Modified CFM's to diffusers, registers, & grilles to match heat pump schedule.
    c. Supply ductwork was extended on heat pumps in shell spaces and diffusers and grilles were added for airflow distribution.
    d. Moved HP-128 and added smoke dampers.
    e. Showed duct detector for HP-108.
13. M-201B:
    a. Added general note for exposed diffuser height.
    b. Modified CFM's to diffusers, registers, & grilles to match heat pump schedule.
14. M-202A:
    a. Added general note for exposed diffuser height.
    b. Modified CFM's to diffusers, registers, & grilles to match heat pump schedule.
    c. Supply ductwork was extended on heat pumps in shell spaces and diffusers and grilles were added for airflow distribution.
    d. Added air to Corridor C205.
    e. Showed duct detector for HP-216.
15. M-202B:
    a. Added general note for exposed diffuser height.
    b. Modified CFM's to diffusers, registers, & grilles to match heat pump schedule.
    c. Supply ductwork was extended on heat pumps in shell spaces and diffusers and grilles were added for airflow distribution.
    d. Added air to Corridor P201.
16. M-301A:
    a. Modified some pipe sizing to heat pumps.
17. M-301B:
    a. Modified some pipe sizing to heat pumps.
18. M-302A:

a. Modified some pipe sizing to heat pumps.
b. Added CD piping for HP-241.

19. M-302B:
    a. Modified some pipe sizing to heat pumps.
    b. Showed location of differential pressure transmitter.
20. M-402:
    a. Showed duct detector for DOAS-1.
    b. Added air outlets on HP-129.
21. M-601:
    a. GRAVITY HOOD SCHEDULE
        i. Added note about factory mounted gravity backdraft damper, this was already specified.
    b. WATER SOURCE HEAT PUMP SCHEDULE – DOAS
        i. Modified notes.
        ii. Modified cooling data, heating data, hydronic data, electrical data, weight, and model numbers.
    c. PACKAGED DOAS UNIT SCHEDULE
        i. Modified notes regarding segments and installation.
22. M-602:
    a. WATER SOURCE HEAT PUMP SCHEDULE
        i. Modified notes.
        ii. Modified CFM's, cooling data, heating data, hydronic data, electrical data, weight, and model numbers.
        iii. Added HP-241.
    b. DIFFUSERS & GRILLES SCHEDULE
        i. Updated connection sizes for SG1, SG4, and SG5.
        ii. Added SG6 an SG7.
23. M-901:
    a. WATER SOURCE HEAT PUMP CONTROL SCHEMATIC
        i. Added BAS zone level humidity sensor for monitoring purposes.
        ii. Added current switch for DOAS-2 thru 8.
        iii. Added note about smoke dampers.
        iv. Modified sequence.
    b. DOAS-1 CONTROL SCHEMATIC
        i. Added current switch for DOAS-1.
        ii. Modified disconnect to be by EC.
        iii. Modified sequence.
24. M-902:
    a. Showed air separator as new.
    b. Called out differential pressure point and added to DDC POINT SCHEDULE.
    c. Existing CTP-1/CTP-2 do not have VFD's, removed VFD's and associated points from DDC POINT SCHEDULE.
    d. Modified note13 for 3-way valve note.
25. EL-101A:
    a. Weatherproof switches were added in showers located in C114 and C115.
    b. Lighting and lighting control placement revised in C116 to align with architectural changes.
    c. Lighting and lighting control revised in MEP room C111 to align with room use.
    d. Lighting control revised to include dimmers in Computer Forensics P147.
    e. Lighting in P161B revised to algin with architectural changes.

f. Keynote 8 and corresponding call out removed from drawing referencing Alternate 3.
g. Keynote 9 added to indicate all exit signs to be circuited to local life safety circuit.

26. EL-101B:
    a. Lighting layout revised in P102 to align with architectural changes.
    b. Occupancy sensor added to P104 Records / Storage.
    c. Lighting control placement revised in P115 Social Worker and P121 Shift Sergeant to align with door placement.
    d. Snap switch revised to dimmer in P119 Report Writing.
    e. Weatherproof switches to control shower lighting added to P159 and P161.
    f. Lighting and lighting control in Corridor F101 revised to align with architectural changes as indicated per drawing.
    g. Dimming added to Circulation F111.
    h. Lighting in Storage F117 and F110 revised as indicated per drawing.
    i. Keynote 10 removed from drawing and corresponding reference to alternate.
    j. Keynote 11 added to indicate all exit signs to be circuited to local life safety circuit.
27. EL-102A:
    a. Keynote 6 added to C204 Stairwell as indicated per drawing.
    b. Exit signs added in C205 Corridor as indicated per drawing.
    c. Lighting revised in C208 MDF as indicated per drawing.
    d. Dimmer removed from P102A Corridor and relocated to Training Room P204.
    e. Light fixtures in P201 corridor shifted to avoid conflict with other disciplines.
    f. Lighting layout revised in P256 Interview to avoid conflict with column.
    g. Keynote 7 added to indicate all exit signs to be circuited to local life safety circuit.
28. EL-102B:
    a. Exit sign added to P201 corridor as indicated per drawing.
    b. Lighting in corridor P201, F202, F203, and F218 shifted to avoid conflicts with other disciplines.
    c. Exit signs added to P210G Corridor as indicated per drawing.
    d. Lighting control added to P206 Corridor as indicated per drawing.
    e. Light fixture placement revised to align with grid in P218 Executive Assistant.
    f. Dimmer added to Breakroom P229 and lighting layout revised.
    g. Lighting control placement revised in P233 Lieutenant.
    h. Lighting control revised in F208 to align with area use.
    i. Switch legs added to lighting control in Assistant Chiefs F206.
    j. Keynote 4 added to type L14 in lobby to address mounting height.
    k. Lighting revised from 2x4 to 2x2 fixture to better suit room configuration and grid layout in rooms 219, 222, 224, 226, and 233.
    l. Lighting revised from 2x2 to 2x4 in Conference P233 to avoid conflicts.
    m. Keynote 11 added to indicate all exit signs to be circuited to local life safety circuit.
29. EP-101A:
    a. Updated circuits and power requirements for heat pumps.
30. EP-101B:
    a. Updated circuits and power requirements for heat pumps.
31. EP-102A:
    a. Updated circuits and power requirements for heat pumps.
    b. Added power for TV’s in Training Room P204 and Detective Conference/RTCC P230.

32. EP-102B:
    a. Updated circuits and power requirements for heat pumps.
33. E-402:
    a. HP-128 moved.
    b. Moved access control panel power.
34. E-601:
    a. Fixture type L15 added to luminaire schedule.
    b. Wattage and lumen package updated for types L11 and L11X.
    c. Additional manufacturers added the following fixture types.
        i. L3
        ii. L3X
        iii. L4
        iv. L4E
        v. L5
        vi. L6
        vii. L14
        viii. W3
        ix. X1
        x. X2
35. T-000:
    a. Added Proximity reader with keypad to security symbols legend.
36. T-101A:
    a. P134, P135, P136, P137, P138, P139, P140 – Removed panic buttons from interview rooms.
    b. C116 – Moved data outlets to +44”.
    c. P147 – Added 2D on the west wall and added keynote 7 to existing 4D to be secure data drops run back to MDF-PD.
    d. P148 – Relocated data outlets from casework to newly added wall on desk.
    e. P153 – Relocated data outlet to new desk location.
    f. P128 – Moved data outlets to +44”.
    g. P123 – Moved data outlets from North wall to East and West walls to coordinate with new furniture layout.
    h. P131 – Modified 1D to 3D and added keynote to account for ceiling microphone. Added axon control panel in corridor. Added data outlet for the Axon Panel. Added keynote 6.
    i. Revised keynote number 2.
37. T-101B:
    a. C117 – Removed data outlets from this area.
    b. F111 – Added data outlets for future desk locations.
    c. P108 – Removed panic button.
    d. P103 – Removed panic button.
    e. Revised keynote number 5.
38. T-102A:
    a. C208 – Added labels to conduit sleeves between floors.
    b. P204 – Removed projectors, added two (2) monitors at front of room at +84”. Added label to conduit.
    c. Corridor P253 – Added labels to conduits.
    d. P256 – Removed panic button. Moved Axon Control Panel closer to door in corridor outside room.
    e. P258 – Added label to conduit.
    f. P259 – Removed cable tray in training room storage.

g. P230 – Added VO rough-ins at +65” for future monitors.
h. P248 – Removed conduit sleeve.
i. P249 – Removed conduit sleeve.
j. P250 – Removed conduit sleeve.
k. P251 – Removed conduit sleeve.
l. P252 – Removed conduit sleeve.
m. P254 – Removed conduit sleeve. Added label to conduit.
n. P245 – Removed conduit sleeve.
o. Offices – P235, P236 P237, P238, P239, P240, P241, P242, P243, P244, P245, P246, P247 – Changed 2Ds to 3Ds to account for secure data outlet in each office. Added keynote on where to run cables back to and specific termination color.
p. Added keynote 8 to sheet keynotes.
q. Revised keynote number 2.

39. T-102B:
    a. P203 – Added label to conduit.
    b. P223 – Relocated VO outlet.
    c. F205 – Moved data outlets to coordinate with new furniture layout.
    d. F206 – Added data outlets at +65”.
    e. F203 – Moved data outlets to coordinate with new furniture layout.
    f. P219, P222, P224, P226, P228, P233, P234 – Changed 2Ds to 3Ds to account for secure data outlet in each office. Added keynote on which tech room to run cables back to and specific termination color.
    g. Added keynote 6 to sheet keynotes.
40. T-201:
    a. P163 – Added label to conduit.
    b. F118 – Added label to cable tray.
41. T-202:
    a. Removed conduit sleeves.
42. T-401:
    a. Detail 3 – Added new 24 port patch panel and updated callout for owner provided switch space.
    b. Detail 6 – Renamed elevation and removed plywood backboard.
    c. Detail 7 – Renamed elevation.
43. T-402:
    a. Detail 1 – Added callout for Access Control panel locations.
    b. Detail 2 – Modified ladder tray width to 18”.
44. T-501:
    a. Detail 5 – Added composite cabling and and updated rough-in and conduit requirements.
    b. Detail 6 – Added composite cabling and and updated rough-in and conduit requirements.
45. T-502:
    a. Detail 2 – Updated to MDF-PD.

ATTACHMENTS:
Specifications:
221123.13, 230923, 237223.13, 238143.13

Drawings:
P000, PD100A, P-100A, P-100B, P-101A, P1-01B, P-102B, P-401, P-501, P-601

MD102A, M-201A, M-201B, M-202A, M-202B, M-301A, M-301B, M-302A, M-302B, M-402, M-601, M-602, M-901, M-902

EL-101A, EL-101B, EL-102A, EL-102B, EP-101A, EP-101B, EP-102A, EP-102B, E-402, E-601

T-000, T-101A, T-101B, T-102A, T-102B, T-201, T-202, T-401, T-402, T-501, T-502

END OF ADDENDUM

SECTION 00 01 10 – TABLE OF CONTENTS

END OF SECTION 00 01 10

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

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. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section “Flush Wood Doors”.
4. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
5. Division 08 Section "Door Hardware".
6. Division 08 Section "Access Control Hardware".
7. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
8. Division 26 "Electrical" Sections for electrical connections including conduit and wiring for door controls and operators installed on frames with factory installed electrical knock out boxes.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
11. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Doors Under Specified Pressure Differences Across the Specimens.
12. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
13. ASTM E 413 - Classification for Rating Sound Insulation.
14. ASTM E1332 - Standard Classification for Determination of Outdoor-Indoor Transmission Class.
15. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
16. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
17. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
18. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
19. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
20. NFRC 102 – Procedure for Measuring the Steady State Thermal Transmittance of Fenestration Systems.
21. NFRC 400 – Procedure for Determining Fenestration Product Air Leakage.
22. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
23. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Informational Submittals:

1. LEED Requirements:

   a. Product Data for Credit MRc2: For products having a product-specific Type III Environmental Product Declaration (EPD), provide documentation of the EPD. Include statement indicating costs for each product having an EPD.

   b. Product Data for Credit MRc4: For products having a Health Product Declaration (HPD), provide documentation of the HPD. Include statement indicating costs for each product having an HPD.

   c. Product Data for Credit EAp2 and EAc2: Contractor required to meet or exceed thermal resistance U-factor of 0.29 (ASTM 1363) and R-factor of 3.4 (ASTM 1363).

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

    a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Energy Efficient Exterior Openings: Comply with minimum thermal ratings, based on ASTM C1363. Openings to be fabricated and tested as fully operable, thermal insulating door and frame assemblies.

1. Thermal Performance (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM C1363 and meet or exceed the following requirements:

    a. Door Assembly Operable U-Factor and R-Value Ratings: U-Factor 0.37, R-Value 2.7, including insulated door, thermal-break frame and threshold.

2. Air Infiltration (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM E283 to meet or exceed the following requirements:

    a. Rate of leakage of the door assembly shall not exceed 0.25 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).

F. Storm Shelter Openings: Provide complete door systems for hurricane or tornado storm shelters, and other areas of refuge, complying and tested according to ICC 500 (2014/2020), ICC/NSSA Standard for the Design and Construction of Storm Shelters.

1. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Sound Transmission Class (STC) Rated Doors: Provide sound transmission class rated doors fabricated as sound-reducing types with testing according to ASTM E 90, and classifications according to ASTM E 413. Submit manufacturer's written results of STC ratings from testing performed by a qualified independent testing agency for sound resistant doors.

H. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

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

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).
3. Steelcraft (S).

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 38 percent.

D. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.

1. Design: Flush panel.
2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 “Laminated Core”.

a. Provide 22-gauge steel stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
b. Thermal properties to rate at a fully operable minimum U-Factor 0.37 and R-Value 2.7, including insulated door, thermal-break frame and threshold.
c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.38 and R-Value 2.6, including insulated door, kerf type frame, and threshold.

3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053 inch - 1.3-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.

a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. Curries Company (CU) - Polystyrene Core - 707 Series.
2. Curries Company (CU) - Energy Efficient - 777 Trio-E Series.

2.4 SPECIAL FUNCTION HOLLOW METAL DOORS

A. Sound Resistant Doors: Subject to the same compliance standards and requirements as standard hollow metal doors, provide manufacturer's standard sound resistant acoustic core tested in accordance with ASTM E90, ASTM 413, and ASTM E1332 standards. Fabricate with minimum 16 gauge construction, 1-3/4" thickness, combined with standard flush frames designed for mid-range and high range sound attenuation from STC 39 through STC 52 applications. Furnish complete with perimeter sound seals, bottom seals, and threshold as required for specified STC rating.

1. Provide sound resistant doors with minimum STC sound rating (32, 38, 41, 43, 46, 50, 52, 54) as indicated on the door schedule:

2. Each unit to bear a physical label applied to door certifying the product construction and identifying the specific STC rating.

3. Manufacturers Basis of Design:

a. Curries Company (CU) - 757 Quiet Noise Series.

2.5 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16” positive thermal break and integral vinyl weatherstripping.

C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
3. Manufacturers Basis of Design:

a. Curries Company (CU) – Thermal Break TQ Series.

D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design:

a. Curries Company (CU) - CM Series.
b. Curries Company (CU) - M Series.

E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.7 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator’s shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.8 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.9 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
5. Electrical Raceways: Provide hollow metal doors to receive electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Sections "Door Hardware" and "Access Control Hardware". Wire nut connections are not acceptable.

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Electrical Knock Out Boxes: Factory weld 18 gauge electrical knock out boxes to frame for electrical hardware preps; including but not limited to, electric through wire transfer hardware, electrical raceways and wiring harnesses, door position switches, electric strikes, magnetic locks, and jamb mounted card readers as specified in hardware sets in Division 08 Sections "Door Hardware" and "Access Control Hardware".

    a. Provide electrical knock out boxes with a dual 1/2-inch and 3/4-inch knockouts.
    b. Conduit to be coordinated and installed in the field (Division 26) from middle hinge box and strike box to door position box.
    c. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 08 Section "Door Hardware".
    d. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.

9. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
10. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
11. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
12. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or

asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

    a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 081113

SECTION 087100 - DOOR HARDWARE

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 commercial door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 01 Section "Sustainable Design Requirements" for additional LEED documentation and requirements.
2. Division 08 Section “Hollow Metal Doors and Frames”.
3. Division 08 Section “Flush Wood Doors”.
4. Division 08 Section “Sound Control Hollow Metal Door Assemblies”.
5. Division 08 Section “Sound Control Wood Door Assemblies”.
6. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
7. Division 28 Section “Access Control Hardware Devices”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

    a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    b. Complete (risers, point-to-point) access control system block wiring diagrams.
    c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. LEED Requirements:

    a. Product Data for Credit MRc4: For products having a Health Product Declaration (HPD), provide documentation of the HPD. Include statement indicating costs for each product having an HPD.

2. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this

Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.

4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship

within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

   a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

   a. Hager Companies (HA) - BB Series, 5-knuckle.
   b. Ives (IV) - 5BB Series, 5-knuckle.
   c. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.3 CONTINUOUS HINGES

A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:.

   a. Hager Companies (HA).
   b. Ives (IV).
   c. Pemko (PE).

2.4 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Hager Companies (HA) - ETW-QC (# wires) Option.
    b. Ives (IV) - Connect.
    c. McKinney (MK) - QC (# wires) Option.

B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Pemko (PE) - EL-CEPT Series.
    b. Securitron (SU) - EL-CEPT Series.

C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

    a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

    a. Hager Companies (HA) - Quick Connect.
    b. McKinney (MK) - QC-C Series.

2.5 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.

4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood (RO).
    c. Trimco (TC).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
6. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood (RO).
    c. Trimco (TC).

2.6 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:

    a. Match Existing, Field Verify.
    b. No Substitution.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.

5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Restricted Keyway.

C. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

D. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

E. Construction Keying: Provide construction master keyed cylinders.

F. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.7 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide locksets with functions and features as follows:

a. Heavy duty 12-gauge wrought steel case.
b. Stainless steel 3/4" one-piece anti-friction reversible latchbolt with a one-piece hardened stainless steel 1” projection deadbolt.
c. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
d. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
e. Meets UL Certification Directory ZHLL.R21744 for products used in windstorm rated assemblies.
f. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.13 requirements to 16 million cycles or greater.
g. Status indicators inside, outside, or on both sides of doors as specified; available with wording for “locked/unlocked”, “vacant/occupied” or custom wording

options. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status.

h. Ten-year limited warranty for mechanical functions.

2. Electromechanical locksets shall have the following functions and features:

a. Universal Molex plug-in connectors that have standardized color-coded wiring and are available in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
c. Options to be available for request-to-exit or enter signaling, latchbolt and deadbolt monitoring.
d. Two-year limited warranty on electrified functions.

3. Manufacturers:

a. Corbin Russwin Hardware (RU) - ML2000 Series.
b. Sargent Manufacturing (SA) - 8200 Series.
c. Schlage (SC) - L9000 Series.

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.9 ELECTROMAGNETIC LOCKING DEVICES

A. Surface Electromagnetic Locks (Heavy Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 2 with minimum holding force strength of 1,200 pounds. Locks to be capable of accepting between 12 to 24 volts direct current and be UL

listed for use on fire rated door assemblies. Electromagnetic coils are to consume no more than 1.5W during normal operation. Locks are to have an integrated door position switch, tamper switch, and lock bond sensor. Locks are to have integrated motion sensor and/or security camera as indicated in the hardware sets. Locks to be capable of detecting door prop conditions and entering low power mode. Provide mounting accessories as needed to suit opening conditions. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.

1. Manufacturers:

    a. Securitron (SU) - M680E Series.

2.10 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.

10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide exit devices with functions and features as follows:

    a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
    b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
    c. No catch points: addition of applied deflectors or other added components are not allowed.
    d. No visible plastic.
    e. Heavy duty end caps with flush and overlapping options made of stainless steel, brass, or bronze with architectural finishes.
    f. Constructed of all stainless steel.
    g. Stainless steel pullman type latch with deadlock feature.
    h. Narrow or wide style exterior trim as specified in the hardware sets.
    i. Center case adjustability on concealed vertical rod exit devices; single operation with hex key individually adjusts top or bottom latches. No retainer screws or clips required to maintain adjustment.
    j. Ten-year limited warranty for mechanical features.

2. Electromechanical exit devices shall have the following functions and features:

    a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
    b. Wire routing for all non-access control electromechanical functions and EcoFlex trim to be contained within the carrier of the device eliminating the need for cavities in doors to be drilled. Include a protective film so that wires don't get damaged if the rail needs to be removed.
    c. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
    d. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
    e. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.

3. Manufacturers:

    a. Corbin Russwin Hardware (RU) - PED4000 / PED5000 Series.
    b. Sargent Manufacturing (SA) - PE80 Series.

2.11 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 30-year warranty.

2. Manufacturers:

a. Corbin Russwin Hardware (RU) - DC6000 Series.
b. LCN Closers (LC) - 4040 Series.
c. Norton Rixson (NO) - 7500 Series.

C. Door Closers, Surface Mounted (Unitrol): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted closers with door stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.

1. Manufacturers:

a. Norton Rixson (NO) - Unitrol Series.

2.12 SURFACE MOUNTED CLOSER HOLDERS

A. Multi-Point Closer Holders: Multi-point closer holder designed to hold open fire or smoke rated doors until interruption of signal from fire alarm, smoke detector or remote release switch. Pull side, push side, or double egress mounting applications available with non-handed track and closer body and dual voltage input (24V/120V). Voltage to be 24VDC unless otherwise specified. Multi position hold-open positions range from 10 to 170 degrees, with trim permitting. Provide optional swing free arm application (pull side) where specified. Auxiliary door stops are required at hold open point.

1. Manufacturers:

    a. Norton Rixson (NO) - 7200 Series.
    b. Norton Rixson (RF) - Smok-Chek V Series.

2.13 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Rockwood (RO).
    c. Trimco (TC).

2.14 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Burns Manufacturing (BU).
b. Rockwood (RO).
c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Norton Rixson (RF).
b. Rockwood (RO).
c. Sargent Manufacturing (SA).

2.15 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko (PE).

2.16 ELECTRONIC ACCESSORIES

A. Push-Button Switches: Industrial grade momentary or alternate contact, back-lighted push buttons with stainless-steel switch enclosures. 12/24 VDC bi-color illumination suitable for either flush or surface mounting.

1. Manufacturers:

a. Alarm Controls (AK) - TS Series.
b. Security Door Controls (SD) - 400 Series.
c. Securitron (SU) - PB Series.

B. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Sargent Manufacturing (SA) - 3280 Series.
b. Security Door Controls (SD) - DPS Series.
c. Securitron (SU) - DPS Series.

C. Wiegand Test Unit: Test unit verifies proper Wiegand output integrated card reader lock installation in the field by testing for proper wiring, card reader data integrity, and lock functionality including lock/unlock, door position, and request-to-exit status. 12 or 24VDC voltage adjustable operating as Fail Safe or Fail Secure.

1. Manufacturers:

a. Sargent Manufacturing (SA) - WT2 Wiegand Test Unit.

D. Switching Power Supplies: Provide power supplies with either single or dual voltage configurations at 12 or 24VDC. Power supplies shall have battery backup function with an integrated battery charging circuit and shall provide capability for power distribution, direct lock control and Fire Alarm Interface (FAI) through add on modules. Power supplies shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs.

1. Manufacturers:

    a. Securitron (SU) - AQD Series.

2.17 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.18 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 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.

3.5 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.6 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.7 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should 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 and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer’s Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. SU - Securitron
4. RO - Rockwood
5. SA - SARGENT
6. RF - Rixson
7. NO - Norton
8. OT - Other

Hardware Sets

Set: 1.0

Doors: P117A

2 Continuous Hinge	DFM_SLF-HD1 PT x Length Required		PE	087100	
2 Electric Power Transfer	EL-CEPT	613E	SU	087100	⚡

1	Narrow CVR Exit Device w/Pull (NL, RX, ELR, Less Dogging)	LD 55 56 ADPE8410 P106 x 863	US10BE	SA	087100	⚡
1	Narrow CVR Exit Device w/Pull (EO, RX, Less Dogging)	LD 55 56 ADPE8410 EO x 863	US10BE	SA	087100	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
2	Surface Closer	UNI7500 (HD PA SPG STP Arm)	690	NO	087100	
2	Drop Plate	7788	690	NO	087100	
2	Blade Stop Spacer	6891	690	NO	087100	
1	Gasketing	Provided By Door/Frame Supplier		OT		
2	Sweep	3452DNB x Length Required		PE	087100	
1	Threshold	273x224AFGT x Length Required x MSES25SS		PE	087100	
1	Card Reader	By Security Supplier				
2	ElectroLynx Harness (Door)	QC-C**** x Length Required		MK	087100	⚡
2	ElectroLynx Harness (Frame)	QC-C1500P		MK	087100	⚡
2	Position Switch	DPS2 - M / W-BK		SU	087100	⚡
1	Power Supply	AQD (Size as required)		SU	087100	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT		

Notes: Perimeter and meeting stile gasket by door / frame manufacturer.
Coordinate all Wiring and conduit with electrical contractor.

Operation:
• Doors are normally closed and secure.
• Access by valid credential presentation retracting the exit latches to allow authorized entry and then relocking.
• Egress always free for immediate exit. Request-to-Exit sensor integrated into the exit device push bar allows exit without alarm condition.
• Door position switches provide open/closed monitoring to both access control system and intrusion alarm service.
• Exit Latch remains projected/locked (fail secure) in event of power loss. Key override cylinder for emergency access.

Set: 2.0

Doors: P130

2	Continuous Hinge	DFM_SLF-HD1 PT x Length Required		PE	087100	
2	Electric Power Transfer	EL-CEPT	613E	SU	087100	⚡
2	Magnetic Lock	M680EBD	613E	SU	087100	⚡

1	Narrow CVR Exit Device w/Pull (NL, ELR, Less Doggin)	LD 56 ADPE8410 P106 x 863	US10BE	SA	087100	⚡
1	Narrow CVR Exit Device w/Pull (EO, ELR, Less Dogging)	LD 56 ADPE8410 863	US10BE	SA	087100	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
2	Surface Closer	UNI7500 (HD PA SPG STP Arm)	690	NO	087100	
2	Drop Plate	7788	690	NO	087100	
2	Blade Stop Spacer	6891	690	NO	087100	
1	Gasketing	Provided By Door/Frame Supplier		OT		
2	Sweep	3452DNB x Length Required		PE	087100	
1	Threshold	273x224AFGT x Length Required x MSES25SS		PE	087100	
2	Card Reader	By Security Supplier				
2	ElectroLynx Harness (Door)	QC-C**** x Length Required		MK	087100	⚡
4	ElectroLynx Harness (Frame)	QC-C1500P		MK	087100	⚡
1	Power Supply	AQD (Size as required)		SU	087100	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT		

Notes: **NO FREE EGRESS AT THIS OPENING
Perimeter and meeting stile gasket by door / frame manufacturer.
Coordinate all Wiring and conduit with electrical contractor.

Operation:
• Doors are normally closed and secure.
• Exterior Entry Access by valid credential presentation retracting the exit latches and shunting the magnetic locks to allow authorized entry and then relocking.
• Interior Egress Access by valid credential presentation releasing the magnetic locks to allow authorized egress by pushing the exit device push bar and then relocking.
• Door position switches integrated in Magnetic Locks provide open/closed monitoring to both access control system and intrusion alarm service.
• Exit Latch remains projected/locked (fail secure) in event of power loss. Key override cylinder for emergency access.
• Magnetic Locks will be dis-engaged UNLOCKED (fail safe) in event of power loss.

Set: 3.0

Doors: P101A, P101B, P117

2	Continuous Hinge	DFM_SLF-HD1 PT x Length Required		PE	087100	
2	Electric Power Transfer	EL-CEPT	613E	SU	087100	⚡

2	Narrow CVR Exit Device (EO, RX, Less Dogging)	LD 55 ADPE8410 EO	US10BE	SA	087100	⚡
2	Surface Closer	UNI7500 (HD PA SPG STP Arm)	690	NO	087100	
2	Drop Plate	7788	690	NO	087100	
2	Blade Stop Spacer	6891	690	NO	087100	
1	Gasketing	Provided By Door/Frame Supplier		OT		
2	Sweep	3452DNB x Length Required		PE	087100	
1	Threshold	273x224AFGT x Length Required x MSES25SS		PE	087100	
2	ElectroLynx Harness (Door)	QC-C**** x Length Required		MK	087100	⚡
2	ElectroLynx Harness (Frame)	QC-C1500P		MK	087100	⚡
2	Position Switch	DPS2 - M / W-BK		SU	087100	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT		

Notes: Perimeter and meeting stile gasket by door / frame manufacturer.
Coordinate all Wiring and conduit with electrical contractor.

Operation:
• Doors are normally closed and secure. Door are EXIT ONLY, No exterior hardware or access.
• Egress always free for immediate exit. Request-to-Exit sensor integrated into the exit device push bar allows exit without alarm condition.
• Door position switches provide open/closed monitoring to both access control system and intrusion alarm service.
• Exit Latch remains projected/locked (fail secure) in event of power loss.

Set: 4.0

Doors: C110

4	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
2	Hinge, Full Mortise, Hvy Wt (PWR TRNS)	T4A3786 QCx (# of Wires and Size as Required)	US26D	MK	087100	⚡
1	Magnetic Lock	M680EBD	613E	SU	087100	⚡
2	Fire Rated CVR Exit Device (EO, RX, LBR)	12 NB 55 MDPE8610 EO	US32D	SA	087100	⚡
2	Surface Closer (Pull side Slide Track)	7500ST	689	NO	087100	
4	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
2	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100	
1	Astragal	S772BL (Door Height)		PE	087100	

1	Gasketing	S88D (Head & Jambs)		PE	087100	
1	Card Reader	By Security Supplier				
2	ElectroLynx Harness (Door)	QC-C**** x Length Required		MK	087100	⚡
3	ElectroLynx Harness (Frame)	QC-C1500P		MK	087100	⚡
2	Position Switch	DPS2 - M / W-BK		SU	087100	⚡
1	Power Supply	AQD (Size as required)		SU	087100	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT		

Notes: Coordinate all Wiring and conduit with electrical contractor.
Kickplates are mounted on Both Sides of the doors.

Operation:
• On the Secure Side of the pair an authorized card read will release the magnetic lock, to allow authorized passage in the diorection of travel, then magnetic lock will re-engage.
• On the unsecured side free egress in the direction of travel is available by pushing the exit device push bar. Request-to-Exit sensor integrated into the exit device push bar allows egress without alarm condition.
• Exit Devices are Fail secure and will remain latched in the event of a fire alarm or power failure.
• Magnetic lock is Fail Safe and will release in the event of a fire alarm or power failure to allow free entry or egress.

Set: 5.0

Doors: C110A

4	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
2	Hinge, Full Mortise, Hvy Wt (PWR TRNS)	T4A3786 QCx (# of Wires and Size as Required)	US26D	MK	087100	⚡
1	SVR Exit Device (STRM, RX, ELR, LBR, Less Dogging)	LD 55 56 NBPE8706 WEJ	US32D	SA	087100	⚡
1	SVR Exit Device (EO, RX, LBR, Less Dogging)	LD 55 NBPE8710 EO	US32D	SA	087100	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
2	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100	
2	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
2	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100	
2	Silencer	608		RO	087100	
1	Card Reader	By Security Supplier				
2	ElectroLynx Harness (Door)	QC-C**** x Length Required		MK	087100	⚡

2	ElectroLynx Harness (Frame)	QC-C1500P	MK	087100	⚡
2	Position Switch	DPS2 - M / W-BK	SU	087100	⚡
1	Power Supply	AQD (Size as required)	SU	087100	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified	OT		

Notes: Coordinate all Wiring and conduit with electrical contractor.

Operation:
• Doors are closed and secure.
• When a proper credential is presented to the Card Reader the exit device latch at the active leaf will be momentarily retracted to allow entry.
• Free egress is available at all times on the unsecured side by pressing either exit device push bar. Request to Exit Switch in push bar will notify Access Control of an authorized egress.
• Key on secured side retracts the exit latch to allow mechanical authorized entry. Request-to-Exit sensor integrated into the exit device push bar allows exit without alarm condition.
• Exit devices are Fail Secure and will remain locked in the event of a fire emergency or power outage.
• Door position switches will notify access control of the doors Open/Closed Status.

Set: 6.0

Doors: F201

4	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
2	Hinge, Full Mortise, Hvy Wt (PWR TRNS)	T4A3786 QCx (# of Wires and Size as Required)	US26D	MK	087100	⚡
1	SVR Exit Device (STRM, RX, ELR, LBR, Less Dogging)	LD 55 56 NBPE8706 WEJ	US32D	SA	087100	⚡
1	SVR Exit Device (EO, RX, LBR, Less Dogging)	LD 55 NBPE8710 EO	US32D	SA	087100	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
2	Surface Closer	CPS7500 (HD PA SPG STP Arm)	689	NO	087100	
2	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
2	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100	
2	Silencer	608		RO	087100	
1	Card Reader	By Security Supplier				
2	ElectroLynx Harness (Door)	QC-C**** x Length Required		MK	087100	⚡
2	ElectroLynx Harness (Frame)	QC-C1500P		MK	087100	⚡
2	Position Switch	DPS2 - M / W-BK		SU	087100	⚡
1	Power Supply	AQD (Size as required)		SU	087100	⚡

1	Wiring Diagram	Elevation and Point to Point as Specified	OT

Notes: Coordinate all Wiring and conduit with electrical contractor.

Operation:
• Doors are closed and secure.
• When a proper credential is presented to the Card Reader the exit device latch at the active leaf will be momentarily retracted to allow entry.
• Free egress is available at all times on the unsecured side by pressing either exit device push bar. Request to Exit Switch in push bar will notify Access Control of an authorized egress.
• Key on secured side retracts the exit latch to allow mechanical authorized entry. Request-to-Exit sensor integrated into the exit device push bar allows exit without alarm condition.
• Exit devices are Fail Secure and will remain locked in the event of a fire emergency or power outage.
• Door position switches will notify access control of the doors Open/Closed Status.

Set: 7.0

Doors: F108B

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
1	Rim Exit Device	12 IN100-PE8877-BIPS WEJ	US26D	SA	281500	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100	
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100	
1	Gasketing	S88D (Head & Jambs)		PE	087100	
1	Aperio Hub	AH (Type as Required based on system requirements)		SA	087100	⚡
1	Aperio Antenna	As Required based on system requiredments		SA	087100	⚡
1	Position Switch	DPS2 - M / W-BK		SU	087100	⚡

Notes: Coordinate all Wiring and conduit with electrical contractor.

Operation:
• Door normally closed and secure.
• Access by valid credential presentation at card reader integrated with Exit Trim, unlocking lever to allow authorized entry and then relocking.
• Egress always free for immediate exit. Request-to-Exit sensor allows exit without alarm condition.
• Door position switch provides open/closed monitoring to both access control system and intrusion alarm service.

• Outside lever trim remains locked (fail secure) in event of power loss (Battery Powered). Key override cylinder for emergency access.

Set: 8.0

Doors: C205

6	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100
2	Fire Rated SVR Exit Device (EO, LBR)	12 LD NBPE8710 EO	US32D	SA	087100
2	Surface Closer (Pull side Slide Track)	7500ST	689	NO	087100
4	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
2	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
1	Astragal	S772BL (Door Height)		PE	087100
1	Gasketing	S88D (Head & Jambs)		PE	087100

Notes: Kickplates are mounted on Both Sides of the doors.

Set: 9.0

Doors: P204, P204A

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100
1	Rim Exit Device (CLRM, CD)	16 PE8813 WEJ (Cyl. Dogging)	US32D	SA	087100
2	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surface Closer	CPS7500 (HD PA SPG STP Arm)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 10.0

Doors: C204, P255, P255A

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100
1	Fire Rated Rim Exit Device (PASS)	12 PE8815 WEJ	US32D	SA	087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
1	Gasketing	S88D (Head & Jambs)		PE	087100

Set: 11.0

Doors: P127

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
1	Fire Rated Rim Exit Device (PASS)	12 PE8815 WEJ	US32D	SA	087100	
1	Surface Closer	CPS7500 (HD PA SPG STP Arm)	689	NO	087100	
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
1	Gasketing	S88D (Head & Jambs)		PE	087100	

Set: 12.0

Doors: C111

6	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
1	Self Latching Flush Bolt Set	2845 / 2945 (as required)	US26D	RO	087100	
1	Dust Proof Strike	570	US26D	RO	087100	
1	Wireless Access Control Mort Lock (Fail Sec., RX)	IN100-82278-BIPS LNMW	US32D	SA	281500	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
2	Surface Closer	CPS7500 (HD PA SPG STP Arm)	689	NO	087100	
2	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
1	Aperio Hub	AH (Type as Required based on system requirements)		SA	087100	⚡
1	Aperio Antenna	As Required based on system requiredments		SA	087100	⚡
2	Position Switch	DPS2 - M / W-BK		SU	087100	⚡

Notes: Operation:
• Doors are normally closed and secure.
• When a proper credential is presented to the Card Reader integrated on lockset escutcheon, the lever on the secure side of the opening will be momentarily released to allow authorized entry and then relock.
• The lever on the unsecured side is free at all times for egress. Request-to-Exit sensor integrated into the lockset allows exit without alarm condition.
• Key outside retracts latch for authorized mechanical entry.
• Lock is Fail Secure and will remain locked in the event of a loss of power (Battery Powered).
• Door position switch will signal the doors OPEN/CLOSED status to the access control panel.

Set: 13.0

Doors: C117, C118A, C202, F107, F201A, F216, F218, P116A, P117B, P130A, P133, P133A, P142, P149,

P150

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
1	Wireless Access Control Mort Lock (Fail Sec., RX)	IN100-82278-BIPS LNMW	US32D	SA	281500	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100	
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100	
3	Silencer	608		RO	087100	
1	Aperio Hub	AH (Type as Required based on system requirements)		SA	087100	⚡
1	Aperio Antenna	As Required based on system requiredments		SA	087100	⚡
1	Position Switch	DPS2 - M / W-BK		SU	087100	⚡

Notes: Operation:
• Doors are normally closed and secure.
• When a proper credential is presented to the Card Reader integrated on lockset escutcheon, the lever on the secure side of the opening will be momentarily released to allow authorized entry and then relock.
• The lever on the unsecured side is free at all times for egress. Request-to-Exit sensor integrated into the lockset allows exit without alarm condition.
• Key outside retracts latch for authorized mechanical entry.

Set: 14.0

Doors: P143

2	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
1	Hinge, Full Mortise, Hvy Wt (PWR TRNS)	T4A3786 QCx (# of Wires and Size as Required)	US26D	MK	087100	⚡
1	Electrified Mortise Lock (Fail Sec, RX)	NAC-82271-24v LNMW	US32D	SA	087100	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100	
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100	
3	Silencer	608		RO	087100	

1	ElectroLynx Harness (Door)	QC-C**** x Length Required		MK	087100
1	ElectroLynx Harness (Frame)	QC-C1500P		MK	087100
1	Position Switch	DPS2 - M / W-BK		SU	087100
1	Keypad / Card Reader	Combination Keypad/Card Reader by Security Supplier		OT	
1	Power Supply	AQD (Size as required)		SU	087100
1	Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes: Coordinate all Wiring and conduit with electrical contractor.

Operation:
• Door is normally closed and Secure.
• Access by valid credential presentation and correct digital code entered into the keypad, unlocking lever trim to allow authorized entry and then relocking.
• The lever on the unsecured side is free at all times for egress. Request-to-Exit sensor integrated into the exit device push bar allows exit without alarm condition.
• Key outside retracts latch for authorized mechanical entry.
• Lock is Fail Secure and will remain locked in the event of a fire emergency or power outage.
• Door position switch will signal the doors OPEN/CLOSED status to the access control panel.
• Lock performance and Cylinder monitoring capability integrated into the lockset if required.

Set: 15.0

Doors: P201

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
1	Wireless Access Control Mort Lock (Fail Sec., RX)	IN100-82278-BIPS LNMW	US32D	SA	281500	
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
1	Surface Closer	CPS7500 (HD PA SPG STP Arm)	689	NO	087100	
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
3	Silencer	608		RO	087100	
1	Aperio Hub	AH (Type as Required based on system requirements)		SA	087100	
1	Aperio Antenna	As Required based on system requiredments		SA	087100	
1	Position Switch	DPS2 - M / W-BK		SU	087100	

Notes: Operation:
• Doors are normally closed and secure.

• When a proper credential is presented to the Card Reader integrated on lockset escutcheon, the lever on the secure side of the opening will be momentarily released to allow authorized entry and then relock.
• The lever on the unsecured side is free at all times for egress. Request-to-Exit sensor integrated into the lockset allows exit without alarm condition.
• Key outside retracts latch for authorized mechanical entry.
• Lock is Fail Secure and will remain locked in the event of a loss of power (Battery Powered).
• Door position switch will signal the doors OPEN/CLOSED status to the access control panel.

Set: 16.0

Doors: P101, P150A

4	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
1	Wireless Access Control Mort Lock (Fail Sec., RX)	IN100-82278-BIPS LNMW	US32D	SA	281500	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
1	Surface Closer	CPS7500 (HD PA SPG STP Arm)	689	NO	087100	
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
3	Silencer	608		RO	087100	
1	Aperio Hub	AH (Type as Required based on system requirements)		SA	087100	⚡
1	Aperio Antenna	As Required based on system requiredments		SA	087100	⚡
1	Position Switch	DPS2 - M / W-BK		SU	087100	⚡

Notes: Operation:
• Doors are normally closed and secure.
• When a proper credential is presented to the Card Reader integrated on lockset escutcheon, the lever on the secure side of the opening will be momentarily released to allow authorized entry and then relock.
• The lever on the unsecured side is free at all times for egress. Request-to-Exit sensor integrated into the lockset allows exit without alarm condition.
• Key outside retracts latch for authorized mechanical entry.
• Lock is Fail Secure and will remain locked in the event of a loss of power (Battery Powered).
• Door position switch will signal the doors OPEN/CLOSED status to the access control panel.

Set: 17.0

Doors: C113, C116, P152

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	

1	Wireless Access Control Mort Lock (Fail Sec., RX)	IN100-82278-BIPS LNMW	US32D	SA	281500	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
1	Conc Overhead Stop	1ADJ-X36	630	RF	087100	
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100	
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
1	Silencer	608		RO	087100	
1	Aperio Hub	AH (Type as Required based on system requirements)		SA	087100	⚡
1	Aperio Antenna	As Required based on system requiredments		SA	087100	⚡
1	Position Switch	DPS2 - M / W-BK		SU	087100	⚡

Notes: Operation:
• Doors are normally closed and secure.
• When a proper credential is presented to the Card Reader integrated on lockset escutcheon, the lever on the secure side of the opening will be momentarily released to allow authorized entry and then relock.
• The lever on the unsecured side is free at all times for egress. Request-to-Exit sensor integrated into the lockset allows exit without alarm condition.
• Key outside retracts latch for authorized mechanical entry.
• Lock is Fail Secure and will remain locked in the event of a loss of power (Battery Powered).
• Door position switch will signal the doors OPEN/CLOSED status to the access control panel.

Set: 18.0

Doors: P147A, P148A

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
1	Wireless Access Control Mort Lock (Fail Sec., RX)	IN100-82278-BIPS LNMW	US32D	SA	281500	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
1	Surface Closer (EL HO)	722x Series (Push or Pull Side Mount as Required)	689	NO	087100	⚡
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
1	Applied Adjustable Perimeter Gasketing	379CS (Head and Jambs)		PE	087100	
1	Applied Door Bottom	217APK x Door Width		PE	087100	
1	Smooth Saddle Threshold	175A MSES25SS (Size as Requred)		PE	087100	
1	Aperio Hub	AH (Type as Required based on		SA	087100	⚡

		system requirements)				
1	Aperio Antenna	As Required based on system requiredments		SA	087100	⚡
1	Position Switch	DPS2 - M / W-BK		SU	087100	⚡

Notes: Apply Perimeter Gaksets before Closers to ensure complete seal.

Operation:
• Doors can be held open by electronic closer/holder and will be released to close upon activation of fire alarm or pressing the remote push button. Power to the electronic closer/holders and relay to fire alarm by others.
• Doors are normally closed and secure.
• When a proper credential is presented to the Card Reader integrated on lockset escutcheon, the lever on the secure side of the opening will be momentarily released to allow authorized entry and then relock.
• The lever on the unsecured side is free at all times for egress. Request-to-Exit sensor integrated into the lockset allows exit without alarm condition.
• Key outside retracts latch for authorized mechanical entry.
• Lock is Fail Secure and will remain locked in the event of a loss of power (Battery Powered).
• Door position switch will signal the doors OPEN/CLOSED status to the access control panel.

Set: 19.0

Doors: P129, P147, P148

2	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
1	Hinge, Full Mortise, Hvy Wt (PWR TRNS)	T4A3786 QCx (# of Wires and Size as Required)	US26D	MK	087100	⚡
1	Electrified Mortise Lock (Fail Sec, RX)	NAC-82271-24v LNMW	US32D	SA	087100	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
1	Surface Closer (EL HO)	722x Series (Push or Pull Side Mount as Required)	689	NO	087100	⚡
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
1	Applied Adjustable Perimeter Gasketing	379CS (Head and Jambs)		PE	087100	
1	Applied Door Bottom	217APK x Door Width		PE	087100	
1	Smooth Saddle Threshold	175A MSES25SS (Size as Requred)		PE	087100	
1	ElectroLynx Harness (Door)	QC-C**** x Length Required		MK	087100	⚡
1	ElectroLynx Harness (Frame)	QC-C1500P		MK	087100	⚡
1	Keypad / Card Reader	Combination Keypad/Card Reader		OT		

	by Security Supplier				
1 Power Supply	AQD (Size as required)		SU	087100	⚡
1 Wiring Diagram	Elevation and Point to Point as Specified		OT		

Notes: Apply Perimeter Gaksets before Closers to ensure complete seal.

Operation:
• Doors can be held open by electronic closer/holder and will be released to close upon activation of fire alarm or pressing the remote push button. Power to the electronic closer/holders and relay to fire alarm by others.
• Access by valid credential presentation and correct digital code entered into the keypad, unlocking lever trim to allow authorized entry and then relocking.
• Egress always free for immediate exit. Request-to-Exit sensor integrated into lockset allows exit without alarm condition.
• Outside lever trim remains locked (fail secure) in event of power loss. Key override cylinder for authorized mechanical access.
• Door position switch will signal the doors OPEN/CLOSED status to the access control panel.
• Lock performance and Cylinder monitoring capability integrated into the lockset if required.

Set: 20.0

Doors: P108

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100	
1	Wireless Access Control Mort Lock (Fail Sec., RX)	IN100-82278-BIPS LNMW	US32D	SA	281500	⚡
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
1	Conc Overhead Stop	1ADJ-X36	630	RF	087100	
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100	
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
1	Acoustic Corner Pads	ACP112BL/2		PE	087100	
1	Acoustic Perimeter Gasketing (1)	S773BL (Head and Jambs)		PE	087100	
1	Acoustic Perimeter Gasketing (2)	S44BL (Head and Jambs)		PE	087100	
1	Acoustic Auto Door Bottom	STC4131CPK x Door Width		PE	087100	
1	Smooth Saddle Threshold	175A MSES25SS (Size as Requred)		PE	087100	
1	Aperio Hub	AH (Type as Required based on system requirements)		SA	087100	⚡
1	Aperio Antenna	As Required based on system requiredments		SA	087100	⚡
1	Position Switch	DPS2 - M / W-BK		SU	087100	⚡

Notes: Coordinate all Wiring and conduit with electrical contractor.
Verify STC Requirements - Coordinate with STC Door/Frame provider, Sound Gaskets and Threshold may be part of door/frame package.

Operation:
• Doors are normally closed and secure.
• When a proper credential is presented to the Card Reader integrated on lockset escutcheon, the lever on the secure side of the opening will be momentarily released to allow authorized entry and then relock.
• The lever on the unsecured side is free at all times for egress. Request-to-Exit sensor integrated into the lockset allows exit without alarm condition.
• Key outside retracts latch for authorized mechanical entry.
• Lock is Fail Secure and will remain locked in the event of a loss of power (Battery Powered).
• Door position switch will signal the doors OPEN/CLOSED status to the access control panel.

Set: 21.0

Doors: P118, P141, P161B, P259

6	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Self Latching Flush Bolt Set	2845 / 2945 (as required)	US26D	RO	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Storeroom/Closet Lock	8204 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
2	Surf Overhead Stop	10-X36	630	RF	087100
2	Silencer	608		RO	087100

Set: 22.0

Doors: F208, F214, F217, P104, P111, P156, P161A, P163, P215, P216, P257

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100
1	Storeroom/Closet Lock	8204 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
3	Silencer	608		RO	087100

Set: 23.0

Doors: C204

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Storeroom/Closet Lock	8204 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surface Closer	CPS7500 (HD PA SPG STP Arm)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Gasketing	S88D (Head & Jambs)		PE	087100

Set: 24.0

Doors: C206, P144, P151, P212, P257A, P257B, P257C

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100
1	Storeroom/Closet Lock	8204 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surf Overhead Stop	10-X36	630	RF	087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 25.0

Doors: C208, F118B

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Storeroom/Closet Lock	8204 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
1	Gasketing	S88D (Head & Jambs)		PE	087100

Set: 26.0

Doors: P145, P146

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100

1	Storeroom/Closet Lock	8204 LNMW	US32D	SA	087100	
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100	
1	Surface Closer (EL HO)	722x Series (Push or Pull Side Mount as Required)	689	NO	087100	⚡
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100	
1	Applied Adjustable Perimeter Gasketing	379CS (Head and Jambs)		PE	087100	
1	Applied Door Bottom	217APK x Door Width		PE	087100	
1	Smooth Saddle Threshold	175A MSES25SS (Size as Requred)		PE	087100	
1	Push Button	PB		SU	087100	⚡

Notes: Apply Perimeter Gaksets before Closers to ensure complete seal.

Operation:
• Doors can be held open by electronic closer/holder and will be released to close upon activation of fire alarm or pressing the remote push button. Power to the electronic closer/holders and relay to fire alarm by others.

Set: 27.0

Doors: F102, F103, F104, F109, F110, F120, F203, F205, F210, F211, P105, P106, P109, P110, P113, P114, P115, P120, P121, P122, P208, P209, P210, P211, P218, P219, P221, P224, P226, P233, P234, P235, P236, P237, P238, P239, P240, P241, P242, P243, P244, P245, P246, P247, P248, P249, P250, P251, P252

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Office/Entry Lock	8205 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
1	Silencer	608		RO	087100

Set: 28.0

Doors: P124, P125, P126, P228

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Office/Entry Lock	8205 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surf Overhead Stop	10-X36	630	RF	087100
3	Silencer	608		RO	087100

Set: 29.0

Doors: C118, C202A, C203, C207A, F117, F207, F209, P119A, P128, P164, P206B, P207, P231, P253

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Office/Entry Lock	8205 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
1	Silencer	608		RO	087100

Set: 30.0

Doors: P102A, P116, P206A, P213A

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Office/Entry Lock	8205 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surface Closer	CPS7500 (HD PA SPG STP Arm)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
3	Silencer	608		RO	087100

Set: 31.0

Doors: C207, F119, F206, P102, P119, P258

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Office/Entry Lock	8205 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surf Overhead Stop	10-X36	630	RF	087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 32.0

Doors: P131, P153

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Classroom Lock	8237 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
1	Silencer	608		RO	087100

Set: 33.0

Doors: P123, P123A

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Classroom Lock	8237 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
3	Silencer	608		RO	087100

Set: 34.0

Doors: P108A, P134, P135, P136, P137, P138, P139, P140, P256, P256A, P258A

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100
1	Classroom Lock	8237 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
1	Acoustic Perimeter Gasketing (1)	S773BL (Head and Jambs)		PE	087100
1	Acoustic Perimeter Gasketing (2)	S44BL (Head and Jambs)		PE	087100
1	Acoustic Auto Door Bottom	STC4131CPK x Door Width		PE	087100
1	Smooth Saddle Threshold	175A MSES25SS (Size as Requred)		PE	087100

Notes: Apply Perimeter Gaksets before Closers to ensure complete seal.

Set: 35.0

Doors: P103

4	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100
1	Classroom Lock	8237 LNMW	US32D	SA	087100
1	Cylinder (Type as Required)	Keyed to match the owners existing key system			087100
1	Surf Overhead Stop	10-X36	630	RF	087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Acoustic Perimeter Gasketing (1)	S773BL (Head and Jambs)		PE	087100
1	Acoustic Perimeter Gasketing (2)	S44BL (Head and Jambs)		PE	087100
1	Acoustic Auto Door Bottom	STC4131CPK x Door Width		PE	087100
1	Smooth Saddle Threshold	175A MSES25SS (Size as Requred)		PE	087100

Notes: Apply Perimeter Gaksets before Closers to ensure complete seal.

Set: 36.0

Doors: P107, P112, P132, P202A, P203A, P220, P222, P225, P227

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Privacy Lock (w/OCC IND)	V21 8265 LNMW	US32D	SA	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
1	Silencer	608		RO	087100

Set: 37.0

Doors: F105, F106, P155, P214

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Privacy Lock (w/OCC IND)	V21 8265 LNMW	US32D	SA	087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
3	Silencer	608		RO	087100

Set: 38.0

Doors: F204, F212, F213, P154, P223, P229, P229A, P230, P230A

3	Hinge, Full Mortise	TA2714 (NRP and Size as Required)	US26D	MK	087100
1	Passage Latch	8215 LNMW	US32D	SA	087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
3	Silencer	608		RO	087100

Set: 39.0

Doors: P159, P160, P162, P202, P203

3	Hinge, Full Mortise, Hvy Wt	T4A3786 (NRP and Size as Required)	US26D	MK	087100
1	Push Plate	70C-RKW	US32D	RO	087100
1	Pull	RM301 Mtg-Type 12XHD	US32D	RO	087100
1	Surface Closer (Tri-Pack)	7500 (RA or PA Mount as Required)	689	NO	087100
1	Kick Plate	K1050 10" high BEV CSK	US32D	RO	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
3	Silencer	608		RO	087100

Set: 40.0

Doors: F101, F111, F112, F113, F114, F115, F116, F118, F118A

1	Hardware by Door/Frame MFR	Hardware by Modular Storefront/Wall System Manufacturer		OT	

Set: 41.0

Doors: C114, C115, F117A, F117B

1	Existing Hardware to Remain	Existing Hardware to Remain		OT	

Set: 42.0

Doors: MISC

1	Repair Kit	QC-R001		MK	087100
1	Crimp Tool	QC-R003		MK	087100

1 Test Unit WT2 SA 087100 

END OF SECTION 087100

SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
2. Section 061000 "Rough Carpentry" for blocking overhead support of floor-and-ceiling-anchored compartments.
3. Section 092216 "Non-Structural Metal Framing" for blocking.
4. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 COORDINATION

A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling to ensure that toilet compartments can be supported and installed as indicated.

1.3 ACTION SUBMITTALS

A. Product Data.

1. Phenolic-core toilet compartments.
   a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.
5. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.
6. .

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.

1. Size: Manufacturers' standard size.

E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

F. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Low-Emitting Materials: Provide testing reports in accordance with the General Emissions Evaluation.
4. Laboratory Test Reports: For product, indicating compliance with requirements for low-emitting materials.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For toilet compartments.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 30 percent.

B. Regional Materials: Manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

C. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.

D. Product shall be made without urea formaldehyde.

2.2 PHENOLIC-CORE TOILET COMPARTMENTS T12, T13

A. Basis-of-Design Product: Subject to compliance with requirements, provide Bradley Phenolic Privacy Partitions or comparable product by one of the following:

1. Bobrick Washroom Equipment, Inc.

B. Toilet-Enclosure Style: Overhead braced Floor anchored, privacy type.

C. Urinal-Screen Style: Wall hung Floor anchored Overhead braced.

D. Door, Panel, and Pilaster Construction: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- thick doors and pilasters and minimum 1/2-inch- thick panels. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).

E. Urinal-Screen Construction: Matching panel construction.

F. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

G. Pilaster Sleeves (Caps): Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

H. Urinal-Screen Post: Manufacturer's standard post design of monolithic phenolic-core urinal screen cutout at bottom to form a post or 1-3/4-inch- square, aluminum tube with satin finish with shoe and sleeve (cap) matching that on the pilaster.

I. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design, stainless steel.

J. Phenolic Compartment Finish: One color in each room.

1. Dark-Core Phenolic: Manufacturer's standard dark color core and edge.
   a. Facing Sheet Color: As selected by Architect from manufacturer's full range.
2. Through-Color Phenolic: Manufacturer's standard solid through-color.
   a. Color: As selected by Architect from manufacturer's full range.

2.3 HARDWARE AND ACCESSORIES

A. Door Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty institutional operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch- thick, stainless steel surface-mounted, paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through bolts.
2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible. Mount with through bolts.
3. Coat Hook: Manufacturer's heavy-duty, combination cast stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.
4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless steel bumper at outswinging doors. Mount with through bolts.
5. Door Pull: Manufacturer's heavy-duty, cast stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible. Mount with through bolts.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

A. Aluminum Castings: ASTM B26/B26M.

B. Aluminum Extrusions: ASTM B221.

C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

D. Stainless Steel Castings: ASTM A743/A743M.

2.5 FABRICATION

A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Manufacturer's standard corrosion-resistant anchoring assemblies at pilasters and walls, with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, inswinging doors for standard toilet enclosures and 36-inch- wide, outswinging doors with a minimum 32-inch- wide, clear opening for toilet enclosures designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:
   a. Pilasters and Panels or Screens: 1/2 inch.
   b. Panels or Screens and Walls: 1 inch.
2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

SECTION 22 1123.13 - DOMESTIC BOOSTER 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. Variable-speed booster pumps.

B. Related Sections:

1. Division 22 Section "Domestic Water Pumps" for domestic-water circulation pumps.
2. Division 22 Section "Facility Indoor Potable-Water Storage Tanks" for separate hydropneumatic domestic-water tanks for multiplex booster pumps.

1.3 DEFINITIONS

A. VFC: Variable-frequency controller(s).

1.4 SUBMITTALS

A. Shop Drawings: For booster pumps. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

B. Clearly indicate materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

1.6 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. ASME Compliance: Comply with ASME B31.9 for piping.

C. UL Compliance for Packaged Pumping Systems:

1. UL 508, "Industrial Control Equipment."
2. UL 508A, "Industrial Control Panels."
3. UL 778, "Motor-Operated Water Pumps."
4. UL 1995, "Heating and Cooling Equipment."

D. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain protective coatings and flange's protective covers during storage.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 VARIABLE-SPEED BOOSTER PUMPS

A. Manufacturers:

1. Armstrong.
2. Bell & Gossett.
3. Grundfos
4. Tigerflow.

B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pumps, piping, valves, specialties, and controls, and mounted on base.

C. Pumps: The pumps shall be vertical, multi-stage, centrifugal type, rated for continuous service with AISI 304 stainless steel impeller and intermediate chamber. Pump housing and base shall be constructed of ASTM 80-55-06 cast iron. The flanged pump connections shall be 150 lb ANSI bolt pattern. Power transmission shall be via cast iron split coupling.

1. Capacity and characteristics: Refer to Plumbing Equipment Schedule on Drawings.
2. The performance curve shall not exceed nameplate horsepower at any point. Performance curve to rise toward shut-off head of 324 ft. Pumps having flat head curves which tend to hunt during flow changes will not be acceptable.

D. Motors:

1. Each pump shall be direct connected to an AC motor. The pump motors shall be designed to exactly match with the variable frequency drive control and shall be capable of meeting all speeds from zero to maximum flow without exceeding the name plate horsepower rating of the motor.
2. Each motor shall have a sufficient horsepower rating to operate the pump at any point on the pump head capacity curve without overloading the nameplate horsepower rating of the motor, regardless of service factor. The motor shall have a service factor of at least 1/15. The service factor is reserved for variations in voltage and frequency. The motor shall be a C-frame configuration in accordance with the latest NEMA Standards.

E. Control System:

1. The system pressure shall be accurately regulated to an operator adjusted setting on a combination pressure indicator and set point programmer located in the control panel. The control system shall adjust the kilowatt power delivered and used by each pump to match the system flow rate requirement at any given time. The operating speed of the pumps shall be reduced to the minimum necessary to satisfy the system demand, and to reduce mechanical wear of the equipment. The control system efficiency shall be maintained at 94%, and the system power factor shall be .95 at all times. The regulator shall always soft start the pumps to reduce momentary power demand, and reduce mechanical and hydraulic shock to the system.
2. The control system shall operate two (2) pumps as necessary to maintain system operating pressure as set by the operating engineer. Each pump shall operate with power and speed regulated controls, as sequenced in the program. Each pump shall have its own V.F.D. inverter.
3. A microprocessor based programmable controller shall be furnished to coordinate operational input signals including pressure set points, operator input, and alarms. The program shall be factory installed and tested in the system and shall have provision for field adjustments.
4. A total of one (1) pressure transmitter shall be provided. The local transmitter shall be located on the discharge header of the system, and shall transmit the exact system output pressure.
5. Pressure transducer signals shall be received by a controller mounted in the control panel. The signal shall be compared to a set point and conditioned for stable operation with internally adjustable rate, reset, and proportional band functions. An adjustable set point shall be provided both above and below the set point for the system

sequencing. The operator adjustable set point shall serve to adjust the group of pressure operating points together with one adjustment to any desired operating pressure, within the system design range. The high and low set points shall adjust with the proportional set point, and shall be a function of the deviation from the adjustable proportional set point. The proportional output signal from the pressure controller shall operate with internally set reset and rate response when following a pressure deviation that is within the adjusted proportional band. When pressure deviates from the set point in proportion greater than the internally adjusted proportional band, the controller shall control rapidly by bypassing rate in order to follow rapidly changing pressure. The pressure controller shall maintain the variable speed proportional band for each pump.

6. The control system shall be housed in a NEMA 1 enclosure. Gauges shall be 4" ASA grad and shall indicate both suction and system pressure. Adjustments shall be provided for low suction pressure shut down, low system pressure alarm, and high system pressure alarm and shut down. The system shall operate completely unattended, and shall have failure contacts for operational connection to building supervisory controls. A low system pressure condition that is not satisfied by a pump within 30 seconds will signal an alarm. A low suction pressure condition will shut down the system until adequate pressure is restored.
7. The lead pump shall operate at varying rates of speed as required to maintain system pressure. Before flow demand exceeds the capacity of the lead pump, lag pump shall turn on and operate each as required, until pressure and flow have been satisfied for an adjustable period of time. The controller will transfer the lead position between two (2) motors, alternating the lead pump every 13-hours.

F. Operator Controls and Indicators:

1. Disconnect for each pump.
2. Manual speed control – each pump
3. Low suction pressure alarm light
4. Low system pressure alarm light
5. High system pressure alarm light

G. Low-Flow Shutdown Feature:

1. An A.S.M.E. rated stamped bladder type hydropneumatic tank shall be provided, to store excess pressure during low-flow periods. The controller shall automatically sense a low-flow period, and raise the variable-speed pump pressure set-point by 10 psi, charge the tank, and allow the pumps to shut-down until normal demand resumes.

H. Piping and Valves:

1. All interconnecting piping between the suction header, pumps and discharge header shall include suitable full-lug style butterfly valves on either side of the pump, and silent check valves on the suction and discharge side of each pump. The sizes shall be as follows: maximum full flow piping velocity shall not exceed 8 ft. per second on the suction piping and 8 ft. per second on the discharge piping.

2. Each of the pumps shall be complete with temperature sensing assembly to drain water on high temperature of any pump casing. Assembly shall include a solenoid, piped to drain or waste line by the plumbing contractor.

I. System:

1. The entire packaged system shall be certified and labeled by Underwriters Laboratory (UL), under Category QCZJ for packaged pump systems. Documentation of this special certification shall be included in the submittal booklets and shall be required prior to approval. Certification and labeling of the control panel only, in lieu of the required packaged system certification, is not acceptable.
2. All piping, valves, pumps and fittings shall have a rated working pressure equal to shut-off head plus maximum suction pressure. System shall be mounted on common steel base with 4-inch suction and 4-inch discharge headers, constructed of fusion bonded epoxy coated steel. The variable frequency drive and logic controller shall be mounted and factory wired to pump motors and accessories. The system shall be totally furnished by one manufacturer, who has manufactured variable set point variable frequency drive systems for a minimum of 10 years, and shall include pumps, motors, controls, start-up engineering service, customer instruction, and full system one (1) year warranty with locally available 24 hour parts and service.

J. Capacities and Characteristics: See Plumbing Equipment Schedule on Drawings

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

3.2 INSTALLATION

A. Equipment Mounting: Install booster pumps on concrete base using elastomeric pads. Comply with requirements for concrete base specified in Division 03 Section Cast-in-Place Concrete"

1. Minimum Deflection: 1/4 inch.
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 concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Equipment Mounting: Install booster pumps using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

1. Minimum Deflection: 1/4 inch.

C. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge headers.

1. Install shutoff valves on piping connections to booster-pump suction and discharge headers. Install butterfly valves same size as suction and discharge headers. Comply with requirements for general-duty valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
2. Install union, flanged, or grooved-joint connections on suction and discharge headers at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Division 22 Section "Domestic Water Piping."
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers. Comply with requirements for domestic-water piping specified in Division 22 Section "Domestic Water Piping."
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers. Comply with requirements for flexible connectors specified in Division 22 Section "Domestic Water Piping."
5. Install piping adjacent to booster pumps to allow service and maintenance.

3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform visual and mechanical inspection.
2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 DEMONSTRATION

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

END OF SECTION 22 11 23.13

SECTION 23 09 23 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Scope:

1. The Temperature Control Contractor (TCC) shall install, furnish, program, and turn over to client a complete operating DDC system for monitoring and controlling of MEP systems as shown in the Contract Documents.

B. Section Includes:

1. DDC system for monitoring and controlling of MEP systems.
2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for **field installation.**

C. Scope not included in 230923:

1. Electrical Contractor (EC) to provide all wiring to all motor starters, variable frequency drives, and motor control centers.
2. EC to provide 120 V/60 Hz power to all direct digital controllers (DDC) that require 120 V power.
3. Sheet Metal Contractor shall install all motorized dampers, duct mounted airflow measuring stations, thermowells (for temperature & pressure sensors), flow meters, control valves, and other accessories that are furnaced by the TCC.
4. Mechanical Contractor shall install all temperature and pressure sensing wells and control valves furnished by the Temperature Control Contactor.

1.2 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:

1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.

3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.

D. Binary: Two-state signal where a high signal level represents ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.

F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

G. COV: Changes of value.

H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.

I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.

J. DOCSIS: Data-Over Cable Service Interface Specifications.

K. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.

L. HLC: Heavy load conditions.

M. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.

N. LAN: Local area network.

O. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

P. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

Q. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

R. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

S. PDA: Personal digital assistant.

T. Peer to Peer: Networking architecture that treats all network stations as equal partners.

U. RAM: Random access memory.

V. RF: Radio frequency.

W. Router: Device connecting two or more networks at network layer.

X. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

Y. UPS: Uninterruptible power supply.

Z. USB: Universal Serial Bus.

AA. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

BB. VAV: Variable air volume.

CC. WLED: White light emitting diode.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.

5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.

6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details where applicable.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail means of vibration isolation and show attachments to rotating equipment.
4. Plan Drawings indicating the following:

    a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
    b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
    c. Each desktop operator workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
    d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
    e. Network communication cable and raceway routing.
    f. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.

5. Schematic drawings for each controlled HVAC system indicating the following:

    a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
    b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
    c. A graphic showing location of control I/O in proper relationship to HVAC system.
    d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
    e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
    f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
    g. Narrative sequence of operation.
    h. Graphic sequence of operation, showing all inputs and output logical blocks.

6. Control panel drawings indicating the following:

a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
c. Front, rear, and side elevations and nameplate legend.
d. Unique drawing for each panel.

7. DDC system network riser diagram indicating the following:

a. Each device connected to network with unique identification for each.
b. Interconnection of each different network in DDC system.
c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or fiber-optic cable type. Indicate raceway type and size for each.
d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.

8. DDC system electrical power riser diagram indicating the following:

a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
c. Each product requiring power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
d. Power wiring type and size, race type, and size for each.

9. Monitoring and control signal diagrams indicating the following:

a. Control signal cable and wiring between controllers and I/O.
b. Point-to-point schematic wiring diagrams for each product.
c. Control signal tubing to sensors, switches and transmitters.
d. Process signal tubing to sensors, switches and transmitters.

C. System Description:

1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
3. System and product operation under each potential failure condition including, but not limited to, the following:

a. Loss of power.
b. Loss of network communication signal.
c. Loss of controller signals to inputs and outpoints.
d. Operator workstation failure.

e. Gateway failure.
f. Network failure
g. Controller failure.
h. Instrument failure.
i. Control damper and valve actuator failure.

4. Complete bibliography of documentation and media to be delivered to Owner.
5. Description of testing plans and procedures.
6. Description of Owner training.

D. Samples:

1. For each exposed product, installed in finished space for approval of selection of aesthetic characteristics.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings, reflected ceiling plan(s), and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Qualification Data:

1. Systems Provider Qualification Data:

a. Resume of project manager assigned to Project.
b. Resumes of application engineering staff assigned to Project.
c. Resumes of installation and programming technicians assigned to Project.
d. Resumes of service technicians assigned to Project.
e. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.
f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
g. Names of staff assigned to past project that will also be assigned to execute work of this Project.
h. Owner contact information for past project including name, phone number, and e-mail address.
i. Contractor contact information for past project including name, phone number, and e-mail address.
j. Architect and Engineer contact information for past project including name, phone number, and e-mail address.

2. Manufacturer's qualification data.
3. Testing agency's qualifications data.

C. Welding certificates.

D. Product Certificates:

1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

E. Product Test Reports: For each product that requires testing to be performed by manufacturer.

F. Preconstruction Test Reports: For each separate test performed.

G. Source quality-control reports.

H. Field quality-control reports.

I. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
c. As-built versions of submittal Product Data.
d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to:

1) Design and install new points, panels, and other hardware.
2) Perform preventive maintenance and calibration.
3) Debug hardware problems.
4) Repair or replace hardware.

h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
i. Backup copy of graphic files, programs, and database on electronic media.
j. List of recommended spare parts with part numbers and suppliers.

k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
m. Licenses, guarantees, and warranty documents.
n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
o. Owner training materials.

1.6 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:

1. Nationally recognized manufacturer of DDC systems and products.
2. DDC systems with similar requirements to those indicated for a continuous period of 5 years within time of bid.
3. DDC systems and products that have been successfully tested and in use on at least 3 past projects.
4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
5. Having full-time in-house employees for the following:

a. Product research and development.
b. Product and application engineering.
c. Product manufacturing, testing and quality control.
d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
e. Owner operator training.

6. TCC to provide Niagara Framework (Tridium) automation system.

7. Acceptable Control Supplier:

a. Honeywell.

B. DDC System Provider Qualifications:

1. Authorized representative of, and trained by, DDC system manufacturer.
2. In-place facility located within 150 miles of Project and be capable of to respond on-site within 4 hours of notice.
3. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
4. Service and maintenance staff assigned to support Project during warranty period.
5. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.

6. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.
7. Acceptable Installation and Service Contractor:
   a. Abbott Controls.
   b. Indy Controls.
   c. E-Solutions.

C. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

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

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period at no cost to client.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.

   a. Install updates only after receiving Owner's written authorization.

3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
4. Warranty Period: 2 years from date of Substantial Completion. Warranty shall cover labor, material, replacement, and repairs for work performed during warranty period.

PART 2 - PRODUCTS

2.1 DDC SYSTEM DESCRIPTION

A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and

processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.

1. DDC system shall consist of a high-speed, peer-to-peer network of distributed DDC controllers, other network devices, operator interfaces, and software.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.

1. System Performance Objectives:

a. DDC system shall manage HVAC systems.
b. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
d. DDC system shall operate while unattended by an operator and through operator interaction.
e. DDC system shall record & store trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

B. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; 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.

C. DDC System Data Storage:

1. Include server(s) with disk drive data storage to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.
2. When logged onto a server, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.
3. Server(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.
4. Server(s) shall use IT industry-standard database platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE).

D. Future Expandability:

1. DDC system size shall be expandable to an ultimate capacity of at least 125% times total I/O points indicated.
2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.
3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.

E. Environmental Conditions for Controllers, Gateways, and Routers:

1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.

    a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.

2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

    a. Outdoors, Protected: Type 4.
    b. Outdoors, Unprotected: Type 4.
    c. Indoors, Heated with Filtered Ventilation: Type 2.
    d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
    e. Indoors, Heated and Air Conditioned: Type 2.
    f. Mechanical Equipment Rooms:

        1) Chiller and Boiler Rooms: Type 4.
        2) Air-Moving Equipment Rooms: Type 4.

    g. Localized Areas Exposed to Washdown: Type 4.
    h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.
    i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.
    j. Hazardous Locations: Explosion-proof rating for condition.

F. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and ventilated as required by instrument and application.

2. Instruments, actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

a. Outdoors, Protected: Type 4.
b. Outdoors, Unprotected: Type 4.
c. Indoors, Heated with Filtered Ventilation: Type 2.
d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
e. Indoors, Heated and Air Conditioned: Type 2.
f. Mechanical Equipment Rooms:

1) Chiller and Boiler Rooms: Type 4.
2) Air-Moving Equipment Rooms: Type 4.

g. Localized Areas Exposed to Washdown: Type 4.
h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 3.
i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4.
j. Hazardous Locations: Explosion-proof rating for condition.

G. Electric Power Quality:

1. Power-Line Surges:

a. Protect DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
b. Do not use fuses for surge protection.
c. Test protection in the normal mode and in the common mode, using the following two waveforms:

1) 10-by-1000-mic.sec. waveform with a peak voltage of 1500 V and a peak current of 60 A.
2) 8-by-20-mic.sec. waveform with a peak voltage of 1000 V and a peak current of 500 A.

2. Power Conditioning:

a. Protect DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:

1) At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
2) During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
3) Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
4) Total harmonic distortion shall not exceed 3-1/2 percent at full load.

3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

H. Backup Power Source:

1. HVAC systems and equipment served by a backup power source shall have associated DDC system products that control such systems and equipment also served from a backup power source.

I. UPS:

1. DDC system products powered by UPS units shall include the following:

a. Desktop operator workstations.
b. Servers.
c. Gateways.
d. DDC controllers.

2. DDC system instruments and actuators powered by UPS units shall be defined in the documents.

J. Continuity of Operation after Electric Power Interruption:

1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.3 SYSTEM ARCHITECTURE

A. System architecture shall consist of no more than 3 levels of LANs.

1. Level one LAN shall connect network controllers and operator workstations.
2. Level two LAN shall connect programmable application controllers to other programmable application controllers, and to network controllers.
3. Level three LAN shall connect application-specific controllers to programmable application controllers and network controllers.

4. Level three LAN shall connect application-specific controllers to application-specific controllers.

B. DDC system shall consist of dedicated and/or separated LANs that are not shared with other building systems and tenant data and communication networks.

C. System architecture shall be modular and have inherent ability to expand to not less than 3 times system size indicated with no impact to performance indicated.

D. System architecture shall perform modifications without having to remove and replace existing network equipment.

E. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.

F. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

G. Special Network Architecture Requirements:

1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s). Basically, create a DDC system LAN that aligns with air-handling system being controlled.

2.4 DDC SYSTEM OPERATOR INTERFACES

A. Operator Means of System Access: Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:

1. Desktop and portable operator workstation with hardwired connection through LAN port.
2. Portable operator terminal with hardwired connection through LAN port.
3. Portable operator workstation with wireless connection through LAN router.
4. Remote connection using outside of system personal computer or through Web access.
5. Remote connection using portable operator workstation and internet connection.
6. Mobile device.

B. Access to system, regardless of operator means used, shall be transparent to operator.

C. Desktop Workstations:

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.

3. Able to communicate, with modems, remotely with any device connected to any DDC system LAN.
4. Communication via a modem shall not interfere with LAN activity and LAN activity shall not prevent workstation from handling incoming calls.

D. Critical Alarm Reporting:

1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention.
2. DDC system shall send alarm notification to multiple recipients that are assigned for each alarm.
3. DDC system shall notify recipients by any or all means, including e-mail, text message, and prerecorded phone message to mobile and landline phone numbers.

E. Simultaneous Operator Use: Capable of accommodating up to 10 simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

2.5 NETWORK COMMUNICATION PROTOCOL

A. Network communication protocol(s) used throughout entire DDC system shall be open to public and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:

1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout entire DDC system.
2. DDC system shall not require use of gateways except to integrate HVAC equipment and other building systems and equipment, not required to use ASHRAE 135 communication protocol.
3. If used, gateways shall connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
4. Operator workstations, controllers and other network devices shall be tested and listed by BACnet Testing Laboratories.

2.6 ASHRAE 135 GATEWAYS

A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, boilers, chillers, and variable-speed drives.

B. Include gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet DDC-controlled equipment, only when specifically requested and approved by Owner.

C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.

D. Gateway Minimum Requirements:

1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.

2.7 DDC CONTROLLERS

A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.

E. Environment Requirements:

1. Controller hardware shall be suitable for the anticipated ambient conditions.
2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.
3. Controllers located outdoors shall be rated for operation at 40 to 150 deg F.

F. Power and Noise Immunity:

1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.

G. DDC Controller Spare Processing Capacity:

1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:

    a. Network Controllers: 50 percent.
    b. Programmable Application Controllers: Not less than 60 percent.
    c. Application-Specific Controllers: Not less than 70 percent.

2. Memory shall support DDC controller's operating system and database and shall include the following:

    a. Monitoring and control.
    b. Energy management, operation and optimization applications.
    c. Alarm management.
    d. Historical trend data of all connected I/O points.
    e. Maintenance applications.
    f. Operator interfaces.
    g. Monitoring of manual overrides.

H. Maintenance and Support: Include the following features to facilitate maintenance and support:

1. Mount microprocessor components on circuit cards for ease of removal and replacement.
2. Means to quickly and easily disconnect controller from network.
3. Means to quickly and easily access connect to field test equipment.
4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.

I. Input and Output Point Interface:

1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.
2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.
3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.
4. AIs:

    a. AIs shall include monitoring of low-voltage (zero- to 10-V dc), current (4 to 20 mA) and resistance signals from thermistor and RTD sensors.
    b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
    c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
    d. Signal conditioning including transient rejection shall be provided for each AI.
    e. Capable of being individually calibrated for zero and span.
    f. Incorporate common-mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal-mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10000 ohms.

5. AOs:

    a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 12 bits or better to comply with accuracy requirements indicated.
    b. Output signals shall have a range of 4 to 20 mA dc or zero- to 10-V dc as required to include proper control of output device.
    c. Capable of being individually calibrated for zero and span.
    d. AOs shall not exhibit a drift of greater than 0.4 percent of range per year.

6. BIs:

    a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
    b. Isolation and protection against an applied steady-state voltage of up to 180-V ac peak.
    c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
    d. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
    e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided to totalize pulses. Pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operator's command.

7. BOs:

    a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.

        1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V ac.
        2) Triac outputs shall include at least 180 V of isolation. Minimum contact rating shall be 1 A at 24-V ac.

    b. BOs shall include for two-state operation or a pulsed low-voltage signal for pulse-width modulation control.
    c. BOs shall be selectable for either normally open or normally closed operation.
    d. Include tristate outputs (two coordinated BOs) for control of three-point floating-type electronic actuators without feedback.
    e. Limit use of three-point floating devices to VAV terminal unit control applications, and other applications indicated on Drawings, Control algorithms shall operate actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.8 NETWORK CONTROLLERS

A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers that perform scheduling shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

B. Communication:

1. Network controllers shall communicate with other devices on DDC system network.
2. Network controller also shall perform routing if connected to a network of programmable application and application-specific controllers.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.
2. Local Keypad and Display:

a. Equip controller with local keypad and digital display for interrogating and editing data.
b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.9 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controllers that perform scheduling shall have a real-time clock.
6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
7. Controllers shall be fully programmable.

B. Communication:

1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.
2. Local Keypad and Display:

    a. Equip controller with local keypad and digital display for interrogating and editing data.
    b. Use of keypad and display shall require security password.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.10 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.

1. Capable of standalone operation and shall continue to include control functions without being connected to network.
2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation. Connection shall extend to port on space temperature sensor that is connected to controller.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

2.11 CONTROLLER SOFTWARE

A. General Controller Software Requirements:

1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
2. I/O points shall be identified by a character point name. Same names shall be used at operator workstations.
3. Control functions shall be executed within controllers using DDC algorithms.
4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.

B. Security:

1. Operator access shall be secured using individual security passwords and user names.
2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
3. Operator log-on and log-off attempts shall be recorded.
4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.

C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:

1. Weekly Schedule:

a. Include separate schedules for each day of week.
b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
c. Each schedule may consist of up to 10 events.

d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.

2. Exception Schedules:

a. Include ability for operator to designate any day of the year as an exception schedule.
b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.

3. Holiday Schedules:

a. Include capability for operator to define up to 99 special or holiday schedules.
b. Schedules may be placed on scheduling calendar and will be repeated each year.
c. Operator shall be able to define length of each holiday period.

D. System Coordination:

1. Include standard application for proper coordination of equipment.
2. Application shall include operator with a method of grouping together equipment based on function and location.
3. Group may then be used for scheduling and other applications.

E. Binary Alarms:

1. Each binary point shall be set to alarm based on operator-specified state.
2. Include capability to automatically and manually disable alarming.

F. Analog Alarms:

1. Each analog object shall have both high and low alarm limits.
2. Alarming shall be able to be automatically and manually disabled.

G. Alarm Reporting:

1. Operator shall be able to determine action to be taken in event of an alarm.
2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.

H. Remote Communication:

1. System shall have ability to dial out in the event of an alarm.

I. Maintenance Management: System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.

J. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.

K. Control Loops:

1. Support any of the following control loops, as applicable to control required:

a. Two-position (on/off, open/close, slow/fast) control.
b. Proportional control.
c. Proportional plus integral (PI) control.
d. Proportional plus integral plus derivative (PID) control.

1) Include PID algorithms with direct or reverse action and anti-windup.
2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
3) Controlled variable, set point, and PID gains shall be operator-selectable.

e. Adaptive (automatic tuning).

L. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.

M. Energy Calculations:

1. Include software to allow instantaneous power or flow rates to be accumulated and converted to energy usage data.
2. Include an algorithm that calculates a sliding-window average (rolling average). Algorithm shall be flexible to allow window intervals to be operator specified (such as 15, 30, or 60 minutes).
3. Include an algorithm that calculates a fixed-window average. A digital input signal shall define start of window period (such as signal from utility meter) to synchronize fixed-window average with that used by utility.

N. Anti-Short Cycling:

1. BO points shall be protected from short cycling.
2. Feature shall allow minimum on-time and off-time to be selected.

O. On and Off Control with Differential:

1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.

P. Run-Time Totalization:

1. Include software to totalize run-times for all BI and BO points.
2. A high run-time alarm shall be assigned, if required, by operator.

2.12 ENCLOSURES

A. General Enclosure Requirements:

1. House each controller and associated control accessories in a enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
2. Do not house more than one controller in a single enclosure.
3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
4. Equip doors of enclosures housing controllers and components with analog or digital displays with windows to allow visual observation of displays without opening enclosure door.
5. Individual wall-mounted single-door enclosures shall not exceed 36 inches wide and 48 inches high.
6. Individual wall-mounted double-door enclosures shall not exceed 60 inches wide and 36 inches high.
7. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.
8. Supply each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door.

B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
2. Arrange layout to group similar products together.
3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
5. Terminate field cable and wire using heavy-duty terminal blocks.
6. Include spare terminals, equal to not less than 25 percent of used terminals.
7. Include spade lugs for stranded cable and wire.
8. Install a maximum of two wires on each side of a terminal.
9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
10. Include enclosure with a line-voltage nominal 20-A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with a 5-A circuit breaker.
11. Mount products within enclosure on removable internal panel(s).
12. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch-high lettering.
13. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.

14. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.
15. Size enclosure internal panel to include at least 25 percent spare area on face of panel.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.

D. Wall-Mounted, NEMA 250, Type 1:
1. Enclosure shall be NRTL listed according to UL 50 or UL 50E.
2. Construct enclosure of steel.
3. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
    a. Exterior color shall be NSF/ANSI 61 gray or manufacturer's standard.
    b. Interior color shall be NSF/ANSI 61 gray or manufacturer's standard.
4. Hinged door full size of front face of enclosure and supported using:
    a. Enclosures sizes less than 36 in. tall: Multiple butt hinges.
    b. Enclosures sizes 36 in. tall and larger: Continuous piano hinges.
5. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
6. Internal panel mounting hardware, grounding hardware and sealing washers.
7. Grounding stud on enclosure body.
8. Thermoplastic pocket on inside of door for record Drawings and Product Data.

E. Wall Mounted NEMA 250, Types 4 and 12:
1. Enclosure shall be NRTL listed according to UL 508A.
2. Seam and joints are continuously welded and ground smooth.
3. Where recessed enclosures are indicated, include enclosures with face flange for flush mounting.
4. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
5. Single-door enclosure sizes up to 60 inches tall by 36 inches wide.
6. Double-door enclosure sizes up to 36 inches tall by 60 inches wide.
7. Construct enclosure of steel.
8. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
    a. Exterior color shall be NSF/ANSI 61 gray or manufacturer's standard.

b. Interior color shall be NSF/ANSI 61 gray or manufacturer's standard.

9. Corner-formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.
   a. Sizes through 24 Inches Tall: Two hinges.
   b. Sizes between 24 Inches through 48 Inches Tall: Three hinges.
   c. Sizes Larger 48 Inches Tall: Four hinges.
10. Double-door enclosures with overlapping door design to include unobstructed full-width access.
   a. Single-door enclosures 48 inches and taller, and all double-door enclosures, with three-point (top, middle and bottom) latch system.
11. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
12. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
13. Grounding stud on enclosure body.
14. Thermoplastic pocket on inside of door for record Drawings and Product Data.

F. Accessories:

1. Electric Heater:

   a. Aluminum housing with brushed finish.
   b. Thermostatic control with adjustable set point from zero to 100 deg F.
   c. Capacity: 100, 200, 400, and 800 W as required by application.
   d. Fan draws cool air from bottom of enclosure and passes air across thermostat and heating elements before being released into enclosure cavity. Heated air is discharged through the top of heater.

2. Ventilation Fans, Filtered Intake and Exhaust Grilles:

   a. Number and size of fans, filters and grilles as required by application.
   b. Compact cooling fans engineered for 50,000 hours of continuous operation without lubrication or service.
   c. Fans capable of being installed on any surface and in any position within enclosure for spot cooling or air circulation.
   d. Thermostatic control with adjustable set point from 32 to 140 deg F.
   e. Airflow Capacity at Zero Pressure:

      1) 4-Inch Fan: 100 cfm.
      2) 6-Inch Fan: 240 cfm.
      3) 10-Inch Fan: 560 cfm.

   f. Maximum operating temperature of 158 deg F.
   g. 4-inch fan thermally protected and provided with permanently lubricated ball-bearings.
   h. 6- and 10-inch fans with ball-bearing construction and split capacitor motors thermally protected to avoid premature failure.
   i. Dynamically balanced impellers molded from polycarbonate material.
   j. Fan furnished with power cord and polarized plug for power connection.

k. Fan brackets, finger guards and mounting hardware provided with fans to complete installation.
l. Removable Intake and Exhaust Grilles: Stainless steel of size to match fan size and suitable for NEMA 250, Types 1 and 12 enclosures.
m. Filters for NEMA 250, Type 1 Enclosures: Washable aluminum, of a size to match intake grille.
n. Filters for NEMA 250, Type 12 Enclosures: Disposable, of a size to match intake grille.

3. Bar handle with keyed cylinder lock set.

2.13 RELAYS

A. General-Purpose Relays:
1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Relays shall have LED indication and a manual reset and push-to-test button.
7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

B. Multifunction Time-Delay Relays:
1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a dust-tight cover.
6. Include knob and dial scale for setting delay time.
7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

C. Latching Relays:
1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
3. Use a plug-in-style relay with a multibladed plug.

4. Construct the contacts of either silver cadmium oxide or gold.
5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
6. Equip relays with coil transient suppression to limit transients to non-damaging levels.
7. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
8. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

D. Current Sensing Relay:
1. Monitors ac current.
2. Independent adjustable controls for pickup and dropout current.
3. Energized when supply voltage is present and current is above pickup setting.
4. De-energizes when monitored current is below dropout current.
5. Dropout current is adjustable from 50 to 95 percent of pickup current.
6. Include a current transformer, if required for application.
7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

E. Combination On-Off Status Sensor and On-Off Relay:
1. Description:

a. On-off control and status indication in a single device.
b. LED status indication of activated relay and current trigger.
c. Closed-Open-Auto override switch located on the load side of the relay.

2. Performance:

a. Ambient Temperature: Minus 30 to 140 deg F.
b. Voltage Rating: Single-phase loads rated for 300-V ac. Three-phase loads rated for 600-V ac.

3. Status Indication:

a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
b. Current Sensor Range: As required by application.
c. Current Set Point: Fixed or adjustable as required by application.
d. Current Sensor Output:

1) Solid-state, single-pole double-throw contact rated for 30-V ac and dc and for 0.4 A.
2) Solid-state, single-pole double-throw contact rated for 120-V ac and 1.0 A.
3) Analog, zero- to 5- or 10-V dc.
4) Analog, 4 to 20 mA, loop powered.

4. Relay: Single-pole double-throw, continuous-duty coil; rated for 10-million mechanical cycles.
5. Enclosure: NEMA 250, Type 1 enclosure.

2.14 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
2. Transformer shall be at least 100 VA.
3. Transformer shall have both primary and secondary fuses.

B. DC Power Supply:

1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
2. Enclose circuitry in a housing.
3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
4. Performance:

a. Output voltage nominally 25-V dc within 5 percent.
b. Output current up to 100 mA.
c. Input voltage nominally 120-V ac, 60 Hz.
d. Load regulation within 0.5 percent from zero- to 100-mA load.
e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

2.15 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS

A. 250 through 1000 VA:

1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.

a. Larger-capacity units shall be provided for systems with larger connected loads.
b. UPS shall provide 5 minutes of battery power.

3. Performance:

a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
d. On Battery Output Voltage: Sine wave.
e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
g. Transfer Time: 6 ms.

h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.

4. UPS shall be automatic during fault or overload conditions.
5. Unit with integral line-interactive, power condition topology to eliminate all power contaminants.
6. Include front panel with power switch and visual indication of power, battery, fault and temperature.
7. Unit shall include an audible alarm of faults and front panel silence feature.
8. Unit with four NEMA WD 1, NEMA WD 6 Configuration 5-15R receptacles.
9. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
10. Batteries shall be sealed lead-acid type and be maintenance free. Battery replacement shall be front accessible by user without dropping load.
11. Include tower models installed in ventilated cabinets to the particular installation location.

B. 1000 through 3000 VA:
1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.

a. Larger-capacity units, or multiple units, shall be provided for systems with larger connected loads.
b. UPS shall provide 5 minutes of battery power.

3. Performance:

a. Input Voltage: Single phase, 120-V ac, plus 20 to minus 30 percent.
b. Power Factor: Minimum 0.97 at full load.
c. Output Voltage: Single phase, 120-V ac, within 3 percent, steady state with rated output current of 10.0 A, 30.0-A peak.
d. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
e. Recharge time shall be a maximum of eight hours to 90 percent capacity.

4. UPS bypass shall be automatic during fault or overload conditions.
5. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
6. Batteries shall be sealed lead-acid type and be maintenance free.
7. Include tower models installed in ventilated cabinets or rack models installed on matching racks, as applicable to the particular installation location and space availability/configuration.

2.16 PIPING AND TUBING

A. Pneumatic, and Pressure Instrument Signal Air, Tubing and Piping:

1. Products in this paragraph are intended for use with the following:

    a. Main air and signal air to pneumatically controlled instruments, actuators and other control devices and accessories.
    b. Signal air between pressure instruments, such as sensors, switches, transmitters, controllers, and accessories.

2. Polyethylene Tubing:

    a. Fire-resistant black virgin polyethylene according to ASTM D 1248, Type 1, Class C and Grade 5.
    b. Tubing shall comply with stress crack test according to ASTM D 1693.
    c. Diameter, as required by application, of not less than nominal 0.25 inch.

3. Polyethylene Tubing Connectors and Fittings:

    a. Brass, barbered fittings and compression type.

2.17 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.

1. Wire size shall be at least No. 14 AWG or sized per length of run.
2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
4. Conductor colors shall be black (hot), white (neutral), and green (ground).
5. Furnish wire on spools.

B. Single Twisted Shielded Instrumentation Cable above 24 V:

1. Wire size shall be a minimum No. 18 AWG or sized per length of run.
2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
7. Furnish wire on spools.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:

1. Wire size shall be a minimum No. 18 AWG or sized per length of run.
2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.

3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.
6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
7. Furnish wire on spools.

D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.

1. Cable shall be plenum rated.
2. Cable shall comply with NFPA 70.
3. Cable shall have a unique color that is different from other cables used on Project.
4. Copper Cable for Ethernet Network:

    a. 100BASE-TX, 1000BASE-T, or 1000BASE-TX.
    b. TIA/EIA 586, Category 6 or 6A.
    c. Minimum No. 22 AWG solid or sized per length of run.
    d. Shielded Twisted Pair (STP).
    e. Thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, Class CMP as plenum rated.

2.18 RACEWAYS FOR CONTROL WIRING, CABLING, AND TUBING

A. Metal Conduits, Tubing, and Fittings:
1. 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.
2. EMT: Comply with NEMA ANSI C80.3 and UL 797.
3. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.19 CONTROL POWER WIRING AND RACEWAYS

A. Installation minimum requirements:
1. Mechanical spaces, services spaces, and areas without ceiling: All wiring including cables in EMT.
2. Space sensors and alarms: All wiring cables in EMT within wall construction.
3. Non-ducted return ceiling plenum: Approved plenum rated cable.
4. Ceiling returns (non-accessible): EMT or code compliant equal solid conduit.
5. Inside air handling units: All wiring including cables in EMT or code compliant equal solid conduit.
6. Non-accessible ceilings: EMT or code compliant equal solid conduit.

7. Inside air handling units or equipment: All wiring including cables in EMT or code compliant solid conduit.
8. Note the use of cable is limited to low voltage service with less than 24 volt only.
9. Do not lay cables on ceiling grids.
10. Conduit junctions and terminations shall utilize compression fittings.
11. Note that all conduit junctions and terminations shall utilize compression fittings.

B. All control wiring that is stated to be routed in EMT shall be separate from any power wiring.

2.20 FIELD EQUIPMENT

A. Space Sensors:

1. All sensors to be provided by TCC.
2. All space sensors to have digital display of setpoint and actual space temperature.
3. Set-point adjustment to be a maximum plus and minus 5 degrees from the null setpoint programmed through the DDC system.
4. Space sensors may be (RTD) 1,000 Ohm platinum with an accuracy of ±0.5 deg F or 10,000 OHM thermistor with accuracy of ±0.5 deg. F for all spaces.
5. Space sensor shall be manufacture's standard color.
6. Provide insulating bases for all sensors located on exterior walls and on exterior column wraps. Foam seal cavity and junction box prior to installing insulating base.
7. Space sensors with occupant set-point adjustment shall be adjustable from the operator's workstation as to the deadband of adjustability allowed to the occupants.

B. Temperature Sensors:

1. Duct sensors for critical spaces shall utilize averaging elements, 1000 OHM platinum Resistance Temperature Detectors (RTD) having an accuracy of ±0.5 deg F.
2. Duct sensors for non-critical spaces may utilize 10,000 OHM or 20,000 OHM thermistor having an accuracy of ±1.0 deg F. 1000 OHM RTDs are also acceptable for non-critical applications.
3. Immersion sensors to be furnished with companion wells separable stainless steel. Well pressure rating shall be consistent with and extend the system pressure it will be immersed in. Wells shall withstand pipe design flow velocities.

C. Low limit thermostats:

1. Low limit safety thermostats shall be manually reset, line voltage with maximum 23'-0" flexible sensing elements responsible to lowest temperature along entire length. Furnish minimum two (2) wired in series on the discharge side of the first hydronic coils (i.e., a 4-section coil requires eight low limit thermostats wired in series). Contractor to note that the operating head of such instruments shall be shielded from conditions whereby it could be activated by low temperature.
2. All flexible averaging sensors shall be attached by wire ties to a suspended wire or insulated cable to prevent sensor contact with metal or other unit components.

3. Install flexible sensors across all coils at a maximum of 6” from the bottom of the bottom coil and a minimum of 7” diameter to turn the sensor. Install the detector with a maximum free distance of 12” between each pass.
4. Staggered coils (if applicable) shall utilize multiple sensors. Each sensor shall cover one section of the staggered coil. Sensing elements shall be a minimum of 17’ long.
5. All flexible sensors shall be protected at point of penetration of unit via a section of poly tubing to prevent contact of the sensor and the unit.
6. Mount detector within 6” of the face of the coil unless noted otherwise. For staggered coil banks, this requirement applies for each half of the bank
7. TCC to note that when any low limit controls are above an elevation 7'-0" above floor level or otherwise inaccessible, they shall employ automatic reset and shall be wired to an auxiliary control panel of a 5'-0" elevation. The control panel with piano hinged door shall utilize a latching reset relay for each individual low limit control which ensures that the fan is de-energized even as the low limit resets automatically. The panel face shall utilize a red alarm pilot light that remains lit until the 10 second time delay reset relay momentary contact switch is activated. An LED inside the panel shall indicate which of low limits has signaled the alarm.

D. Electronic Actuators:

1. Manufactured, brand labeled or distributed by Belimo or Johnson Controls, Inc. or Siemens.
2. Size for torque required for damper seal at load conditions.
3. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
4. Mounting: Actuators shall be direct shaft mount type. Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
5. Overload protected electronically throughout rotation.
6. Fail safe operation: Mechanical, spring return mechanism.
7. Power requirements (spring return): 24 VAC.
8. Proportional actuators shall be fully programmable through an EEPROM without the use of actuator mounted switches.
9. Temperature rating: -22 deg. F to +122 deg. F.
10. Housing: Minimum requirement NEMA Type 2/IP54 mounted in any orientation. NEMA 4/4X (IP67) required for outdoor applications.
11. Agency listings: ISO 9001 or UL.
12. The manufacturer shall warrant all components for a period of 5 years from the date of production with the first two years unconditional.
13. All damper actuators used on equipment introducing outdoor air shall be furnished with mechanical spring return mechanism as indicated in “fail safe operation” above.
14. All actuators shall have external adjustable stops to limit the travel in either direction and a gear release to allow manual positioning.
15. Actuators shall be provided with position feedback signal (2-10 VDC or 4-20 mA) where indicated on control drawings. Feedback signal shall be independent of the input signal and shall provide true position indication.

E. Dampers:

1. All automatic dampers furnished by this Contractor for modulating control shall be of the proportioning type with opposed or parallel blades depending on the application or as shown on the drawings. Dampers for two position action shall be of the opposed blade type for all applications except those located immediately at the inlet of fans and as noted otherwise on the drawings. Dampers for generator radiator fan exhaust shall be opposed blade type.
2. All dampers for outdoor air service and exhaust air service to be equivalent to TAMCO Series 9000 aluminum and have the following features:

    a. Frames shall be 4" deep X 1" and no less than .080" in thickness, mill finish extruded aluminum 6063-T5 with mounting flanges on both sides of the frame. Frame to be assembled using plated steel mounting fasteners.
    b. Entire frame shall be thermally broken by means of two polyurethane resin pockets complete with thermal cuts.
    c. Blades shall be extruded aluminum 6063-T5, mill finish air foil profiles, internally insulated with expanded polyurethane foam and shall be thermally broken.
    d. Blade and frame seals shall be of extruded silicone and shall be secured in an integral slot within the aluminum extrusions. Blade and frame seals are to be mechanically fastened to eliminate shrinkage and movement over the life of the damper. Adhesive or clip on type blade seals shall not be approved. Jamb seals shall be silicone.
    e. Maintenance free bearings are to be composed of an inner bearing fixed to a 7/16" aluminum hexagon blade pivot pin, rotating within a polycarbonate outer bearing inserted into the frame. There shall be no metal-to-metal or metal-to-plastic contact.
    f. Adjustable 7/16" hexagonal drive rod, U-bolt fastener and hexagonal retaining nuts shall be corrosion resistant, zinc plated steel to provide positive connection to blades and linkage.
    g. Linkage hardware shall be installed in the frame side. All linkage crank arm and rod hardware parts shall be constructed of mill finished aluminum, complete with corrosion resistant, zinc plated trunnions and cup point trunnion screws for a slip-proof grip.
    h. Dampers are to be designed for operation in temperatures ranging between -40 deg. F (-40 deg. C) and 212 deg. F (100 deg. C).
    i. Dampers shall be rated Leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential. Standard air leakage data shall be certified under the AMCA Certified Ratings Program.
    j. Dampers shall be made to size required without blanking off free area.
    k. Dampers shall be available as "flanged to duct" mounting type.
    l. Installation of dampers must be in accordance with manufacturer's installation guidelines provided with each damper shipment.
    m. Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width. (See manufacturer's installation guidelines).

3. Dampers for all other applications to be equal to TAMCO Series 1500 Ultra Low Leakage Air Foil Aluminum and have the following features:

a. Frames shall be 4" deep X 1" and no less than .080" in thickness, mill finish extruded aluminum 6063-T5 with mounting flanges on both sides of the frame. Frame to be assembled using plated steel mounting fasteners.
b. Entire frame shall be thermally broken by means of two polyurethane resin pockets complete with thermal cuts.
c. Blades shall be extruded aluminum 6063-T5, mill finish air foil profiles, internally insulated with expanded polyurethane foam and shall be thermally broken.
d. Blade and frame seals shall be of extruded silicone and shall be secured in an integral slot within the aluminum extrusions. Blade and frame seals are to be mechanically fastened to eliminate shrinkage and movement over the life of the damper. Adhesive or clip on type blade seals shall not be approved.
e. Maintenance free bearings are to be composed of an inner bearing fixed to a 7/16" aluminum hexagon blade pivot pin, rotating within a polycarbonate outer bearing inserted into the frame. There shall be no metal-to-metal or metal-to-plastic contact.
f. Adjustable 7/16" hexagonal drive rod, U-bolt fastener and hexagonal retaining nuts shall be corrosion resistant, zinc plated steel to provide positive connection to blades and linkage.
g. Linkage hardware shall be installed in the frame side. All linkage crank arm and rod hardware parts shall be constructed of mill finished aluminum, complete with corrosion resistant, zinc plated trunnions and cup point trunnion screws for a slip-proof grip.
h. Dampers are to be designed for operation in temperatures ranging between -40 deg. F (-40 deg. C) and 212 deg. F (100 deg. C).
i. Dampers shall be rated Leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential. Standard air leakage data shall be certified under the AMCA Certified Ratings Program.
j. Dampers shall be made to size required without blanking off free area.
k. Dampers shall be available with either opposed blade action or parallel blade action.
l. Dampers shall be available as "flanged to duct" mounting type.
m. Installation of dampers must be in accordance with manufacturer's installation guidelines provided with each damper shipment.
n. Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width. (See manufacturer's installation guidelines).

4. Automatic dampers (modulating) shall be designed for face velocity that varies from 1,200 fpm to 2,000 fpm in most cases as approved by the design engineer. Dampers to be selected by the supplier with blade shaft lengths that prevent torsion that will create a leakage of more than 2 percent of the rated leakage capacity. Beyond that point, the dampers shall be broken into multiple sections. Field supplied mullions are required on large dampers exceeding 200 square feet.
5. Individual damper section actuators are preferred unless access to actuators is difficult and then jack shafting is acceptable. TCC to note that drive shafts between dampers of different air paths (i.e., outdoor air and return air or return air and exhaust air) is not acceptable. Jack shafting between sections is permitted when such shafting is designed to accommodate and eliminate the effects of torsion.

6. TCC to note that free access to all actuators is the responsibility of the TCC.
7. Each damper shall be equipped with an individual damper operator of the size and style required for the service intended.
8. Actuators to be designed for modulating control with spring return to the fail "safe" position. Actuators to be low voltage with 100% surplus torque (submittals to incorporate calculations to prove 100 percent closure under 4.0" wg status pressure differential for modulating service and 2.0" wg for two position application).
9. Terminal box/AFCV damper actuators to be low voltage, non-spring return and incremental control with 200 percent torque. All control actuators to utilize auto zero program to insure total accuracy of damper actuator. The feature to be activated during periods of low or no occupancy.

F. Insertion Turbine Flow Meters for Closed Loop Condenser Water:

1. Provide dual turbine flow meter complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand insertable up to 400 psi. The flow meter shall have two contra-rotating axial turbines, with electronic impedance-based sensing and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion.
2. The flow meter shall be installed in accordance with the manufacturer's installation guide including meter orientation and straight pipe recommendations.
3. Wetted metal components shall be nickel-plated brass for applications operating below 250 degrees F, 316L SS construction for DW applications, HTHW applications operating over 250 degrees F, and for any application in non-metallic pipe. The maximum operating temperature shall be 280 degrees F, 300 F peak.
4. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST. The manufacturer's certificate of calibration shall be provided with each flow meter.
5. Accuracy shall be within ± 0.5% of rate at the calibrated velocity, within ± 1% of rate over a 10:1 turndown (3.0 to 30 ft/s) and within ± 2% of rate over a 50:1 turndown (from 0.4 to 20 ft/s).
6. The flow meter shall include integral analog output(s), 4-20 mA, 0-10V, or 0-5V, and a high resolution frequency output for use with peripheral devices (remote display or BTU Meter). FB-1210 for Bi-directional applications shall include an isolated contact closure output for direction.
7. The flow meter shall be covered by the manufacturer's two-year warranty.
8. Turbine meter shall be ONICON Incorporated Model F-1210 Dual Turbine, or equivalent as approved by the Engineer.

G. Energy BTU Measurement System:

1. The entire energy BTU measurement system shall be built and calibrated by a single manufacturer and shall consist of a flow meter, two temperature sensors, a BTU meter, temperature thermowells, and all required mechanical installation hardware. The BTU meter and associated sensors and flow meter shall be installed in accordance with the manufacturer's installation guide.
2. The BTU meter shall provide the following points both at the integral LCD and as outputs to the building control system: Energy total, Energy rate, flow rate, supply temperature

and return temperature. Output signals shall be either serial network (protocol conforming to BACnet® MS/TP, JCI-N2, MODBUS RTU, MODBUS TCP, or Siemens-P1) and/or via individual analog and pulse outputs.

3. Each BTU meter shall be factory programmed and tagged for its specific application, and shall be re-programmable using the front panel keypad (no special interface device or computer required).
4. Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST traceable) for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within ±0.15°F (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).
5. A certificate of NIST traceable calibration shall be provided with each system.
6. Flow meter shall be in accordance with paragraph A, B, C, or D, refer to meter schedule for specific flow meter type.
7. All equipment shall be covered by the manufacturer's two-year warranty.
8. Energy BTU measurement system shall be ONICON Incorporated System-10 BTU Meter, or equivalent as approved by the Engineer.

H. Differential Pressure Transmitter:

1. Liquid: Furnish field mounted differential pressure transmitters as indicated on plans for measuring differential pressure and transmitting an isolated 4 to 20 mA DC output linear differential pressure signal.
   a. **Diaphragm type;** the unit shall be accurate to ±0.20% of calibrated span. It shall withstand static pressures of 1000 psig with negligible change in output. The flanges shall be made of stainless steel with stainless steel wetted sensing components, wetted parts all stainless steel and a silicone fill fluid. A brass or stainless 3 valve bypass manifold and bracket mounting kit shall be utilized for easier on-site equalization and calibration. Unit shall be protected against radio frequency interference and shall have a water-tight (NEMA Type 4) electrical enclosure with 1/2" NPT conduit connection. An LCD display is not required.
      1) The Type A transmitter shall be a standard process grade loop powered transmitter as manufactured by:
         a) Rosemount Model 3051C.
         b) Foxboro Model IDP10.
         c) Yokogawa Model EJA110A.

2. Air: Furnish field mounted differential pressure transmitters using a 4-20 mA (or 0-10 VDC) output linear with measured differential pressure. Accuracy shall be ±0.8% of calibrated span. Response time shall be 250 milliseconds. Transmitter shall be in a standard grade transmitter manufactured by Ashcroft or Setra.

~~**I. Airflow Measuring Stations:**~~

~~**1. All air flow measuring stations to be furnished under this contract as shown on control schematics and as scheduled.**~~

~~a. Approved manufacturers are Tek-Air Systems, Air Monitor, Paragon, Ebtron, Farr, and Airflow Wing.~~

~~2. Duct mounted stations shall be installed by the Sheet Metal Contractor while fan inlet station installation responsibility shall be by this Contractor.~~

~~3. Sizing and physical location of stations shall be the responsibility of this Contractor. TCC to ensure that sufficient distance is available both upstream and downstream such that turbulence is not a factor in the velocity pressure measurement. Sizing shall insure that the minimum velocity across the station affords accuracy of measurement and the design engineer shall be notified within 30 days of contract award if any modifications are required to the field ductwork.~~

~~4. TCC to ensure that a proper access door upstream of the station is provided in the ductwork such that the inlet face of the unit may be cleaned as necessary.~~

~~5. Duct mounted air flow measuring stations:~~

~~a. Furnish and install air flow measuring stations constructed of 16 gage sheet metal casing and a copper velocity pressure traverse section.~~

~~b. The velocity pressure traverse section shall consist of air straightening tubes, total pressure sensors and static pressure sensors, all interconnected to form a traverse by copper manifolds which shall equalize and integrate each type sensor measurement into one (1) total pressure and one (1) static pressure metering port. There shall be one static pressure sensor for each total pressure sensor.~~

~~c. A minimum of one static and one total pressure sensor shall be used for every 16 square feet in cross section. For larger ducts, a minimum of one static and one total pressure sensor shall be used for every 36" of duct cross sectional area up to a maximum as recommended by ASHRAE guide for traverse measurement.~~

~~d. Identification: Each air flow measuring station shall have a nameplate with the following information:~~

~~1) Unit size.~~
~~2) Unit designation.~~
~~3) Design air quantity.~~
~~4) Direction of air flow.~~
~~5) Design air velocity.~~

~~6. Fan inlet air flow sensing (non-intrusive piezometer type):~~

~~a. Accuracy: Within 2% throughout the velocity range of 600 fpm and over, when installed in accordance with published recommendations~~

~~b. Temperature: 350 deg F continuous operation; 400 deg F intermittent operation~~

~~c. Humidity: 0-100% continuous operation~~

~~d. Corrosion resistance: Good salt air and mild acid resistance, excellent solvent and aromatic hydrocarbon resistance~~

~~e. Material: 6063-T5 anodized aluminum, galvanized mounting brackets~~

~~J. Thermal Dispersion Air Flow Measurement:~~

~~1. Air volume measurement system to consist of multiple sensors designed to average velocity using thermal dispersion principles. System to be designed to be totally independent of temperature, density, and humidity. Tek-Air or Ebtron.~~
~~2. The quantity of sensing tubes shall conform to manufacturer's requirements for spacing based on the specified accuracy and the actual inlet and outlet conditions.~~
~~3. Unit to be accurate to 1.5% between 50 fpm and 6000 fpm. Output to be 4-20 mA.~~

K. **Water Source Heat Pump** ~~**VAV/CAV Terminal Unit**~~ Control Components (DDC Control):

Component	Furnished By	Installed By	Wired By
Disconnect Switch	Manufacturer	Manufacturer	Manufacturer
Transformer	**Manufacturer**	Manufacturer	Manufacturer
Damper Actuator	**N/A**	**N/A**	**N/A**
Flow Controller	**N/A**	**N/A**	**N/A**
Flow Sensing	**N/A**	**N/A**	**N/A**
Misc Accessories	TCC/MC	TCC/MC	TCC/EC

L. Control Valves:

1. Source Limitations: Obtain valves from single manufacturer.
2. Selection Criteria:
   a. Control valves shall be suitable for operation at following conditions:
      1) Refer to specification section 232113 – Hydronic Piping for system pressures.
   b. Fail positions unless otherwise indicated:
      1) Condenser Water: Open.
   c. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
   d. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of
      1) 1 psig for two-position unless otherwise indicated.
      2) 5 psig for two way modulating unless otherwise indicated.
      3) 5 psid for three way modulating unless otherwise indicated.
   e. Actuators:
      1) Actuators for Steam Control Valves: Shutoff against 1.5 times design pressure.

2.21 BALL-STYLE CONTROL VALVES

A. Ball Valves with Single Port and Characterized Disk:

1. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
2. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.

3. Close-off Pressure: 200 psig.
4. Process Temperature Range: Zero to 212 deg F.
5. Body and Tail Piece: Cast bronze ASTM B 61, ASTM B 62, ASTM B 584, or forged brass with nickel plating.
6. End Connections: Threaded (NPT) ends.
7. Ball: 300 series stainless steel.
8. Stem and Stem Extension:

    a. Material to match ball.
    b. Blowout-proof design.
    c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.

9. Ball Seats: Reinforced PTFE.
10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
11. Flow Characteristic: Equal percentage.

B. Ball Valves with Two Ports and Characterized Disk:

1. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
2. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
3. Close-off Pressure: 200 psig.
4. Process Temperature Range: Zero to 212 deg F.
5. Body and Tail Piece: Cast bronze ASTM B 61, ASTM B 62, ASTM B 584, or forged brass with nickel plating.
6. End Connections: Threaded (NPT) ends.
7. Ball: 300 series stainless steel.
8. Stem and Stem Extension:

    a. Material to match ball.
    b. Blowout-proof design.
    c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.

9. Ball Seats: Reinforced PTFE.
10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
11. Flow Characteristics for A-Port: Equal percentage.
12. Flow Characteristics for B-Port: Modified for constant common port flow.

2.22 GLOBE-STYLE CONTROL VALVES

A. General Globe-Style Valve Requirements:

1. Globe-style control valve body dimensions shall comply with ISA 75.08.01.
2. Construct the valves to be serviceable from the top.
3. For cage guided valves, trim shall be field interchangeable for different valve flow characteristics, such as equal percentage, linear, and quick opening.
4. Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1 and larger.
5. Replaceable seats and plugs.
6. Furnish each control valve with a corrosion-resistant nameplate indicating the following:

    a. Manufacturer's name, model number, and serial number.
    b. Body and trim size.
    c. Arrow indicating direction of flow.

B. Two-Way Globe Valves NPS 2 and Smaller:

1. Globe Style: Single port.
2. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: PTFE V-ring.
6. Plug: Top guided.
7. Plug, Seat, and Stem: stainless steel.
8. Process Temperature Range: 35 to 248 deg F.
9. Ambient Operating Temperature: 35 to 150 deg F.
10. Leakage: FCI 70-2, Class IV.
11. Rangeability: 25 to 1.
12. Equal percentage flow characteristic.

C. Three-Way Globe Valves NPS 2 and Smaller:

1. Globe Style: Mix flow pattern.
2. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
3. End Connections: Threaded.
4. Bonnet: Screwed.
5. Packing: PTFE V-ring.
6. Plug: Top guided.
7. Plug, Seat, and Stem: stainless steel.
8. Process Temperature Range: 35 to 248 deg F.
9. Ambient Operating Temperature: 35 to 150 deg F.
10. Leakage: FCI 70-2, Class IV.
11. Rangeability: 25 to 1.
12. Linear flow characteristic.

D. Two-Way Globe Valves NPS 2-1/2 to NPS 6:

1. Globe Style: Single port.
2. Body: Cast iron complying with ASME B61.1, Class 125.
3. End Connections: Flanged, suitable for mating to ASME B16.5, Class 150 flanges.
4. Bonnet: Bolted.

5. Packing: PTFE cone-ring.
6. Plug: Top or bottom guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Rating: 35 to 281 deg F.
9. Leakage: 0.1 percent of maximum flow.
10. Rangeability: Varies with valve size between 6 and 10 to 1.
11. Modified linear flow characteristic.

2.23 ACCESSORIES

A. Damper Blade Limit Switches:

1. Sense positive open and/or closed position of the damper blades.
2. NEMA 250, Type 13, oil-tight construction.
3. Arrange for the mounting application.
4. Additional waterproof enclosure when required by its environment.
5. Arrange to prevent "over-center" operation.

2.24 IDENTIFICATION

A. Instrument Air Pipe and Tubing:

1. Engraved tag shall bear the following information:

   a. Service (Example): "Instrument Air."
   b. Pressure Range (Example): 0 to 30 psig.

2. Letter size shall be a minimum of 0.25 inch high.
3. Tag shall consist of white lettering on blue background.
4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded blue with contrasting white center exposed by engraving through outer layer.
5. Include tag with a brass grommet, chain and S-hook.

B. Control Equipment, Instruments, and Control Devices:

1. Engraved tag bearing unique identification.

   a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.

2. Letter size shall be as follows:

   a. Operator Workstations: Minimum of 0.5 inch high.
   b. Printers: Minimum of 0.5 inch high.
   c. DDC Controllers: Minimum of 0.5 inch high.
   d. Gateways: Minimum of 0.5 inch high.

e. Repeaters: Minimum of 0.5 inch high.
f. Enclosures: Minimum of 0.5 inch high.
g. Electrical Power Devices: Minimum of 0.5 inch high.
h. UPS units: Minimum of 0.5 inch high.
i. Accessories: Minimum of 0.5 inch high.
j. Instruments: Minimum of 0.5 inch high.
k. Control Damper and Valve Actuators: Minimum of 0.5 inch high.

3. Tag shall consist of white lettering on black background.
4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer.
5. Tag shall be fastened with drive pins.
6. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

C. Valve Tags:

1. Brass tags and brass chains attached to valve.
2. Tags shall be at least 1.5 inches in diameter.
3. Include tag with unique valve identification indicating control influence such as flow, level, pressure, or temperature; followed by location of valve, and followed by three-digit sequential number. For example: TV-1.001.
4. Valves with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

D. Raceway and Boxes:

1. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.
3. For raceways housing pneumatic tubing, add a phenolic tag labeled "HVAC Instrument Air Tubing."
4. For raceways housing air signal tubing, add a phenolic tag labeled "HVAC Air Signal Tubing."

E. Equipment Warning Labels:

1. Acrylic label with pressure-sensitive adhesive back and peel-off protective jacket.
2. Lettering size shall be at least 14-point type with white lettering on red background.
3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.5 inch beyond white border.

2.25 SOURCE QUALITY CONTROL

A. Product(s) and material(s) will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.

1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Communication Interface to Equipment with Integral Controls:

1. DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.
2. Equipment to Be Connected:
   a. Boilers.
   b. Cooling towers.
   c. Pumps.
   d. Humidifier.
   e. Water source heat pumps.
   f. Energy recovery ventilators.
   g. Dedicated outdoor air systems.
   h. Variable frequency drives.
   i. Generators.

3.3 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.

B. Deliver the following to duct fabricator and Installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. DDC control dampers.
2. Airflow sensors and switches.
3. Pressure sensors.

C. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. DDC control valves.
2. Pipe-mounted flow meters.
3. Pipe-mounted sensors, switches and transmitters.
4. Tank-mounted sensors, switches and transmitters.
5. Pipe- and tank-mounted thermowells.

3.4 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, tubing, piping wiring and raceways.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop penetrations made in fire-rated assemblies.

G. Seal penetrations made in acoustically rated assemblies.

H. Welding Requirements:

1. Restrict welding and burning to supports and bracing.
2. No equipment shall be cut or welded without approval. Welding or cutting will not be approved if there is risk of damage to adjacent Work.

3. Welding, where approved, shall be by inert-gas electric arc process and shall be performed by qualified welders according to applicable welding codes.
4. If requested on-site, show satisfactory evidence of welder certificates indicating ability to perform welding work intended.

I. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

J. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

3.5 OPERATOR WORKSTATION INSTALLATION

A. Desktop Operator Workstations Installation:

1. Install operator workstation(s) at location(s) directed by Owner.
2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.
3. Install software on workstation(s) and verify software functions properly.
4. Develop Project-specific graphics, trends, reports, logs and historical database.
5. Power workstation through a dedicated UPS unit. Locate UPS adjacent to workstation.

B. Portable Operator Workstations Installation:

1. Turn over portable operator workstations to Owner at Substantial Completion.
2. Install software on workstation(s) and verify software functions properly.

C. Color Graphics Application:

1. Use system schematics indicated as starting point to create graphics.
2. Develop Project-specific library of symbols for representing system equipment and products.
3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
4. Submit sketch of graphic layout with description of all text for each graphic for Owner's and Engineer’s] review before creating graphic using graphics software.
5. Seek Owner input in graphics development once using graphics software.
6. Final editing shall be done on-site with Owner's and Engineer’s review and feedback.
7. Refine graphics as necessary for Owner acceptance.
8. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

3.6 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.

B. Connect controllers to field power supply and to UPS units where indicated.

C. Install controller with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Installation of Network Controllers:

1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 72 inches of finished floor.

F. Installation of Programmable Application Controllers:

1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 72 inches of finished floor.

G. Application-Specific Controllers:

1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

3.7 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Routers.
3. Controllers.
4. Electrical power devices.
5. UPS units.
6. Relays.
7. Accessories.
8. Instruments.
9. Actuators

B. Attach wall-mounted enclosures to wall using the following types of steel struts:

1. For NEMA 250, Type 1 Enclosures: Use painted steel strut and hardware.
2. For NEMA 250, Type 4 or Type 4X Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.
3. Install plastic caps on exposed cut edges of strut.

C. Align top of adjacent enclosures of like size.

D. Install floor-mounted enclosures located in mechanical equipment rooms on concrete housekeeping pads. Attach enclosure legs using stainless-steel anchors.

E. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

3.8 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to DDC system products requiring electrical power connections.

B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.

C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.

D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.

E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

3.9 NETWORK INSTALLATION

A. Install copper cable when connecting between the following network devices located in same building:

1. Operator workstations.
2. Operator workstations and network controllers.
3. Network controllers.

B. Install copper cable when connecting between the following:

1. Gateways.
2. Gateways and network controllers or programmable application controllers.
3. Routers.
4. Routers and network controllers or programmable application controllers.
5. Network controllers and programmable application controllers.

6. Programmable application controllers.
7. Programmable application controllers and application-specific controllers.
8. Application-specific controllers.

C. Install network cable in continuous raceway.

1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.10 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

B. ASHRAE 135 Networks:

1. MAC Address:

a. Every network device shall have an assigned and documented MAC address unique to its network.
b. Ethernet Networks: Document MAC address assigned at its creation.
c. ARCNET or MS/TP networks: Assign from 00 to 64.

2. Network Numbering:

a. Assign unique numbers to each new network.
b. Provide ability for changing network number through device switches or operator interface.
c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.

3. Device Object Identifier Property Number:

a. Assign unique device object identifier property numbers or device instances for each device network.
b. Provide for future modification of device instance number by device switches or operator interface.
c. LAN shall support up to 4,194,302 unique devices.

4. Device Object Name Property Text:

a. Device object name property field shall support 32 minimum printable characters.
b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.

1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102".

5. Object Name Property Text for Other Than Device Objects:

    a. Object name property field shall support 32 minimum printable characters.
    b. Assign object name properties with plain-English names descriptive of application.

        1) Example 1: "Zone 1 Temperature."
        2) Example 2 "Fan Start and Stop."

6. Object Identifier Property Number for Other Than Device Objects:

    a. Assign object identifier property numbers according to drawings indicated.
    b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

3.11 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

B. Comply with TIA 568-C.1.

C. Wiring Method: Install cables in raceways and cable trays except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

E. Field Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

F. Conduit Installation:

1. Install conduit expansion joints where conduit runs exceed 200 feet, and conduit crosses building expansion joints.
2. Coordinate conduit routing with other trades to avoid conflicts with ducts, pipes and equipment and service clearance.
3. Maintain at least 3-inch separation where conduits run axially above or below ducts and pipes.
4. Limit above-grade conduit runs to 100 feet without pull or junction box.

5. Do not install raceways or electrical items on any "explosion-relief" walls, or rotating equipment.
6. Do not fasten conduits onto the bottom side of a metal deck roof.
7. Flexible conduit is permitted only where flexibility and vibration control is required.
8. Limit flexible conduit to 3 feet long.
9. Conduit shall be continuous from outlet to outlet, from outlet to enclosures, pull and junction boxes, and shall be secured to boxes in such manner that each system shall be electrically continuous throughout.
10. Direct bury conduits underground or install in concrete-encased duct bank where indicated.

    a. Use rigid, nonmetallic, Schedule 80 PVC.
    b. Provide a burial depth according to NFPA 70, but not less than 24 inches.

11. Secure threaded conduit entering an instrument enclosure, cabinet, box, and trough, with a locknut on outside and inside, such that conduit system is electrically continuous throughout. Provide a metal bushing on inside with insulated throats. Locknuts shall be the type designed to bite into the metal or, on inside of enclosure, shall have a grounding wedge lug under locknut.
12. Conduit box-type connectors for conduit entering enclosures shall have an insulated throat.
13. Connect conduit entering enclosures in wet locations with box-type connectors or with watertight sealing locknuts or other fittings.
14. Offset conduits where entering surface-mounted equipment.
15. Seal conduit runs used by sealing fittings to prevent the circulation of air for the following:

    a. Conduit extending from interior to exterior of building.
    b. Conduit extending into pressurized duct and equipment.
    c. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.

G. Wire and Cable Installation:

1. Cables serving a common system may be grouped in a common raceway. Install control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
2. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.

    a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.

3. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

5. UTP Cable Installation:

    a. Comply with TIA 568-C.2.
    b. Do not untwist UTP cables more than 1/2 inch from the point of termination, to maintain cable geometry.

6. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.
7. Provide strain relief.
8. Terminate wiring in a junction box.

    a. Clamp cable over jacket in junction box.
    b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.

9. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
10. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
11. Keep runs short. Allow extra length for connecting to terminal boards. Do not bend flexible coaxial cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
12. Ground wire shall be copper and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
13. Wire and cable shall be continuous from terminal to terminal without splices.
14. Use insulated spade lugs for wire and cable connection to screw terminals.
15. Use shielded cable to transmitters.
16. Use shielded cable to temperature sensors.
17. Perform continuity and meager testing on wire and cable after installation.
18. Do not install bruised, kinked, scored, deformed, or abraded wire and cable. Remove and discard wire and cable if damaged during installation, and replace it with new cable.
19. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
20. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
21. Protection from Electro-Magnetic Interference (EMI): Provide installation free of (EMI). As a minimum, comply with the following requirements:

    a. Comply with BICSI TDMM and TIA 569-C for separating unshielded cable from potential EMI sources, including electrical power lines and equipment.
    b. Separation between open cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

        1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
        2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
        3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

c. Separation between cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

d. Separation between cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

e. Separation between Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
f. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.12 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Testing of Pneumatic and Air-Signal Tubing:

a. Test for leaks and obstructions.
b. Disconnect each pipe and tubing line before a test is performed, and blowout dust, dirt, trash, condensate and other foreign materials with compressed air. Use commercially pure compressed air or nitrogen as distributed in gas cylinders. Air from an oil-free compressor with an air dryer is an acceptable alternative for the test.
c. After foreign matter is expelled and line is free from obstructions, plug far end of tubing run.
d. Connect a pressure source to near end of run with a needle valve between air supply and tubing run.
e. Connect a pressure gage accurate to within 0.5 percent of test between the shutoff needle valve and tubing run under test.
f. For system pressures above 30 psig, apply a pressure of 1.5 times operating pressure. Record pressure in tubing run every 10 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 1 psig.

g. For system pressures 30 psig and below, apply a pressure of 2.0 times operating pressure to piping and tubing run. Record pressure in tubing run every 5 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 0.5 psig.

C. Testing:

1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.
4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
5. Test Equipment: Use a fiber-optic time domain reflectometer for testing of length and optical connectivity.
6. Test Results: Record test results and submit copy of test results for Project record.

3.13 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.

E. For pneumatic products, verify that air supply for each product is properly installed.

F. Control Damper Checkout:

1. Verify that control dampers are installed correctly for flow direction.
2. Verify that proper blade alignment, either parallel or opposed, has been provided.
3. Verify that damper frame attachment is properly secured and sealed.
4. Verify that damper actuator and linkage attachment is secure.

5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
6. Verify that damper blade travel is unobstructed.

G. Control Valve Checkout:

1. For pneumatic valves, verify that pressure gages are provided in each air line to valve actuator and positioner.
2. Verify that control valves are installed correctly for flow direction.
3. Verify that valve body attachment is properly secured and sealed.
4. Verify that valve actuator and linkage attachment is secure.
5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
6. Verify that valve ball, disc or plug travel is unobstructed.
7. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

H. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:

    a. Verify sensing element type and proper material.
    b. Verify length and insertion.

3.14 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.

E. Provide diagnostic and test equipment for calibration and adjustment.

F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.

G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.

I. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

J. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

K. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact making or breaking.

L. Control Dampers:

1. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

M. Control Valves:

1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.

2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.

O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

P. Switches: Calibrate switches to make or break contact at set points indicated.

Q. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.15 DDC SYSTEM CONTROLLER CHECKOUT

A. Verify power supply.

1. Verify voltage, phase and hertz.
2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.
5. If applicable, verify if connected to a backup power source.
6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.

B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.

C. Verify that spare I/O capacity is provided.

3.16 DDC CONTROLLER I/O CONTROL LOOP TESTS

A. Testing:

1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2. Test every I/O point throughout its full operating range.
3. Test every control loop to verify operation is stable and accurate.

4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5. Test and adjust every control loop for proper operation according to sequence of operation.
6. Test software and hardware interlocks for proper operation. Correct deficiencies.
7. Operate each analog point at the following:

    a. Upper quarter of range.
    b. Lower quarter of range.
    c. At midpoint of range.

8. Exercise each binary point.
9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3.17 DDC SYSTEM VALIDATION TESTS

A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.

B. After approval of Test Plan, execute all tests and procedures indicated in plan.

C. After testing is complete, submit completed test checklist.

D. Pretest Checklist: Submit the following list with items checked off once verified:

1. Detailed explanation for any items that are not completed or verified.
2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required DDC system components, wiring, and accessories are installed.
5. Installed DDC system architecture matches approved Drawings.
6. Control electric power circuits operate at proper voltage and are free from faults.
7. Required surge protection is installed.
8. DDC system network communications function properly, including uploading and downloading programming changes.
9. Using BACnet protocol analyzer, verify that communications are error free.
10. Each controller's programming is backed up.
11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
12. All I/O points are programmed into controllers.
13. Testing, adjusting and balancing work affecting controls is complete.
14. Dampers and actuators zero and span adjustments are set properly.
15. Each control damper and actuator goes to failed position on loss of power.

16. Valves and actuators zero and span adjustments are set properly.
17. Each control valve and actuator goes to failed position on loss of power.
18. Meter, sensor and transmitter readings are accurate and calibrated.
19. Control loops are tuned for smooth and stable operation.
20. View trend data where applicable.
21. Each controller works properly in standalone mode.
22. Safety controls and devices function properly.
23. Interfaces with fire-alarm system function properly.
24. Electrical interlocks function properly.
25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
26. Record Drawings are completed.

E. Test Plan:

1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of DDC system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 10 business days before start of tests.

F. Validation Test:

1. Verify operating performance of each I/O point in DDC system.

    a. Verify analog I/O points at operating value.
    b. Make adjustments to out-of-tolerance I/O points.

        1) Identify I/O points for future reference.
        2) Simulate abnormal conditions to demonstrate proper function of safety devices.
        3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.

2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:

    a. Re-check I/O points that required corrections during initial test.
    b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.

5. After 24 Hours of Second Validation Test:

    a. Re-check I/O points that required corrections during second test.
    b. Continue validation testing until I/O point is normal on two consecutive tests.

6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

G. DDC System Response Time Test:

1. Simulate HLC.

    a. Heavy load shall be an occurrence of 50 percent of total connected binary COV, one-half of which represent an "alarm" condition, and 50 percent of total connected analog COV, one-half of which represent an "alarm" condition, that are initiated simultaneously on a one-time basis.

2. Initiate 10 successive occurrences of HLC and measure response time to typical alarms and status changes.
3. Measure with a timer having at least 0.1-second resolution and 0.01 percent accuracy.
4. Purpose of test is to demonstrate DDC system, as follows:

    a. Reaction to COV and alarm conditions during HLC.
    b. Ability to update DDC system database during HLC.

5. Passing test is contingent on the following:

    a. Alarm reporting at printer beginning no more than 2 seconds after the initiation (time zero) of HLC.
    b. All alarms, both binary and analog, are reported and printed; none are lost.
    c. Compliance with response times specified.

6. Prepare and submit a report documenting HLC tested and results of test including time stamp and print out of all alarms.

H. DDC System Network Bandwidth Test:

1. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated HLC.
2. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

3.18 FINAL REVIEW

A. Submit written request to Engineer and Construction Manager when DDC system is ready for final review. Written request shall state the following:

1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. DDC system is complete and ready for final review.

B. Review by Engineer and Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.

E. Prepare and submit closeout submittals when no deficiencies are reported.

F. A part of DDC system final review shall include a demonstration to parties participating in final review.

1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
3. Demonstration shall include, but not be limited to, the following:

a. Accuracy and calibration of 10 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 10I/O points shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.
c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.

d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.
e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
f. Trends, summaries, logs and reports set-up for Project.
g. For up to 3 HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.
h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.
i. Software's ability to edit control programs off-line.
j. Data entry to show Project-specific customizing capability including parameter changes.
k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
l. Execution of digital and analog commands in graphic mode.
m. Spreadsheet and curve plot software and its integration with database.
n. Online user guide and help functions.
o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.
p. System speed of response compared to requirements indicated.
q. For Each Network and Programmable Application Controller:

    1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.
    2) Operator Interface: Ability to connect directly to each type of digital controller with a portable operator workstation and PDA. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.
    3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
    4) Electric Power: Ability to disconnect any controller safely from its power source.
    5) Wiring Labels: Match control drawings.
    6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.
    7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.

r. For Each Operator Workstation:

    1) I/O points lists agree with naming conventions.
    2) Graphics are complete.
    3) UPS unit, if applicable, operates.

s. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Requirements must be met even if only one manufacturer's equipment is installed.

1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated.
4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
10) Device and Network Management:

a) Display of network device status.
b) Display of BACnet Object Information.
c) Silencing devices transmitting erroneous data.
d) Time synchronization.
e) Remote device re-initialization.
f) Backup and restore network device programming and master database(s).
g) Configuration management of routers.

3.19 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.20 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by DDC system manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.21 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for one year.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within one year from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access system and to upgrade computer equipment if necessary.

3.22 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:

a. Provide not less than five days of training total.
b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
c. Total days of training shall be broken into not more than two separate training classes.
d. Each training class shall be not less than two consecutive day(s).

C. Training Schedule:

1. Schedule training with Owner 20 business days before expected Substantial Completion.

2. Schedule training to provide Owner with at least 10 business days of notice in advance of training.
3. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays, with two morning sessions and two afternoon sessions. Each morning session and afternoon session shall be split in half with 30-minute break between sessions. Morning and afternoon sessions shall be separated by 60-minute lunch period. Training, including breaks and excluding lunch period, shall not exceed 8 hours per day.
4. Provide staggered training schedule as requested by Owner.

D. Training Attendee List and Sign-in Sheet:

1. Request from Owner in advance of training a proposed attendee list with name, phone number and e-mail address.
2. Provide a preprinted sign-in sheet for each training session with proposed attendees listed and no fewer than six blank spaces to add additional attendees.
3. Preprinted sign-in sheet shall include training session number, date and time, instructor name, phone number and e-mail address, and brief description of content to be covered during session. List attendees with columns for name, phone number, e-mail address and a column for attendee signature or initials.
4. Circulate sign-in sheet at beginning of each session and solicit attendees to sign or initial in applicable location.
5. At end of each training day, send Owner an e-mail with an attachment of scanned copy (PDF) of circulated sign-in sheet for each session.

E. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes flash drive with PDF copy of all hard-copy materials.

F. Organization of Training Sessions:

1. Organize training sessions into logical groupings of technical content and to reflect different levels of operators having access to system. Plan training sessions to accommodate the following three levels of operators:

    a. Daily operators.
    b. Advanced operators.
    c. System managers and administrators.

2. Plan and organize training sessions to group training content to protect DDC system security. Some attendees may be restricted to some training sessions that cover restricted content for purposes of maintaining DDC system security.

G. Training Outline:

1. Submit training outline for Owner review at least 10 business day before scheduling training.
2. Outline shall include a detailed agenda for each training day that is broken down into each of four training sessions that day, training objectives for each training session and synopses for each lesson planned.

H. On-Site Training:

1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.
5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

I. Training Content for Daily Operators:

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control drawings.
11. Understanding physical location and placement of DDC controllers and I/O hardware.
12. Accessing data from DDC controllers.
13. Operating portable operator workstations.
14. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
15. Running each specified report and log.
16. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
17. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.

18. Executing digital and analog commands in graphic mode.
19. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
20. Demonstrating DDC system performance through trend logs and command tracing.
21. Demonstrating scan, update, and alarm responsiveness.
22. Demonstrating spreadsheet and curve plot software, and its integration with database.
23. Demonstrating on-line user guide, and help function and mail facility.
24. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
25. Demonstrating the following for HVAC systems and equipment controlled by DDC system:

    a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.
    b. For HVAC equipment with factory-installed software, show that integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.
    c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.
    d. Hardware interlocks and safeties function properly and DDC system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
    e. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.
    f. Each control loop responds to set point adjustment and stabilizes within time period indicated.
    g. Sharing of previously graphed trends of all control loops to demonstrate that each control loop is stable and set points are being maintained.

J. Training Content for Advanced Operators:

1. Making and changing workstation graphics.
2. Creating, deleting and modifying alarms including annunciation and routing.
3. Creating, deleting and modifying point trend logs including graphing and printing on an ad-hoc basis and operator-defined time intervals.
4. Creating, deleting and modifying reports.
5. Creating, deleting and modifying points.
6. Creating, deleting and modifying programming including ability to edit control programs off-line.
7. Creating, deleting and modifying system graphics and other types of displays.
8. Adding DDC controllers and other network communication devices such as gateways and routers.
9. Adding operator workstations.
10. Performing DDC system checkout and diagnostic procedures.
11. Performing DDC controllers operation and maintenance procedures.

12. Performing operator workstation operation and maintenance procedures.
13. Configuring DDC system hardware including controllers, workstations, communication devices and I/O points.
14. Maintaining, calibrating, troubleshooting, diagnosing and repairing hardware.
15. Adjusting, calibrating and replacing DDC system components.

K. Training Content for System Managers and Administrators:

1. DDC system software maintenance and backups.
2. Uploading, downloading and off-line archiving of all DDC system software and databases.
3. Interface with Project-specific, third-party operator software.
4. Understanding password and security procedures.
5. Adding new operators and making modifications to existing operators.
6. Operator password assignments and modification.
7. Operator authority assignment and modification.
8. Workstation data segregation and modification.

L. Video of Training Sessions:

1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
2. Stamp each recording file with training session number, session name and date.
3. Provide Owner with two flash drives for later reference and for use in future training.
4. Owner retains right to make additional copies for intended training purposes without having to pay royalties.

END OF SECTION 23 09 23

SECTION 23 72 23.13 - PACKAGED INDOOR HEAT WHEEL ENERGY RECOVERY UNITS

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. Heat wheels in packaged energy-recovery units with water source DX coils.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include packaged, indoor, heat wheel, energy-recovery-unit rated capacities, operating characteristics, furnished specialties, and accessories.
2. Fans:

a. Certified fan-performance curves with system operating conditions indicated.
b. Certified fan-sound power ratings.
c. Fan construction and accessories.
d. Motor ratings, electrical characteristics, and motor accessories.

B. Sustainable Design Submittals:

1. Product data showing compliance with ASHRAE 62.1.
2. Laboratory Test Reports: For antimicrobial coatings, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For air-to-air energy recovery equipment.

1. Include plans, elevations, sections, details, mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

D. Delegated-Design Submittal: For air-to-air energy-recovery equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of air-to-air energy-recovery equipment.
2. Vibration-Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Design Calculations: Calculate requirements for selecting vibration isolators ~~[and seismic restraints]~~ and for designing vibration-isolation bases.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, elevations, and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Data: Certificates, for air-to-air energy-recovery equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-to-air energy-recovery equipment to include in maintenance manuals.

1.6 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. Filters: Two set(s) of each type of filter specified in addition to one set of Merv 8 for use during startup.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, indoor, heat wheel energy-recovery units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Packaged Energy-Recovery Units: 2 years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

B. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1.
2. Capacity ratings for air-to-air energy-recovery equipment shall comply with ASHRAE 84.

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. UL Compliance:

1. Packaged heat-recovery ventilators shall comply with requirements in UL 1812 or UL 1815.
2. Electric coils shall comply with requirements in UL 1995.

E. Comply with ASTM E84.

F. Delegated Design: Engage a qualified professional engineer~~, as defined in Section 014000 "Quality Requirements,"~~ to design vibration-isolation controls [~~and seismic restraints~~], including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

~~G. Seismic Performance: Packaged, indoor, heat wheel energy-recovery units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.~~

~~1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."~~

2.2 PACKAGED, INDOOR, HEAT WHEEL ENERGY-RECOVERY UNITS

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

1. Water Furnace.
2. Or approved equivalent.

B. Source Limitations: Obtain packaged, indoor, heat wheel energy-recovery units from single manufacturer.

C. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, gasketed hinged access doors or removable panels with neoprene gaskets for inspection and access to internal parts, minimum 1-inch thick, R-6 minimum thermal insulation, knockouts for electrical connections, exterior drain connection, and lifting lugs.

E. Heat Wheel:

1. Casing:

    a. Manufacturer's standard construction with standard factory finish.
    b. Slide-in, slide-out cassette style for easy access.
    c. Integral purge section.
    d. Casing seals on periphery of rotor and on duct divider and purge section.
    e. Support vertical rotors on grease-lubricated ball bearings having extended grease fittings or permanently lubricated bearings with an L-50 of 200,000 hours. Support horizontal rotors on tapered roller bearing.

2. Rotor: Aluminum or polymer segmented wheel, strengthened with radial spokes.
3. Rotor: Aluminum or polymer segmented wheel, strengthened with radial spokes, with nontoxic, noncorrosive, silica-gel coating.
4. Rotor: Aluminum, metallic, or polymer segmented wheel, strengthened with radial spokes impregnated with nonmigrating, water-selective, four-angstrom, molecular-sieve desiccant coating.
5. Drive: Fractional horsepower motor and gear reducer, with speed changed by variable-frequency motor controller and self-adjusting multilink belt around outside of rotor.

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. 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.
6. Integral bypass dampers, actuators, and controls.

F. Supply and Exhaust Fans: Backward-inclined or Forward-curved, centrifugal fan with spring isolators or restrained, spring isolators of 1-inch static deflection.

1. Motor and Drive: Direct driven with ECM motors.
2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

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.

G. Filters:

1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
2. UL Compliance: Comply with UL 900.
3. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial coating.
4. Filter-Mounting Frames: Arranged with access doors or panels on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
5. 2" thick Merv 13 minimum.

H. Water source DX Coils:

1. Complete with water source DX coils with hot gas reheat, **variable speed scroll** compressors, and controls.
2. Modulating hot gas reheat.
3. **Refrigerant-to-Water Heat Exchangers:**
   a. **Coaxial heat exchangers with copper or cupronickel water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube are leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.**
   b. **Stainless-steel, brazed-plate heat exchanger is leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.**

I. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls, so only external connections are required during installation.

1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
2. Include fused disconnect switches.

J. Dampers:

1. Outdoor air dampers with integral actuation and control.
2. Exhaust air dampers with integral actuation and control.

K. Refrigerant Circuit Components:

1. Sealed Refrigerant Circuit: Charge with R-410A refrigerant.
2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.
3. Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.
4. Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.
5. Compressor:

a. Scroll.
b. Variable speed.
c. Installed on vibration isolators and mounted on a structural steel base plate and full-length channel stiffeners.
d. Exterior of compressor shall be wrapped with a high-density sound-attenuating blanket and housed in an acoustically treated enclosure.
e. Factory-Installed Safeties:

1) Antirecycle timer.
2) High-pressure cutout.
3) Low-pressure cutout or loss of charge switch.
4) Internal thermal-overload protection.
5) Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F.
6) Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.
7) Water-coil, low-temperature switch.

6. Refrigerant Piping Materials: ASTM B743 copper tube with wrought-copper fittings and brazed joints.
7. Pipe Insulation: Refrigerant minimum 3/8-inch-thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes according to ASTM E84.
8. Refrigerant Metering Device: Thermal-expansion valve.
9. Refrigerant Metering Device: Dual-port, thermal-expansion valve to allow specified operation with entering-water temperatures from 25 to 125 deg F.
10. Hot-Gas Reheat Valve: Pilot-operated, sliding-type valve with replaceable magnetic coil.

2.3 CONTROLS

A. Control Panel: Solid-state, programmable, integral microprocessor-based control unit. Integrate to BACnet MS/TP.

B. Starting relay, factory mounted and wired, and manual motor starter for field wiring.

C. Frost Control: Variable rotor speed.

D. Economizer Control: Stop wheel rotation or modulate wheel rotation when conditions are favorable for economizer operation.

E. Economizer Control: Heat wheel airflow bypass.

F. Enthalpy sensor.

G. Factory installed smoke detector wired to disable unit on detection of smoke.

H. Rotation sensor and alarm.

I. Dirty filter switch.

J. Low-Voltage Transformer: Integral transformer to provide control voltage to unit from primary incoming electrical service.

K. Integral Variable-Frequency Motor Controller for supply and exhaust fans.

L. Integral Variable-Frequency Motor Controller: Serving wheel rotation motor.

M. Variable-Speed Control: Factory mounted and wired, permitting input of field-connected, 4-20 mA or 1-10-V control signal.

N. Variable-Speed Control: Factory mounted and wired, with exhaust-air sensor to vary rotor speed and maintain exhaust temperature above freezing.

O. Variable-Speed Control: Factory mounted and wired, with exhaust- and outdoor-air sensors, automatic changeover thermostat, and set-point adjuster, to vary rotor speed and maintain exhaust temperature above freezing and air differential temperature above set point. Rotor speed shall increase to maximum when exhaust-air temperature is less than outdoor-air temperature.

2.4 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended application.

B. AHRI Compliance: Capacity ratings for air-to-air energy-recovery equipment certified as complying with AHRI 1060 (AHRI 1061).

C. Fan Performance Rating: Comply with AMCA 211 and label fans with AMCA-certified rating seal. Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency according to AMCA 210/ASHRAE 51.

D. Fan Sound Rating: Comply with AMCA 301 or AHRI 260 (IP). Air-handling unit fan sound ratings shall comply with AMCA 301 or AHRI 260 (IP).

E. UL Compliance:

1. Packaged heat recovery ventilators shall comply with requirements in UL 1812 or UL 1815.
2. Electric Coils: Comply with UL 1995.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before packaged, indoor, heat wheel energy-recovery unit installation. Replace with new insulation materials any filter media that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install packaged, indoor, heat wheel energy-recovery units, so supply and exhaust airstreams flow in opposite directions, and rotation is away from exhaust side to purge section to supply side.

1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."

B. Equipment Mounting:

1. Install packaged, indoor, heat wheel energy-recovery units on 4-inch cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration-isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration-isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. Install units with clearances for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

3.3 DUCTWORK CONNECTIONS

A. Comply with requirements for ductwork according to Section 233113 "Metal Ducts."

B. Connect duct to units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.4 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to unit, allow service and maintenance.

C. Connect piping to units mounted on vibration isolators with flexible connectors.

D. Condensate Drain Piping: See Section 232113 "Hydronic Piping" for pipe type. Pipe drains from drain pans to nearest floor drain, same size as condensate drain connection.

1. Construct deep trap at connection to drain pan, and install cleanouts at changes in direction.

3.5 ELECTRICAL CONNECTIONS

A. Install electrical devices furnished with units but not factory mounted.

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Packaged, indoor, heat wheel energy-recovery equipment will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Startup unit with Merv 8 filters only. Change to Merv 13 upon completion of a successful startup.

3.9 ADJUSTING

A. Adjust moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature and humidity set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.10 DEMONSTRATION

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

END OF SECTION 23 72 23.13

SECTION 23 81 46.13 - WATER-TO-AIR HEAT PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes unitary heat pumps with refrigerant to water heat exchangers, refrigeration circuits, and compressors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction information, material information, dimensions, clearances, and finishes for each heat pump.
   2. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

   1. Include diagrams for power, signal, and control wiring.
   2. Include mounting and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data

1.5 QUALITY ASSURANCE

A. ASHRAE Compliance:

   1. ASHRAE 15.
   2. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

C. Comply with NFPA 70.

D. Comply with safety requirements in UL 484 for assembly of free-delivery, water-source heat pumps.

E. Comply with safety requirements in UL 1995 for duct-system connections.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, refrigeration components.
2. Warranty Period Compressor: 5 years from date of Substantial Completion.
3. Warranty Period all other components: 4 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCEALED WATER-SOURCE HEAT PUMPS, 6 TONS AND SMALLER

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

1. Bosch.
2. Carrier.
3. ClimateMaster.
4. Daikin.
5. Trane.
6. WaterFurnace.
7. York.

B. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ASHRAE/ARI/ISO-13256-1.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

C. Cabinet and Chassis: Galvanized-steel casing with the following features:

1. Access panel for access and maintenance of internal components.
2. Knockouts for electrical and piping connections.
3. Flanged duct connections.

4. Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181, ASTM C 1071, and ASTM G 21.
5. Units field convertible for various discharge configurations.
6. Condensate Drainage: High-density polyethylene plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1.

    a. Condensate Overflow Protection Switch: Solid state electronic; mechanical float switch not permitted.

7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Fan: Direct driven, centrifugal, with multispeed motor resiliently mounted in fan inlet and with inlet rings to allow wheel removal from one side without removing housing.

1. General requirements for motors are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Motor: Multispeed, permanently lubricated, variable speed ECM motor.

E. Water Circuit:

1. Refrigerant-to-Water Heat Exchangers:

    a. Coaxial heat exchangers with copper or cupronickel water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube are leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.
    b. Stainless-steel, brazed-plate heat exchanger is leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

2. Device provided by MC in piping external to unit:
    a. Water-Regulating Valves: Limit water flow through refrigerant-to-water heat exchanger, and control head pressure on compressor during cooling and heating. Valves shall close when heat-pump compressor is not running.
    b. Motorized Isolation Valve: Stop water flow through the unit when compressor is off.

F. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.
1. Fully insulated stainless steel drain pan.
2. Condensate overflow detection wired to shut down supply fan.

G. Refrigerant Circuit Components:

1. Sealed Refrigerant Circuit: Charge with R-410A refrigerant.
2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.
3. Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.

4. Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.
5. Compressor: Hermetic **variable speed** scroll compressor **(if available in tonnage size)** installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties as follows:

    a. Antirecycle timer.
    b. High-pressure cutout.
    c. Low-pressure cutout or loss of charge switch.
    d. Internal thermal-overload protection.
    e. Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F.
    f. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.
    g. Water-coil, low-temperature switch.
    h. Air-coil, low-temperature switch.

6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.
7. Pipe Insulation: Refrigerant minimum 3/8-inch-thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes according to ASTM E 84.
8. Refrigerant Metering Device: Thermal-expansion valve.
9. Refrigerant Metering Device: Dual-port, thermal-expansion valve to allow specified operation with entering-water temperatures from 25 to 125 deg F.
10. Hot-Gas Reheat Valve: Pilot-operated, sliding-type valve with replaceable magnetic coil.

H. Hot-Gas Reheat: Reheat valve diverts refrigerant hot gas to reheat coil when remote humidistat calls for dehumidification.

I. Filters: Disposable, pleated type, 1 inch thick and with a minimum efficiency reporting value (MERV) of 13 according to ASHRAE 52.2.

J. Controls:

1. Basic Unit Control Modes and Devices:

    a. Dehumidification mode.
    b. Unit shutdown on high or low refrigerant pressures.
    c. Unit shutdown on low water temperature.
    d. Low- and high-voltage protection.
    e. Overcurrent protection for compressor and fan motor.
    f. Random time delay, three to ten seconds, start on power-up.
    g. Time delay override for servicing.
    h. Control voltage transformer.
    i. Water-coil freeze protection (selectable for water or antifreeze).
    j. Air-coil freeze protection (check filter switch).
    k. Condensate overflow shutdown switch.
    l. Option to reset unit at thermostat or disconnect.

m. Fault type shall be retained in memory if reset at thermostat.
n. Automatic intelligent reset. Unit shall automatically reset five minutes after trip if the fault has cleared. Should a fault reoccur three times sequentially, lockout requiring manual reset occurs.
o. Ability to defeat time delays for servicing.
p. Light-emitting diodes (LED) to indicate high pressure, low pressure, low voltage, and high voltage.
q. The low-pressure switch SHALL NOT be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.
r. Remote fault-type indication at thermostat.
s. Selectable 24-V dc or pilot duty dry contact alarm output.
t. 24-V dc output to cycle a motorized water valve with compressor contactor.
u. Electric heat output to control two stages of electric heat (emergency heat).
v. Service test mode for troubleshooting and service.
w. Unit-performance sentinel warns when the heat pump is running inefficiently.

2. Thermostat:

a. Wall-Mounted Thermostat:

1) Heat-cool-off switch.
2) Fan on-auto switch.
3) Automatic changeover.
4) Exposed temperature set point.
5) Exposed temperature indication.
6) Deg F & C indication.

b. Wall-mounted temperature sensor.
c. Unoccupied period override push button.
d. LED to indicate fault condition at heat pump.
e. Data entry and access port.

1) Input data include room temperature and humidity set points for occupied and unoccupied periods.
2) Output data include room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

3. Terminal Controller:

a. Scheduled operation for occupied and unoccupied periods on 365-day clock with minimum of four programmable periods per day.
b. Two hour unoccupied override period.
c. Remote-control panel to contain programmable timer and LED for fault condition.
d. Compressor disable relay to stop compressor operation for demand limiting or switch to unoccupied operation.
e. Automatic restart after five minutes if fault clears. Lockout after three attempts to restart following fault. Indicate fault for service technician.
f. Return-air temperature high-limit (firestat). Stop unit on high temperature.
g. Backup for volatile memory.

h. Differential pressure switch to indicate fan status. Fan failure alarm.
i. Differential pressure switch to indicate filter status. Dirty filter alarm.
j. Smoke detector to disable unit.

K. Electrical Connection: Single electrical connection with fused disconnect.

~~**L. Factory installed smoke detector wired to disable fan on detection of smoke. Only required on units that are 2,000 CFM and larger.**~~

2.2 HOSE KITS

A. Refer to section 232116 – Hydronic Piping Specialties for flexible connectors.

B. Supply connection: combination manual shut off valve, strainer, PT test plug, blowdown & drain valve.

C. Return connection: combination PT test plug, manual air vent, isolation valve, combination automatic flow control valve with PT test plus, shut off valve.

D. Balancing Device: Mount in return connection. Include meter ports to allow flow measurement with differential pressure gage.

1. Automatic balancing valve, factory set to operate within 10 percent of design flow rate over a 40:1 differential pressure range of 2 to 80 psig.

E. Motorized Isolation Valve: Slow-acting, 24-V dc, with NPT connections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Suspended Units: Install water-source heat pumps with continuous-thread hanger rods and rubber isolator of size required to support weight of water-source heat pump unit.
1. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install wall-mounting thermostats, humidistats, and switch controls in electrical outlet boxes at heights to match lighting controls or as required in Section 230923.27 "Temperature Instruments," Section 230923.19 "Moisture Instruments," and Section 230923 "Direct Digital Control (DDC) System for HVAC."

C. Connect supply and return hydronic piping to heat pump.

D. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

E. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

F. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

G. Install piping adjacent to machine to allow service and maintenance.

H. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:

1. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Heat pumps will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 23 81 46.13

SECTION 281500 - INTEGRATED ACCESS CONTROL HARDWARE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes access control door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Section includes, but is not necessarily limited to, the following for the integrated access control security and site management system:

1. Electrified and Integrated Access Control Card Key Door Hardware

C. Related Sections include the following:

1. Division 08 Section “Door Schedule”.
2. Division 08 Section “Door Hardware Schedule”.
3. Division 08 Section "Hollow Metal Doors and Frames."
4. Division 08 Section "Flush Wood Doors".
5. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
6. Division 08 Section "Door Hardware".
7. Division 14 Section "Elevators" for security access to elevator floor selection controls.
8. Division 26 Section "Electrical" for connections to electrical power system and for low-voltage wiring work.
9. Division 27 Section "Communications" for connections to the LAN.
10. Division 28 Section "Access Control" for access control devices and equipment installed at door openings and provided as part of a security and site management system.
11. Division 28 Section "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion detection system.
12. Division 28 Section "Video Surveillance" for motion detection and video camera devices and equipment installed at door openings and provided as part of a security and site management system.
13. Division 28 Section "Fire Detection and Alarm" for connections to building fire alarm system.

D. References:

1. ANSI A117.1 (1998) - Accessible and Usable Buildings and Facilities.
2. IBC - International Building Code
3. NFPA 70 (2002) - National Electrical Code.
4. NFPA 80 (1999) - Fire Doors and Windows.
5. NFPA 101 (2006) - Life Safety Code.
6. UL 294 - Access Control Systems.
7. UL 1076 - Proprietary Burglar Alarm Units and Systems.

E. Products installed, but not provided under this Section include the following. Coordination to remain a requirement of this Section.

1. Security or High Security keyed cylinders, including provisions for temporary construction keying, for mechanical override at access control locking hardware to be furnished under Division 8 Section "Door Hardware".

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. System Operational Descriptions: Complete system operational narratives for the integrated access controlled openings defining the owner's prescribed requirements for the opening functionality. Narratives include, but are not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions, and interfaces with other building control systems.

C. Shop Drawings: Details of electrified integrated locking hardware and access control firmware, indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication and control of the access control system electrified hardware and firmware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.

2. Electrical Coordination: Coordinate with related Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Proof of Certification: Upon request provide a copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary access control components.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete access control and site management installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and telephone number of the supplier/integrator providing the installation and the nearest service representatives for each item of equipment included in the system. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

1. As-Built Drawings: During system installation, the Contractor to maintain a separate hard copy set of drawings, elevation diagrams, and wiring diagrams of the access control system to be used for record drawings. This set to be kept up to date by the Contractor with all changes and additions to the access control system accurately recorded.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum of five (5) years of documented experience in providing access control and security systems equipment and software similar to that indicated for this Project and that have a proven record of successful in-service performance.

1. Software and access control systems components to have been previously and thoroughly tested together with proven installations similar in size and functionality to the design requirements indicated for this Project.

B. Supplier Qualifications: Supplier/Dealers, verifiably authorized and in good standing with the primary product manufacturers, with a minimum of three (3) years of experience supplying integrated access control systems similar in material, design, and scope to that indicated for this Project and whose work has resulted in construction with a proven record of successful in-service performance.

1. ASSA ABLOY access control products are required to be supplied only through designated “Authorized Channel Partners.”

C. System Integrator Qualifications: Systems Integrators, verifiably factory trained and certified by the primary product manufacturers, with a minimum of three (3) years documented experience installing complete integrated access control systems similar in material, design, and scope to that indicated for this Project and whose work has resulted in construction with a proven record of successful in-service performance. Qualifications include, but are not necessarily limited, to the following:

1. References: Provide a list of references for similar projects including contact name, phone number, name and type of project.
2. Professional Staffing: Firms to have a dedicated access control systems integration department with full time, experienced professionals on staff experienced in providing

on site consulting services for both electrified door hardware and integrated access control systems installations.

3. Factory Training: Installation and service technicians are to be competent factory trained and certified personnel capable of maintaining the system.
4. Service Center: Firms to have a service center capable of providing training, in-stock parts, and emergency maintenance and repairs at the Project site with 24-hour/7-days a week maximum response time.

D. Installer Qualifications: Certified technicians, verifiably authorized with the primary product manufacturers for installation of IP-Enabled, Wireless, and Power-over-Ethernet Access Control products in accordance with documented instructions and NFPA 80.

1. ASSA ABLOY access control products are required to be installed only through designated "Preferred Installers."

E. Source Limitations: Obtain the access control door hardware, system firmware and application software specified in this Section from a single source, qualified supplier/integrator unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide integrated access control door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:

1. Comply with NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1.
3. Comply with NFPA 101 "Life Safety Code" for doors in a means of egress.
4. Comply with NFPA 80 "Fire Doors and Windows" for fire labeled opening assemblies.
5. The installed access control system shall conform to all local jurisdiction requirements.

G. Keying Conference: Reference Division 8 Section "Door Hardware".

H. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier/Dealer, Systems Integrator, and Contractor to review proper methods and procedures for receiving, handling, and installing the access control system hardware. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedules.

1. Inspect and discuss Division 26 electrical roughing-in and similar preparatory work performed by other trades.

2. Review and verify sequence of operation descriptions for each unique access controlled opening.
3. Review and finalize construction schedule and verify availability of materials.
4. Review the required inspecting, testing, commissioning, and demonstration procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store electronic access control hardware, software or related accessories at Project site without prior authorization.

1. Access control firmware and software: Where approved and directed, inventory upon receipt and store electronic access control equipment in a secure, temperature and humidity controlled environment in original manufacturer's sealed containers.

B. Tag each item or package separately with identification related to the final Access Control Door Schedule, and include basic installation instructions with each item or package.

C. Deliver permanent keys, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner established at the “Pre-Submittal Conference".

1.6 COORDINATION

A. Coordinate quantity and arrangement of assemblies with ceiling space configuration and with components occupying ceiling space, including structural members, pipes, air-distribution components, raceways, cable trays, recessed lighting fixtures, and other items.

B. Access Control System Electrical Coordination: Coordinate the layout and installation of scheduled electrified door hardware, and related access control equipment, with required connections to source power junction boxes, power supplies, detection and monitoring hardware and fire alarm system.

1. Door Hardware Interface: The card key access control system to interface and be connected to electronic door control hardware (electromechanical locks, electric strikes, magnetic locks, door position switches, other monitoring contacts, and related auxiliary control devices) as described under Division 8 "Door Hardware". Coordinate the installation and configuration of specified door hardware being monitored or controlled with the controls, software and access control hardware specified in this Section.

C. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing electrified door hardware and access control system components. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing access control system hardware to comply with indicated requirements.

D. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to

receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article will not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and are in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of the installed access control system hardware and software that fails in materials or workmanship, including all related parts and labor, within specified warranty period after final testing and acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods (Electrified Access Control Door Hardware):

1. Two years for Electrified, Wiegand Output, and IP-Enabled Access Control Door Hardware.

E. Maintenance Support and Extended Service Agreement: Submit for Owner’s consideration an optional extended Service Agreement for the installed access control system, including support for software related issues. The extended Service Agreement is considered elective and is without manufacturer's requirement stipulating mandatory coverage for owner and/or vendor system support.

1. A published copy of this agreement to be included with the submittal package
2. Support for the installed access control system components is provided through the vendor under a 24 hour technical assistance program.
3. Access control and management system components are to be available on a one-day turn around time frame from the manufacturer.
4. Primary systems manufacturer to offer and provide remote modem or internet access for direct factory support to the vendor. The factory level support to include diagnostics and troubleshooting support on systems related issues at no additional cost to the owner.

F. Access Control Software Upgrades: Version upgrades and "fix" releases to the access control system software are available at no extra charge as long as the version of software provided

under this specification remains the current manufacturer's version or for up to (2) years after a new version release.

1. Major access control software revisions that provide new functionality to the product provided free of charge for up to one (1) year from the date of substantial completion.
2. Access control system software is to be upgradable as may be required or as necessary, to expand and manage the owner's site or sites. Upgrades are to be offered at a published flat fee for the primary system software, with single license modules included in the primary fee structure. System upgrades offered at a costing structure based upon the original number of licensed modules issued, or on those to be purchased at a future date, are not allowed.
3. As part of the submittal package, provide a list of available software upgrades and/or expansions modules. List to identify related costs for upgrades, or expansions to the original system, up to the next qualifying operational level.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of the installed access control system hardware and components.

B. Maintenance Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance by skilled employees of the Systems Integrator. Include repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

1.9 SCOPE OF WORK

A. On-Line Electronic Access Control System: Furnish and install at the indicated locations the specified electrified and integrated door hardware and access control firmware and software for a completely operational access control and security site management system. System includes, but is not necessarily limited, to the following:

1. Electrified integrated card reader locks and exit hardware, network control processors, reader controller panels, I/O monitor/control interfaces, door position switches, remote card readers, keypads, and display terminals, access cards and credentials, system application software, special tools, operating manuals, and required cabling and accessories as detailed below and listed in the Access Control Hardware Sets at the end of Part 3.

    a. Provide the appropriate number of reader controller panels and I/O monitoring/control expansion interfaces as needed to handle the number of card readers, locking devices, door status devices, and identified alarm inputs specified in this section, and as shown on the security drawings.

b. Provide manufacturer approved integrated card reader locks, exit hardware, and remote mounted card readers, keypads, and display terminals that are functionally compatible with the specified access control equipment interfaces.

2. Access control system equipment to be installed in an enclosure box compatible with the specified components. This enclosure to include, but is not necessarily limited to, the network control processor, I/O monitor/control interface panels, power supplies, terminal strips, wire ducts, keyed lock cylinder, integrated outlet for A/C power, and standoffs.

   a. Enclosure box to be located in the designated IT/Telecom room(s) with connection to local area network for communication back to the central server host.

3. Owner to provide the following:

   a. Central server host computer, client workstations, and hardware peripherals to be from an approved, major line computer manufacturer. Specific information detailing compliance with system requirements to be included in the project submittal package as specified.
   b. Owner will be responsible for ensuring that each computer hardware component includes the required interfaces, expansion boards, and peripherals that will be necessary to allow the system to operate as described within this specification and as indicated on the drawings.
   c. Power Sourcing and Network Switches: Quantity as required to accommodate installed access control (and video surveillance) devices.
   d. Network Control Processor Connections:

      1) LAN/Ethernet communication ports (jacks) and network interface cards as needed, CAT5e cabling from network router/switch to network control processor, outlet and cover plates and/or patch cables required for network connection within each designated IT/Telecom room.
      2) Required static IP addresses.

4. Power Supplies, including battery back up and separately fused surge protection, required for the electrified door hardware and access control equipment.
5. Installation, final configuration and commissioning of electrified door and access control system hardware, communication firmware, power supplies and related accessories.
6. System application software including installation, programming, and end user training of the access control system demonstrating operating, repair, and maintenance procedures. Include no fewer than 8 hours of on-site central server training for designated personnel (facilities maintenance, security, IT, administration) by a factory certified representative.

7. Provide manufacturer required power controllers, interface boards, and programming that may be required for approved electric latch retraction exit devices supplied under Division 08 Section "Door Hardware."
8. Electrical contractor, Division 26, to provide the following:

a. Source power wiring (120VAC) as required for the electrified locking and access control hardware, equipment, accessories and power supplies. This includes quad outlets as required on a dedicated circuit in the designated IT/Telecom room(s) and the related conduit, stub-in, junction boxes and connectors required for the source power delivery and connections.
b. Provide required conduit, stub-in, junction and back boxes for both the electrified locking hardware and access control equipment at each of the access controlled or monitored openings per plan drawings and specs. Supply and install conduit between each of the aforementioned devices and between the electrical junction boxes, power supplies and access control equipment located on or above the door opening.

    1) At wall mounted remote readers, provide conduit on the secured side of the door, 36" from the finish floor and 6" from the edge of the frame, to the related power supplies and access control equipment.
    2) At electrical hardware power transfers provide conduit on the secured side of the opening from the power transfer, thru-wire hinge, or serviceable panel location on the frame jamb to the related power supplies and access control equipment.

c. Electrical Contractor to provide all 120VAC cabling connections and terminations from the electrical junction boxes to these electrical devices.

9. Access Control System Integrator to provide the following:

    a. Low voltage wiring (12/24VDC) and communication cabling (RS-232/RS-485) from network control processors to reader controllers, I/O monitor/control interface panels, electrified and integrated locking hardware, remote card readers, keypads, or display terminals, monitoring and signaling switches, and power supplies. Work includes related connectors, final terminations, and hook-ups required for a complete and functional access controlled opening in accordance with applicable codes and specified system operational narratives.

10. Elevator Contractor to provide the following:

    a. Interface or landing of interface cable onto the elevator call button will be performed by a certified elevator contractor.
    b. Coordinate with access control systems integrator provisions for a card reader with output allowing the elevator call button to be activated. A validated card read will be required for activation.
11. Full and seamless integration of the site intrusion alarm service if applicable, with the installed site access control system software.
12. Final connections to fire alarm system, if required, by electrical and fire alarm system contractors.
13. Provide permits, submittals and approvals required by the authority having jurisdiction, prior to commencing with work.

14. Provide manufacturer required power controllers, interface boards, and programming that may be required for approved electric latch retraction exit devices supplied under Division 08 Section "Door Hardware."
15. Electrical contractor (Division 26) to provide the following:

    a. Provide required conduit, stub-in, junction and back boxes for both the electrified locking hardware and access control equipment at each of the access controlled or monitored openings per plan drawings and specs. Supply and install conduit between each of the aforementioned devices and between the electrical junction boxes, power supplies and access control equipment located on or above the door opening.

        1) At off-line remote readers, provide conduit on the secured side of the door, 36" from the finish floor and 6" from the edge of the frame, to the related power supplies and access control equipment.
        2) At electrified hardware power transfers provide conduit on the secured side of the opening from the power transfer, thru-wire hinge, or serviceable panel location on the frame jamb to the related power supplies and access control equipment.

    b. Electrical Contractor to provide all 120VAC cabling connections and terminations from the electrical junction boxes to these electrical devices.

16. Access Control System Supplier to provide the following:

    a. Low voltage wiring (12/24VDC) for the electrified locking hardware, remote card readers, monitoring and signaling switches, and power supplies. Work includes related connectors, final terminations and hook-ups required for a complete and functional access controlled opening in accordance with applicable codes and specified system operational narratives.

17. Typical System Requirements (Owner Provided): Central server host computer, client workstations, and hardware peripherals to be from an approved, major line computer manufacturer. Specific information detailing compliance with system requirements to be included in the project submittal package as specified.

PART 2 - PRODUCTS

2.1 APERIO WIRELESS ACCESS CONTROL

A. Wireless Access Control Mortise Locks: Wireless technology ANSI/BHMA A156.13 Grade 1 mortise lockset with integrated card reader, deadbolt monitoring, and request-to-exit and door position switch signaling in one complete unit. Motor driven locking/unlocking control of the lever handle trim, 3/4" stainless steel latch, and optional 1" deadbolt with hardened inserts. Lock is U.L listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Wireless access control lock interface using local wireless connection between the lock unit and a nearby communication hub. Communication hub connected via RS-485 or Wiegand to a new or existing online electronic access control system platform.
2. Fully-encrypted AES 128 wireless communication between lock and communication hub (IEEE 802.15.4, 2.4 GHz) with no proprietary programming device requirements. Locks will continue functional operation independent of wireless connection slowdown or failure.
3. Integrated card reader supports 125kHz proximity credentials; 13.56 MHz contactless credentials: HID® iCLASS (full authentication, all formats, including SEOS), Mifare Classic (Sector and UID), DESFire, NFC-enabled mobile phones.
4. Support for HID Mobile Access via Bluetooth Low Energy (BLE) short-range wireless communication.
5. Lockdown capability with maximum 10 second response.
6. Patent pending credential cache to ensure offline access.
7. Power Source: 6 AA alkaline batteries power supply with LED indication of locked, programming mode and low capacity warning status conditions.
8. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
9. Outside lever rigid except when valid user code is entered. Emergency override access capability with optional mechanical key cylinder retraction of lock latch bolt without necessary electronic activation.
10. Communication Hub: Provide the necessary number of hubs which is connected to the access control system via RS-485 or Wiegand as required by the system. Provide hubs factory paired with the locks, but allow for field configuration as needed.
11. Complete installation to include manufacturer's Installation Tool and USB Radio Dongle for initial lock set-up and configuration. Electronic on-line access control system platform, including communication cabling and software, by others.

12. Manufacturers:

    a. Corbin Russwin Hardware (RU) – IN100 – ML2000 Series.
    b. Sargent Manufacturing (SA) – IN100 – 7900 Series.

B. Wireless Access Control Exit Hardware: Wireless technology ANSI/BHMA A156.3 Grade 1 rim and mortise exit device hardware with integrated card reader. Separate DPS connects directly to exit hardware electronics for door position (open/closed status) monitoring. Motor driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or "fire exit hardware" for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override trim.

1. Wireless access control exit hardware interfaces using local wireless connection between the electronic exit trim and a communication hub located directly above the door. Communication hub connected via RS-485 to a new or existing online electronic access control system platform.
2. Fully-encrypted AES 128 wireless communication between lock and communication hub (IEEE 802.15.4, 2.4 GHz) with no proprietary programming device requirements. Locks

will continue functional operation independent of wireless connection slowdown or failure.

3. Integrated card reader supports 125kHz proximity credentials; 13.56 MHz contactless credentials: HID® iCLASS (full authentication, all formats, including SEOS), Mifare Classic (Sector and UID), DESFire, NFC-enabled mobile phones.
4. Support for HID Mobile Access via Bluetooth Low Energy (BLE) short-range wireless communication.
5. Lockdown capability with maximum 10 second response.
6. Patent pending credential cache to ensure offline access.
7. Power Source: 6 AA alkaline batteries power supply with LED indication of locked, programming mode and low capacity warning status conditions.
8. Outside lever rigid except when in "passage" mode, or valid user code is entered. Emergency override access capability with optional mechanical key cylinder retraction of exit device latch without necessary electronic activation.
9. Complete installation to include manufacturer's Installation Tool and USB Radio Dongle for initial lock set-up and configuration. Electronic on-line access control system platform, including communication cabling and software, by others.

10. Manufacturers:

    a. Corbin Russwin Hardware (RU) – IN100 – ED5000 Series.
    b. Sargent Manufacturing (SA) - IN100 – 80 Series.

2.2 INTEGRATED WIRED OUTPUT ACCESS CONTROL, MULTI-CLASS READER

2.3 CABLES AND WIRING

A. Comply with Division 27 Section "Conductors and Cables for Electronic Safety and Security."

B. Data Line Supervision: System to include alarm initiation capability in response to opening, closing, shorting, or grounding of data transmission lines.

C. Install appropriate number of conductor pairs, in the wire gage (AWG) recommended by manufacturer, corresponding to the electronic locking functions specified, amperage drawn and distances covered between the power supplies, power transfer devices, electrified hardware and access control equipment.

2.4 ACCESS CONTROL HARDWARE FINISHES

A. Standard: Comply with BHMA A156.18.

B. Protect mechanical finishes on exposed surfaces from damage by applying temporary protective coverings before shipping.

C. Where specified, finishes on integrated card key locksets or exit hardware to incorporate an FDA recognized antimicrobial coating (i.e., MicroShield™) listed for use on equipment as a

suppressant to the growth and spread of a broad range of bacteria, algae, fungus, mold and mildew.

D. BHMA Designations: Comply with base material and finish as specified.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance of the installed access control system.

B. Examine roughing-in for electrical source power to verify actual locations of wiring connections before electrified and integrated access control door hardware installation.

C. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

D. Notify architect of any discrepancies or conflicts between the specifications, drawings and scheduled access controlled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Doors and frames at scheduled access controlled openings to be properly prepared to receive specified electrified and access control hardware and connections without additional in-field modifications.

3.3 INSTALLATION

A. Install each item of electronic integrated door hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

B. Mounting Heights: Mount electronic integrated door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."

C. Boxed Power Supplies: Verify locations.

1. Configuration: Provide the least number of power supplies required to adequately serve doors with access control hardware and equipment.

D. Final connect the system control switches (integrated card key locking hardware, remote readers, keypads, display terminals, biometrics), and monitoring, and signaling equipment to the related Controller devices at each opening to properly operate the electrified door and access control hardware according to system operational narratives.

E. Retrofitting: Install each door hardware and access control item to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

F. System Application Software: Install, and test application(s) software and databases for the complete and proper operation of systems involved. Assign software license(s) to Owner.

3.4 ADJUSTING

A. Adjust and check each operating item of integrated access control door hardware, and each door opening to ensure proper secured operation and function of every unit. Replace units that cannot be adjusted to operate as intended.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by access control system installation.

B. Clean operating items as necessary to restore proper finish and provide final protection and maintain conditions that ensure access control door hardware is without damage or deterioration at time of owner occupancy.

3.6 DEMONSTRATION

A. Engage an authorized systems manufacturer representative to train Owner's maintenance personnel to adjust, operate, and maintain electronic integrated door hardware and the access control system.

3.7 ACCESS CONTROL HARDWARE SETS

A. The access control system hardware sets listed below represent the design intent and direction of the owner, architect, and security consultant (as applicable). They are intended as a guideline only and should not be considered a detailed opening schedule. Discrepancies, conflicting, and missing items should 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 and functionality.

B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.

END OF SECTION 281500