



State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Solicitation

NUMBER

WSH13095

PAGE

1

ADDRESS CORRESPONDENCE TO ATTENTION OF

ROBERTA WAGNER
304-558-0067

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HEALTH AND HUMAN RESOURCES
OPERATIONS
VARIOUS LOCALES AS INDICATED
ON PURCHASE ORDER

DATE PRINTED:

03/04/2013

BID OPENING DATE:

03/19/2013

BID OPENING TIME 1:30PM

LINE	QUANTITY	UOP	CAT NO	ITEM NUMBER	UNIT PRICE	AMOUNT
ADDENDUM NO. 4						
1. ADDENDUM ISSUED TO PROVIDE REVISED SPECIFICATIONS, DRAWINGS AND TO ANSWER VENDORS' QUESTIONS. DOCUMENTS AND DRAWINGS ARE INCLUDED ON CD, WHICH IS ALSO INCLUDED WITH THE HARD COPY MAILING. DUPLICATE DOCUMENTS AND DRAWINGS ARE POSTED ONLINE IN THE WEST VIRGINIA PURCHASING BULLETIN WITH CORRESPONDING SOLICITATION.						
2. TO ADD CODE OF STATE RULES SECTION 148-1-7.2 VERBIAGE AS DEFINED ON "ATTACHMENT A".						
3. TO MOVE THE BID OPENING DATE FROM: MARCH 6, 2013 TO: MARCH 19, 2013 THE BID OPENING TIME OF 1:30 PM REMAINS UNCHANGED.						
4. TO PROVIDE ADDENDUM ACKNOWLEDGEMENT. THIS DOCUMENT SHOULD BE SIGNED AND RETURNED WITH YOUR BID. FAILURE TO SIGN AND RETURN MAY RESULT IN THE DISQUALIFICATION OF YOUR BID.						
----- END OF ADDENDUM NO. 4 -----						

SIGNATURE

TELEPHONE

DATE

TITLE

FEIN

ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO SOLICITATION, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'



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WSH13095

PAGE
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ADDRESS CORRESPONDENCE TO ATTENTION OF:
ROBERTA WAGNER 804-558-0067

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03/04/2013

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03/19/2013

BID OPENING TIME 1:30PM

LINE	QUANTITY	UOP	CAT. NO.	ITEM NUMBER	UNIT PRICE	AMOUNT
0001	1	JB		968-20		
50 BED ADDITION TO WILLIAM R. SHARPE JR. HOSPITAL						
***** THIS IS THE END OF RFQ WSH13095 ***** TOTAL:						

SIGNATURE	TELEPHONE	DATE
TITLE	FEIN	ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO SOLICITATION, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

SOLICITATION NUMBER: WSH13095

Addendum Number: 04

The purpose of this addendum is to modify the solicitation identified as ("Solicitation") to reflect the change(s) identified and described below.

Applicable Addendum Category:

- ☒ Modify bid opening date and time
- ☒ Modify specifications of product or service being sought
- ☒ Attachment of vendor questions and responses
- ☐ Attachment of pre-bid sign-in sheet
- ☐ Correction of error
- ☒ Other

Description of Modification to Solicitation:

1. To provide revised specifications, drawings and to answer vendors' questions. Revisions and Q&A are provided via the attached CD.
2. To move the bid opening date from March 6, 2013 to March 19, 2013. Bid opening time at 1:30 PM remains the same.
3. To add Code of State Rules Section 148-1-7.2 verbiage as defined on ATTACHMENT A.
4. To provide Addendum Acknowledgement.

Additional Documentation: Documentation related to this Addendum (if any) has been included herewith as Attachment A and is specifically incorporated herein by reference.

Terms and Conditions:

1. All provisions of the Solicitation and other addenda not modified herein shall remain in full force and effect.
2. Vendor should acknowledge receipt of all addenda issued for this Solicitation by completing an Addendum Acknowledgment, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

ATTACHMENT A

As noted in West Virginia Code of State Rules Section 148-1-7.2, Spending units may not use brand names to restrict competition. If, however, brand names are used, the brand name shall be followed by the phrase "or equal" to promote and encourage competition. This addendum hereby modifies the original solicitation by placing the phrase "or equal" after each brand name reference. As noted in the specifications, firms desiring to take advantage of the "or equal" requirement were required to submit alternates/substitutions that the vendor considered to be equal during the Question Period ending January 23, 2013. Vendors were to include pertinent literature, data and specifications.

Any alternates submitted were reviewed by the project architects and engineers, and decisions regarding the equality of those submissions have been published in this Addendum.

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.: WSH13095

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:

(Check the box next to each addendum received)

<input type="checkbox"/> Addendum No. 1	<input type="checkbox"/> Addendum No. 6
<input type="checkbox"/> Addendum No. 2	<input type="checkbox"/> Addendum No. 7
<input type="checkbox"/> Addendum No. 3	<input type="checkbox"/> Addendum No. 8
<input type="checkbox"/> Addendum No. 4	<input type="checkbox"/> Addendum No. 9
<input type="checkbox"/> Addendum No. 5	<input type="checkbox"/> Addendum No. 10

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

Company

Authorized Signature

Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.
 Revised 6/8/2012

WSH13095

ADDENDUM #4

50-BED ADDITION

WILLIAM SHARPE HOSPITAL

WESTON, WEST VIRGINIA



**IKM INCORPORATED
ARCHITECTS INTERIOR DESIGNERS
ONE PPG PLACE
PITTSBURGH, PENNSYLVANIA 15222**

JANUARY 30, 2013

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NOVEMBER 2012

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WSH13095 Addendum #4

January 30, 2013

RFQ: Questions, Responses and Modifications

1. Does the steel fabricator for the William R. Sharpe Hospital project have to be AISC certified?
This will exclude many capable steel fabricators from West Virginia.
Response: [AISC Certified steel fabricators are required. See Section 2.02 of Specification 05 12 00.](#)
2. On Page 5 of the Solicitation, it states, "In the event that Vendor is responding to a request for proposal, the Vendor shall submit one original technical and one original cost proposal plus 5 convenience copies." Since this Solicitation only requires submission of a cost proposal, please confirm that we shall submit one (1) original and five (5) copies of the cost proposal documents.
Response: [Vendor should submit one original cost proposal.](#)
3. The forms included with the Solicitation are the Bid Bond, Drug Free Workplace Conformance Affidavit, Purchasing Affidavit, Certification and Signature Page and Addendum Acknowledgement Form. Volume 1 of the Specifications includes the Form of Proposal, some of the same forms included in the Solicitation, and additional forms, including Bid Supplements #2 through #6. Please provide a list of the forms that are required to be included with our bid submission.
Response: [All forms listed in the Solicitation should be included in the bid submission. Also include the forms from Division 0 of the Specification that are not duplicates from the Solicitation.](#)
4. Please clarify whether a separate Addendum Acknowledgement Form should be submitted for each Addendum issued or whether one (1) Addendum Acknowledgement Form acknowledging receipt of all addenda received is required to be submitted with the bid (i.e. if there are three (3) total addenda issued for the project, should we return three (3) separate forms or just one (1) form acknowledging Addendum No. 1, 2, and 3?)
Response: [One \(1\) Addendum Acknowledgement Form Acknowledging receipt of All Addenda should be submitted with the bid but must be received prior to the award of a contract.](#)
5. Sheet S010 shows column and wall footing types. Some of the column footings are not labeled. Will column footings not labeled be FTG3? Response: [Column Footings not labeled will be FTG3. See revised Drawing S010.](#)
6. RFQ, Page 5, Item 6 – "In the event that Vendor is responding to a request for proposal, the Vendor shall submit one original technical and one original cost proposal plus 5 convenience copies". General Contractors will be working up until the final minutes before the submission deadline to finalize their numbers to ensure the owner receives the best price possible. There

simply isn't sufficient time to fill out the RFQ, FOP, and supporting documentation and make 5 convenience copies in this short window of time. Please either waive this requirement, or allow time after the submission deadline to provide 5 convenience copies. Response: [Vendor should submit one original cost proposal.](#)

7. Plans, S001, Foundation Notes, 2. – Due to the unquantifiable nature of this item, please provide an allowance in conjunction with a unit price for foundation over excavation and concrete pad. Response: [Underground materials are Unclassified. See Spec section 31 20 00 \(Site Preparation\) section 3.4 for more information. Refer to Geotech Reports for information.](#)
8. Plans, S001, Foundation Notes, 7. – Due to the unquantifiable nature of this item, please provide an allowance in conjunction with a unit price for unsuitable fill removal and replacement. Response: [Underground materials are Unclassified. See Spec section 31 20 00 \(Site Preparation\) section 3.4 for more information. Refer to Geotech Reports for information.](#)
9. Detail 6 on A204 shows the scupper detail. I only find one (1) shown on the Drawing A101. Please clarify. Response: [There are two scuppers; one shown on 6/A101, and on 5/A204.](#)
10. Are there any requirements for frost free type slabs at the exterior door concrete pads, could not find any details or sections? Response: [No.](#)
11. Could not find a spec for the underslab vapor barrier?? Response: [Please refer to Specification Section 03 30 00 found in this Addendum for underslab vapor retarder information.](#)
 - a. [Section 2.05 \(Accessory Materials\):](#)
 - i. [Added Section C "Underslab Vapor Retarder"](#)
 - ii. [Added Section D.](#)
12. On drawing C105- There is a detail mark 3/115 (conc. curb) adjacent to the bldg on the West side near the sallyport-Is curb required against the bldg in that area?? Response: [No.](#)
13. Please advise type of concrete required under the canopy at the sallyport area. Response: [Sidewalk as per Detail 1/C115.](#)
14. On drawing C109 does the sidewalk that runs east to west between the new and existing paving require curb both sides? Response: [See attached Sketch SKC-3 "Main Entrance Parking" for information.](#)
15. On drawing C115 details 5 & 6 show ADA ramps, I do not see any locations for same on the site plans-Please clarify. Response: [See attached Sketch SKC-3 "Main Entrance Parking" for information.](#)
16. On drawing C113 what is the transition detail from new asphalt paving to the H.D concrete on the north side of the mech bldg-Is there a flush or haunched curb required?? Response: [Flush Curb.](#)
17. The site benches listed per the drawing are 96" long-the concrete pads for same scale at 60"—What length bench is required?? Response: [Benches are 60" See attached drawings A100a, A100b and A100c for clarification.](#)

18. Please clarify locations for the air barriers in spec 07-27-19 and 07-28-00. Response: [Refer to Wall Sections for locations of both air and weather barriers in the exterior wall construction.](#)
19. Please clarify type and size of steel reinforcing for the slab on deck supporting the roof equipment. Response: [Modification to drawing S120, change note to W6x6-W2.1xW2.1 Galvanized WWF for the roof deck concrete, For Slab on Grade on Drawing S100 use 4" thick slab with W6x6-W2.9xW2.9 plain WWF.](#)
20. On drawing A101 detail shows a note for a concrete curb, if required please provide information for same. Response: [Concrete curb is not required. See revised drawing A101.](#)
21. On drawing C115 detail 4/115, please provide location, if required. Response: [See attached Sketch SKC-3 "Main Entrance Parking" for information.](#)
22. Glass schedule on drawings call for 1" tinted Low E insulated glass (types 1, 3 and 7) while the spec's call for Ultraclear Low E. Please confirm glass color/composition. Response: [Glazing types indicated in the drawings as being "Tinted Glazing with Low-E" are correct. Please refer to Glazing Spec Section 08 81 00 edited as a part of this Addendum for characteristics of the Tint required. Other glazing types listed as being "Clear Glazing with Low-E Coating" on the drawings is correct as well and should follow the requirements listed in the spec section.](#)

The following edits have been made to the Glazing Types (1, 3 & 7) listed in this question. Please refer to drawings A609 and A610 as a part of this Addendum which reflect these clarifications among others:

[Type 1: 3 ½" Insulating Unit](#)

[Interior: Clear Laminated Security Pane](#)

[Exterior: 1" Insulating Unit \(Tinted\) with Low-E Coating Surface #2](#)

[Type 3: 1" Insulating Shaded Unit](#)

[Interior: Clear Glazing Pane](#)

[Exterior: Tinted Glazing with Low-E Coating Surface #2](#)

[Type 7: 3/8" Fire Rated Glazing](#)

[Modification to Specification Section 08 81 00:](#)

23. Please confirm overall glass thickness and PVB interlayer requirements of laminated glass at the following locations (sheets A609 and A610):
- a.) Clear laminated exterior security pane of glass types 1 and 2. Response: [The Glazing Thickness is 3/8". For PVB Interlayer requirements refer to specification Section 08 81 00 Glazing. Glazing Types in the Glass Schedule have been updated in the drawings to reflect changes and clarifications. Refer to Drawings A609 and A610 in this Addendum.](#)

b.) Clear laminated glass type 4. Response: [The Glazing Thickness is 1/4" Tempered Glazing. For glazing requirements refer to specification Section 08 81 00 Glazing. Glazing Types in the Glass Schedule have been updated in the drawings to reflect changes and clarifications. Refer to Drawings A609 and A610 in this Addendum.](#)

c.) One-way mirrored laminated security pane glass type 5. Response: [The Glazing Thickness is 1/2". For PVB Interlayer requirements refer to specification Section 08 81 00 Glazing. Glazing Types in the Glass Schedule have been updated in the drawings to reflect changes and clarifications. Refer to Drawings A609 and A610 in this Addendum.](#)

24. Glass types 3 and 7 on drawings call for same glass composition. Please confirm they are the same? Response: [Glazing Types in the Glass Schedule have been updated in the drawings to reflect changes and clarifications. Refer to Drawings A609 and A610 in this Addendum.](#)
25. Interior curtainwall frames type 5, 6, 7, 11 and 12 call for glass type 7 at all upper lites (1" tinted insulated glass) and all the lower lites to be glass type 4 (clear laminated glass). Please confirm glass types at these frames. Response: [Drawings A609 and A610 have been edited as a part of this Addendum. Please refer to these sheets for changes and clarifications.](#)
26. Door glazing note (A) on door schedule sheet A608 calls for a nominal 3/8" Armor Protect Glass by Oldcastle. Oldcastle publishes their ArmorProtect glass with a nominal 1/2" thickness. They publish their ArmorProtect Max glass with a nominal 3/8" thickness. Please confirm glass requirements. Response: [Drawing A608 has been edited as part of this addendum. Please refer to sheet for clarification.](#)
27. Please provide specifications for laminated fire rated glass (glass type C on door schedule sheet A608). Response: [Please refer to Specification Section 08 81 00 Glazing found in this Addendum for fire rated glass requirements. Additionally refer to Sheet A608 also found in this Addendum for clarification of fire rated glazing in the Door Glazing Schedule Notes.](#)
28. Glass type 1 calls for and shows Low E coating on the #2 and #3 surface of the insulated glass. Please confirm this should be the #2 surface per the specifications. Response: [Low-E Coating should be located on the #2 Surface only, as per the Specifications. Drawings A609 and A610 located within this Addendum have been updated in the drawings to reflect changes and clarifications.](#)
29. Note #2 on Drawing M203. "Coordinate CHWS and CHWR, and HWS and HWR pipe routes up." Can you provide specific information as to what is required? Response: [Refer to Plan Note #2 revision issued on revised Drawing M203.](#)
30. In the RFQ it requests that the vendor submit one original cost proposal and five (5) convenience copies to the Purchasing Division. Are these five copies to be submitted in the

same envelope as the original or are all items to have their own envelope? Response: [All copies may be submitted in the same envelope.](#)

31. Please clarify if the structural steel fabricator must be AISC Certified. Response: [Please refer to answer for RFQ Question #1.](#)

32. Can we go with 2 ½" rigid insulation and z furring at the exterior of the building in lieu of 3"? 3"z furring is not a standard size and will have to be a special made item. Response: [Contractor is required to provide 3" Z-furring to provide lateral connection and support for Fiber Cement Panel System as detailed in the exterior wall system. Methods of attaching 3" Rigid Insulation in areas where such connections are not required to complete the exterior shell , while not diminishing the insulated quality of the wall as designed may be explored.](#)

33. Will the retainage for the whole project be released after substantial and final completion have been achieved? Or will it be held until the 24th month. Warranty and maintenance period is completed? Response: [Warranty and Maintenance will be carried as a separate line item on the Pay Application, and will not affect the retainage of the Construction.](#)

34. Are there Spec Sections for the following Systems: Access Control, Intercom System & Security Camera System? Response: [There are no specification sections for the Intercom and Security camera systems. Provide as based on the drawings, schematics and notes. The access control system shall be provided by others. Rough-in, conduit, boxes, etc. shall be provided in this contract as indicated on the drawings and coordinated with Owner/Supplier.](#)

35. What are the existing systems in place at the hospital? Response: [Existing systems are not relevant to this Project.](#)

36. Detail 6/A505 calls for ½" metal studs. Should this be 1 5/8" metal studs? Response: [Modification to Drawing A505: note on Detail 6 for stud size changed to be 1 5/8". Throughout the drawings, change note for studs labeled at 1 ½" to 1 5/8" to match industry standards.](#)

37. ACP-2 is called out to be Ultima Health Zone with a tegular edge. However, the tile number 3114 refers to an Optima Health Zone with a square edge. Please advise as to which tile is desired. Response: [Please use: 3114 refers to an Optima Health Zone with a square edge](#)

38. During the Pre-bid Meeting, it was noted that all bid forms require notarization; however, not all of the bid forms have notarial language on them, and would not be eligible for notary signature without alteration to add the necessary language. Please confirm that only the forms with notarial language require the notary signature and provide the names of these forms. Response: [Only the Bid Forms required by solicitation WSH13095 which have notarial language require notary signature.](#)

39. Drawings A100a-c provide a Markerboard/Tackboard Key but the specifications do not include a Display Board section. Please advise. Response: [Please refer to Specification Section 10 11 00 found in this Addendum for Visual Display Unit information.](#)
40. Drawing A501, Details 1-6 all require 3" metal faced rigid insulation with "Z" clips. Specification 072100 - 2.1.B lists three acceptable Metal-Wrapped Plastic Board manufacturers. The Centria system does not allow for "Z" clips, and the other two appear to be rigid insulation that do not require "Z" clips. Are "Z" Clips required for insulation behind brick veneer? Response: [Contractor is required to provide 3" Z-furring to provide lateral connection and support for Fiber Cement Panel System as detailed in the exterior wall system. Methods of attaching 3" Rigid Insulation in locations other than where the Fiber Cement Panel System is located, Z-furring is not a requirement and the manufacturer's recommendation should be used for attachment.](#)
41. Subparagraph 1.2 of specification 12 56 00 - Furniture states that all bidders are required to attend a mandatory pre-bid conference. The invitation to bid states that only General Contractors and MEP Subcontractors are to attend the mandatory meeting. Please advise. Response: [Addendum #2 removed the requirement for any subcontractors to attend the Pre-Bid meeting. Only General or Prime contractors interested in bidding on the project were required to be present at the Pre-Bid meeting .](#)
42. Request for Substitution was submitted for the Vapor Barrier: BASF is a manufacturer of a fluid applied air and water resistive barrier called Enershield HP, and we have an applicator who would like to bid on the William R Sharpe Junior Hospital . Unfortunately, our Enershield HP product is not list in the 072726 specifications at this time. BASF would like to submit Enershield HP for prior approval. Enershield HP is ABAA approved, has a significantly lower VOC content than the currently specified product, and could save the project on up-front material cost, and this is all accomplished while maintaining the highest performance. Response. [This substitution is approved. Refer to the BASF, Enershield-HP cut sheet submitted as a part of this Addendum for product information.](#)
43. Is the sprinkler bid list closed to any one contractor in particular? Response: [No.](#)
44. It is unclear which application will be applied where, please clarify where the fluid applied air barrier (072726) goes vs. the sheet air barrier (072719). Response: [Use of fluid applied air barrier vs. sheet air barrier shall be the contractor's preference.](#)
45. Drawing C111 - Loading Dock Area - Please clarify the note "under construction". Response: [The area was under construction at the time of the topographical survey. That label has been deleted.](#)
46. Drawing S010 - Note #2 - Please clarify "all column footings are FTG UNO ? (is it FTG 3). Please clarify. Response. [Please refer to question #8. Note 2 should read "FTG3."](#)
47. REMCON does not provide a 12"h x 12"w x 12"d locker as shown on the drawings. In addition, a specification is not provided. Please clarify and provide a specification. Response: [Refer to Specification Section 10 51 26 Plastic Lockers](#)

48. Request made to send the mandatory pre bid sign in sheet and any addendums issued after #2 on project# WSH13095 - William Sharpe Hospital Care Facility (Add/Renov) that is due to bid on 2/13? Response: [Refer to Pre-Bid Sign In Sheet, attached to this Addendum. No additional Addendas have gone out after Addendum #2 as of January 30, 2013.](#)
49. Request for Substitution was submitted for Plumbing Fixtures: Acorn, Dura-Ware 2120 Series Response: [Acorn Engineering shall be an acceptable substitution for Plumbing Fixture Types WC-1, WC-1H and flush valve cover for same.](#)
50. Request for Substitution was submitted for Furniture elements: Workscape Response: [This substitution is NOT approved.](#)
51. What type of insulation for the roof? Response: [The roof is 4" polyisocyanurate. Refer to revised Specification Section 07 53 23 EPDM Roofing as a part of this Addendum.](#)
- a. Section 2.5 (Roof Insulation):
 - i. Deleted Section B (Extruded Polystyrene Board Insulation)
 - ii. Added Section B (Polyisocyanurate Board Insulation)
52. Will the insulation run up over the walls? Response: [Refer to Wall Sections on sheets A500 – A504 for insulation locations.](#)
53. Does the insulation need to be adhered down or mechanically attached? Response: [Roof Insulation is to be adhered. Only the substrate board is mechanically fastened in the roof system.](#)
54. Sheet S010 gives footer designations. Note 2 states all column footings are FTG. Please Clarify. Response: [Please refer to question #8. Note 2 should read "FTG3."](#)
55. Some columns have footers and piers. Sheet S011 shows pier details but we do not see a pier schedule. Response: [No pier schedule. See Detail 2 on S011, Typical Concrete Pier Detail and Column Scheduled. Sizes are shown on the Column Schedule.](#)
56. Where does footing type SF3 occur? Response: [Refer to answer for RFQ Question #8.](#)
57. The Site Drawings indicate the removal and salvage of existing fence. Please indicate if this fence is to be reinstalled. Please indicate the extent of New Fencing. What are the requirement for temporary fencing? Please indicate the extent of temporary fencing. Response: [The removed fence is not to be reinstalled; it is to be stockpiled at a location as indicated by owner. Modification to drawing C102 shows the extent of the new fencing and labeled as "8' CHAIN LINK FENCE." Modification to drawing C102 also shows the extent and location of the temporary fencing.](#)

58. Is there a need for medical gas headwalls to be provided? Response: [There are no medical gases in the project and no need for headwalls.](#)
59. On the bid envelope, who is to be listed as “the Buyer”? Response: [State of West Virginia. Department of Administration. Purchasing Division. Attention: Roberta Wagner. 2019 Washington Street East. PO Box 50130. Charleston, WV 25305-0130](#)
60. Does each addenda need to be signed and attached to our bid, or can we fill out **one** “Addendum Acknowledgement Form” that acknowledges each of addenda we received and attach it to our bid? Response: [Yes](#)
61. In the RFQ, Page 5, item 9. Bid Formatting - states that Vendors should electronically or type entries onto the bid form. Since the bids must be hand delivered, and we won’t have our price ready until a few minutes before the bid, is it permissible to hand write the dollar value entries onto the bid form? Response: [Hand written \(Number and words\) is acceptable](#)
62. In the RFQ, Page 5 states that we are to submit one original bid and (5) five copies. In the specifications, Section 00 11 16 “Invitation to Bid” states that bidders are to submit one original and (2) two copies. Please clarify how many copies of the bid are required to be submitted. Response: [See answer to RFQ question #2.](#)
63. Spec Section 06 40 23 Interior Architectural Woodwork, Article 1.5 states that the casework requires AWI certification. Can this requirement be waived? Response: [This requirement CANNOT be waived.](#)
64. Spec Section 05 12 00 Structural Steel, Article 1.05 H states that the steel fabricator is to be AISC certified. Can this requirement be waived? Response: [See answer to RFQ Question #1.](#)
65. Drawing A100a Courtyard Materials Key – Item #5 Concrete Benches – These are not in the specs. Are the concrete benches to be provided by the General Contractor? Response: [See response to RFQ Question #17.](#)
66. Spec Section 32 92 00 Turf and Grasses – there is reference throughout this spec to sod. Please define what areas of the lawn are to be seeded and which are to be sod. Response: [Sod is NOT required for this project. See modification to Specification 32 92 00 for revision.](#)
67. Spec Section 32 93 00 Plants – Article 2.14 references a metal trellis system. Is this applicable to this project? If so, please define where this will be located. Response: [Metal Trellis is NOT required for this project. See modification to Specification 32 93 00 for revision.](#)
68. Drawing C115, Detail 4- Typical Concrete Curb Back of Walk – Where does this detail occur? This detail is not referenced on the site layout plans. Since it is a typical detail, is this to occur at every place that sidewalk touches lawn? Response: [See sketch “SKC-3” for clarification.](#)
69. Modification to Drawing: Sheet A608 Door Schedule, Door and Frame Types and Details(Replace Sheet in its entirety)

- a. Doors 1349, 1349A, 1349B, 1349C & 1349D were modified to be a door type that includes glazing and glazing type was modified.
 - b. Door 1338 was modified to not include a glazing type.
 - c. Doors 1143B & 1220B were modified to have the glass eliminated from the “Dutch” Door.
 - d. Doors 1122, 1134 & 1165 were modified to include Door Glazing Type (A).
 - e. Door 1164 was changed to an aluminum door.
70. Modification to Drawing: Sheet A300 Enlarged Plans (Replace Sheet in its entirety)
- a. Window Tags were added to 3/A300, 7/A300 and 8/A300.
 - b. Door 1324A Frame Type was edited to include Window Sidelight.
71. Modification to Drawing: Sheet A611 Window and Glazing Types and Schedules (Replace Sheet in its entirety)
- a. Detail 17/A611 was added to Sheet.
72. Modification to Specification: Specification Section 09 65 19 Resilient Flooring and Base. Replace specification section in its entirety with attached revised specification as a part of this Addendum.
- a. Section 3.1 Examination:
 - i. Deleted language in Section B, paragraph 1
 - ii. Added language in paragraph 3 and 4
 - iii. Added language in Section D.
73. Modification to Specification: Specification Section 09 67 23 Resinous Flooring. Replace specification section in its entirety with attached revised specification as a part of this Addendum.
- a. Section 3.1 Preparation:
 - i. Added language in Section 3, paragraph b
 - ii. Deleted language in paragraph c
74. Modification to Specification: Section 31 20 00 – Earth Moving. Replace specification section in its entirety with attached revised specification with the following changes:
- a. Revised utility trench bedding material and compaction requirements.
75. Modification to Drawing: Sheet C105 – Building Expansion Site / Layout Plan (Replace Sheet in its entirety)
- a. Clarified when the 8’ fence is to be installed.
76. Modification to Drawing: Sheet C111 – Loading Dock Existing Conditions (Replace Sheet in its entirety)
- a. Added existing conduit and utilities lines.
77. Modification to Drawing: Sheet C112 – Loading Dock Demolition Plan (Replace Sheet in its entirety)
- a. Clarified demo electrical utility trench.

78. Modification to Drawing: Sheet C113 – Loading Dock Site and Layout Plan (Replace Sheet in its entirety)
- a. Clarified electrical utility construction.
 - b. Added note and dashed line showing electrical conduit. See electrical plans for details.
79. Modification to Drawing: Sheet C116 – Details (Replace Sheet in its entirety)
- a. Revised trench bedding material and compaction requirements.
80. Sketch Issued: SKC-1 (8.5" x 11") Additional Laydown Area
- a. Plan showing location for construction storage.
81. Sketch Issued: SKC-2 (8.5" x 11") Detail 9/C115
- a. Detail name change.
82. Modification to Specification: Section 22 13 16 – Sanitary Waste And Vent Piping. Replace specification section in its entirety with attached revised specification with the following changes:
- a. Delete Paragraph 2.4B in its entirety.
 - b. Delete the words "or Cellular-core" in Paragraphs 3.10A.2, 3.10B.1, and 3.10C.2.
83. Modification to Specification: Section 23 31 13 – Metal Ducts. Replace specification section in its entirety with attached revised specification with the following changes:
- a. Delete Paragraph 3.8F in its entirety.
84. Modification to Specification: Section 23 25 00 – HVAC Water Treatment. Replace specification section in its entirety with attached revised specification.
85. Modification to Specification: Section 23 74 10 – Custom Outdoor Air-Handling Units. Replace specification section in its entirety with attached revised specification with the following changes:
- a. Add line item 2.1A.1.e as noted.
 - b. Revise Paragraph 2.2D as noted.
 - c. Replace Paragraph 2.2D.1 as noted.
 - d. Revise Paragraph 2.3B as noted.
86. Modification to Specification: Section 26 13 00 – Medium-Voltage Switchgear: Issue new specification section as attached.
87. Modification to Drawing: Sheet MEP101 – Roof Plan (Replace Sheet in its entirety)
- a. Revise Plan Note #1 to clarify CHWS, CHWR, HWS and HWR connections to existing piping on roof by others.

- b. Add sizes and designations to CHWS, CHWR, HWS and HWR on roof plan.
- 88. Modification to Drawing: Sheet M203 – Nursing Unit 2 – HVAC Piping (Replace Sheet in its entirety)
 - a. Revise Plan Note #2 to further clarify continuation of pipe routing.
 - b. Change CHWS and CHWR pipe size from 6" to 4".
- 89. Modification to Drawing: Sheet M204 – Enlarged Floor Plans (Replace Sheet in its entirety)
 - a. Change CHWS and CHWR pipe size from 6" to 4".
 - b. Add VAV-1342 tag to VAV box located below the piping in the corridor.
- 90. Modification to Drawing: Sheet P101 – Nursing Unit 1 – Sanitary & Vent Plumbing Plan
 - a. Refer to Plan Note #3 – Change 1" Vent to 1 ½" Vent.
 - b. Added General Note #2: "Refer to Drawing P105 for Rain Water piping and Downspout Nozzles not shown on these drawings."
 - c. Add continuation of sanitary and vent piping to fixtures shown on Sheet P103 that were not previously indicated on this sheet.
- 91. Modification to Drawing: Sheet s P102 – Nursing Unit 2 – Sanitary & Vent Plumbing Plan
 - a. Revise Plan Note #3 to change vent size from 1" to 1-1/2".
 - b. Added General Note #2: "Refer to Drawing P105 for Rain Water piping and Downspout Nozzles not shown on these drawings."
 - c. Add 2" floor drain and piping for condensate drain from CC-1345, continued on Sheet P103.
- 92. Modification to Drawing: Sheet s P103 – Office and Sally Port – Sanitary & Vent Plumbing Plan
 - a. Revise Plan Note #5 to change vent size from 1" to 1-1/2".
 - b. Added General Note #2: "Refer to Drawing P105 for Rain Water piping and Downspout Nozzles not shown on these drawings."
 - c. Add 2" floor drain and piping for condensate drain from CC-1345.
- 93. Modification to Drawing: Sheet P203
 - a. Add to the end of Plan Note #5 – "This Contractor shall be responsible for furnishing and installing the 2" HW/2" RHW through the new connecting corridor and into the existing hospital. This contractor shall make final connections to the existing piping installed during the renovations project. Assume connections to existing piping will be a maximum of 10'-0" past the existing building wall and connections will be made above the ceiling. "
 - b. Add CW piping to Roof Hydrant (RH-1).
- 94. Modification to Drawing: Sheet P204 – Enlarged Floor Plans (Replace Sheet in its entirety)
 - a. Add Plan Note #5 for two (2) sinks provided by Kitchen equipment supplier.
 - b. Add Plan Note #6 and plan change to indicate ¾" CW to Roof Hydrant (RH-1).
 - c. Revise pipe sizes as indicated.
 - d. Add pipe size note to icemaker supply box (IB-1) in room 1323.

95. Modification to Drawing: Sheet P401
 - a. Revise "Floor Drain Installation Detail"
96. Modification to Drawing: Sheet P402
 - a. Revise "Vent Thru Roof Detail"
97. Modification to Drawing: Sheet ES101
 - a. Refer to attached Sketch SKE-1 that adds furnishing and installing underground conduits to this Project.
98. Modification to Drawing: Sheet E203
 - a. Refer to attached Sketch SKE-2 with revised electrical equipment layout/configuration in Main Electrical Room #1345.
 - b. Refer to attached Sketch SKE-3 indicating the location of the main 500 KVA transformer at enclosure #1356.
99. Modification to Specification 08 81 00 Glazing:
 - a. Section 1.1 Summary:
 - i. Deleted Section B.
 - b. Section 1.4 Submittals, Section B (Samples):
 - i. Added Fire Rated Glazing .
 - c. Section 1.5 Quality Assurance:
 - i. Added Section L (Fire-Protection-Rated Glazing Labeling)
 - d. Section 2.3 Glazing Sealants:
 - i. Added Section C (Glazing Sealants for Fire-Rated Glazing Products)
 - e. Added Section 2.8 (Tempered Glass – Glass Type 4):
 - f. Section 2.9:
 - i. Changed Language to add Glass Type 8
 - ii. Section A (Basis of Design);
 1. Added description for laminate
 2. Delete Section 1.
 - g. Section 2.10 (Added language for Glass Type 5)
 - i. Added Section A.
 - ii. Added Section E.
 - h. Section 2.11 (Added language for Glass Type 1):
 - i. Added Section A lanugage.
 - ii. Added language to Section D.
 - iii. Added language to Section F
 - i. Section 2.12 (Added language for Glass Type 2):
 - i. Added language to Section B
 - ii. Added language to Section E
 - j. Section 2.13 (Added language for Glass Type 3):
 - i. Added language for Section A
 - ii. Added language for Section B
 - iii. Added language for Section C
 - iv. Added language for Section D
 - v. Added language for Section E
 - k. Section 2.14 (Added language for Glass Type 6)
 - l. Section 2.15 (Added language for Glass Type 7)
100. Addition of Specification 01 91 13 (General Commissioning Requirements):

- a. Specification was omitted from Bid Set.
101. Modification to Drawing: Sheet C102 – Overall Site Plan (Replace Sheet in its entirety)
- a. Added Gravel Construction Parking Area.
 - b. Located and defined Construction Sign.
 - c. Added Construction traffic route.
 - d. Identified construction fence location
 - e. Clarified electrical trench material.
 - f. Clarified gravel construction route material and thickness.
 - g. Clarified areas to be seeded.
 - h. Modified plant type. See Plant Schedule.
102. Modification to Drawings A500, A501 & A502: Changed note on Detail 3/A500, Detail 4/A501, Detail 8/A501 and Detail 11/A502 where “Aluminum Coping” is called out to read “Gravel Stop and Fascia Cap.” Modification to Specification Section 07 62 00 Sheet Metal Flashing and Trim as a part of this change:
- a. Section 1.6 (Quality Assurance), Section B added.
 - b. Section 1.8 (Warranty), Section B added.
 - c. Section 2.1 (Products), Section E added.
 - d. Section 2.5 (Fabrication, General)
 - i. Section A – Added language
 - e. Section 2.7 (Low-Slope Roof Sheet Metal Fabrications)
 - i. Deleted Section A – Copings
 - ii. Added Section A – Copings (new language)
 - iii. Deleted Section B – Roof Edge Flashing (Gravel Stop)
 - iv. Added Section B – Gravel Stop/Fascia Cap
 - f. Section 3.5 (Roof Flashing Installation)
 - i. Deleted language “Roof Edge Flashing” in Section B
 - 1. Added language “Gravel Stop/Fascia Cap” in Section B
103. Clarification: Consideration for AutoCAD file release (as stated in Specification Section 01 33 00, Section 1.3, paragraph A) will not be considered until WSH13095 is awarded.
104. Modification to Specification: Specification Section 00 45 13 Contractor Qualification Statement has been added as a part of this Addendum.
105. Modification to Specification: Section 26 36 00 – Transfer Switches. Replace specification section in its entirety with attached revised specification with the following changes:
- a. Revise Paragraph 2.2G as noted.
 - b. Delete Paragraph 2.2H in its entirety.

106. Modification to Drawing: Sheet C114 – Loading Dock Grading & Drainage Plan
 - a. Refer to attached Sketch SKC-4 – Gas Line Future Connection, which adds an underground 4” gas line with sleeve between the maintenance building and main Hospital Building for future connection under the renovation project.
107. Modification to Specification: Section 07 21 00: Thermal Insulation. Replace one manufacturer of metal wrapped plastic board insulation.
 - a. Products Section 2.1 (B) – Delete “Dow Chemical”
 - i. Replace with “Hunter Panels”
 - b. Section 2.3 (A) – Delete “Owens Corning Foamular CC”
 - i. Replace with “Hunter Xci Class A”.

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section: 31 20 00 Earth Moving

Corresponding to RFQ Item: 7, 8, 74

SECTION 31 20 00 – EARTH MOVING

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) Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and, plants.
- 2) Excavating and backfilling for buildings and structures.
- 3) Drainage course for concrete slabs-on-grade.
- 4) Subbase course for concrete walks and pavements.
- 5) Subbase course and base course for asphalt paving.
- 6) Subsurface drainage backfill for walls and trenches.
- 7) Excavating and backfilling trenches for utilities and pit for buried utility structures.

B. Related Sections:

- 1) Division 01 Section for recording preexcavation and earth moving progress.
- 2) Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
- 3) Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
- 4) Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

- 1) Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
- 2) Final Backfill: Backfill placed over initial backfill to fill a trench.

- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1) Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2) Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1) Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom; measured according to SAE J-1179.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 **SUBMITTALS**

- A. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698

1.5 **QUALITY ASSURANCE**

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- B. Pre-excavation Conference: Conduct conference at project site.

1.6 **PROJECT CONDITIONS**

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 - 1) Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without written permission from Architect and authorities having jurisdiction.
 - 2) Provide alternate routes around closed or obstructed traffic ways if required by Architect/Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service for area where project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Section "Temporary Facilities and Controls" and Division 31 Section "Site Clearing" are in place.

PART 2 PRODUCTS

2.1 **SOIL MATERIALS**

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 1) Plasticity Index: 15 percent.
 - 2) Liquid limit less than 40

- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1) Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand with composition and gradation conforming to requirements of the WVDOH, "Construction and Material Specifications."
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- H. Drainage Course: Narrowly graded mixture of washed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.
- J. Sand: ASTM C 33; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

PART 3 EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1) Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1) If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2) Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a) 24 inches (600 mm) outside of concrete forms other than at footings.
 - b) 12 inches (300 mm) outside of concrete forms at footings.
 - c) 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
 - d) Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e) 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
 - f) 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.
- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
 - 1) Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a) Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
 - 2) Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

- a) 24 inches (600 mm) outside of concrete forms other than at footings.
- b) 12 inches (300 mm) outside of concrete forms at footings.
- c) 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
- d) Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
- e) 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
- f) 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1) Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1) Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated. Excavated material from trenches shall be stockpiled on site. Any such material as is not used for backfill elsewhere shall be disposed of offsite by the contractor, at the expense of the contractor.
 - 1) Clearance: 12 inches (300 mm) each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1) For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2) For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.

- 3) For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 - 4) Excavate trenches **6 inches (150 mm)** deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches **4 inches (100 mm)** deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
- 1) Excavate trenches **6 inches (150 mm)** deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

- A. Notify Architect and Soils Lab when excavations have reached required subgrade.
- B. If Architect and Soils Lab determine that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than **15 tons (13.6 tonnes)** to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1) Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to **3 mph (5 km/h)**.
 - 2) Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of **2500 psi (17.2 MPa)**, may be used when approved by Architect/Engineer.
 - 1) Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect/Engineer.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

- 1) Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1) Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2) Surveying locations of underground utilities for Record Documents.
 - 3) Testing and inspecting underground utilities.
 - 4) Removing concrete formwork.
 - 5) Removing trash and debris.
 - 6) Removing temporary shoring and bracing, and sheeting.
 - 7) Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within **18 inches (450 mm)** of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03.
- ~~D. Trenches under Roadways: Provide 4-inch (100-mm) thick, concrete base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase course. Concrete is specified in Division 03.~~
- D. Trenches under concrete and paved areas shall be backfilled up to the subgrade elevation with either Class I (angular crushed stone or rock, dense or open graded with little or no fines (1/4 inch to 1 1/2 inches in size) or Class II (clean, coarse grained materials, such as gravel coarse sands and gravel/sand mixtures (1 1/2 inches in size), as defined by ASTM D-2321.
- E. Backfill voids with satisfactory soil while removing shoring and bracing.

- F. Place and compact initial backfill of subbase material, free of particles larger than **1 inch (25 mm)** in any dimension, to a height of **12 inches (300 mm)** over the pipe or conduit.
 - 1) Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- G. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- H. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- I. Install warning tape directly above utilities, **12 inches (300 mm)** below finished grade, except **6 inches (150 mm)** below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1) Under grass and planted areas, use satisfactory soil material.
 - 2) Under walks and pavements, use satisfactory soil material.
 - 3) Under steps and ramps, use engineered fill.
 - 4) Under building slabs, use engineered fill.
 - 5) Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within -3% to +4% of optimum moisture content.
 - 1) Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2) Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by -3% to +4% and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1) Under structures, building slabs, steps, and pavements, scarify and recompact top **12 inches (300 mm)** of existing subgrade and each layer of backfill or fill soil material at 98 percent.
 - 2) Under walkways, scarify and recompact top **6 inches (150 mm)** below subgrade and compact each layer of backfill or fill soil material at 98 percent.
 - 3) Under turf or unpaved areas, scarify and recompact top **6 inches (150 mm)** below subgrade and compact each layer of backfill or fill soil material at 98 percent.
 - 4) For utility trenches, compact each layer of initial and final backfill soil material at 98 percent.. Backfill under concrete and paved areas (Class I and/or Class II materials) shall be compacted to a minimum of 90% of standard proctor.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1) Provide a smooth transition between adjacent existing grades and new grades.
 - 2) Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1) Turf or Unpaved Areas: Plus or minus **1 inch (25 mm)**.
 - 2) Walks: Plus or minus **1 inch (25 mm)**.
 - 3) Pavements: Plus or minus **1/2 inch (13 mm)**.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of **1/2 inch (13 mm)** when tested with a **10-foot (3-m)** straightedge.

3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1) Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

- 2) Place base course material over subbase course under hot-mix asphalt pavement.
 - 3) Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 4) Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
 - 5) Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 6) Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.18 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1) Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2) Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.
 - 3) Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 4) Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

- A. Soils engineer for testing and inspection of proofrolling and compaction operations shall be provided by Owner.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by testing agency.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1) Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
 - 2) Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length, but no fewer than two tests.
 - 3) Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length, but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1) Scarify or remove and replace soil material to depth as directed by Architect and Soils Lab; reshape and recompact.
- C. Where settling occurs before project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1) Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section: 03 30 00 Cast-in-Place Concrete

Corresponding to RFQ Item: 11

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete formwork.
- B. Concrete foundation walls.
- C. Concrete reinforcement.
- D. Joint devices associated with concrete work.
- E. Concrete curing.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; American Concrete Institute International; 2010.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
- C. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.
- D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (Errata 2007).
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- F. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
- G. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
- H. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001 (Reapproved 2008).
- I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.
- J. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- K. ASTM A497/A497M - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete; 2007.
- L. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2012.
- M. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2011a.
- N. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2012a.
- O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2012.

- P. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2011b.
- Q. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2010a.
- R. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.
- S. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.
- T. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2010b.
- U. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- V. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- W. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2012.
- X. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2012.
- Y. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2011.
- Z. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2010.
- AA. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 1999 (Reapproved 2008).
- AB. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2011.
- AC. ASTM D994/D994M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type); 2011.
- AD. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.
- AE. ASTM E 1643 Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
- AF. ASTM E 96: Standard Test Method for Water Vapor Transmission of Materials

1.04 SUBMITTALS

- A. See Section 013300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
 - 1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Floor and slab treatments.
- D. Samples: Submit samples of underslab vapor retarder to be used.
- E. Samples: Submit one, 12 inch long sample of construction joint devices.

- F. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.
- G. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
- H. Manufacturers' Literature: Submit manufacturers' standard specifications, test data, and installation instructions for each product, edited to correlate to specific job requirements.
- I. Substitution: Any request for product substitution must be submitted for review, documentation prior to time of bid. No requests for substitutions will be considered after bids have been received.
- J. Shop Drawings:
 - 1. Scope: The Contractor shall prepare shop drawings showing detail layouts of reinforcing, including dimensions, openings, and spacing, bending details, bar schedules, and similar items required for the proper construction of the work. Provisions for the connection of work by other trades shall be indicated on the shop drawings. The location of all embedded items shall be indicated by the contractor on the shop drawings. All shop drawings shall be submitted for approval in accordance with the requirements of the Contract Documents.
 - 2. Submissions: At least one month prior to commencing with job standard and shop drawing submission, the Contractor shall submit for approval a job standard and shop drawing weekly submission schedule. This schedule shall include a list and format of all drawings scheduled to be submitted each week, including but not limited to the number of job standards, erection drawings and piece drawings.
 - 3. Once shop drawing submissions have commenced, any modification or addition to this schedule must be submitted for approval at least one month before the modification or addition is proposed to take place.
 - 4. Shop drawings relating to the parts comprising a proposed unit shall be submitted simultaneously so that parts may be checked individually and as an assembly for said unit. Shop drawings shall list the Contract Drawings used as reference in the development of said shop drawings. Shop drawings shall be submitted per the format called for in the General Requirements.
 - 5. If at any time the total number of job standards and shop drawings received in any one week period exceeds the approved scheduled amount by more than 10% for that week, the engineer has the right to add an additional 2 days to the average turnaround times for each 20% increment that it exceeds for that week's submissions. For example, if the weekly total exceeds the schedule by 10% to 20%, 2 days may be added, if it is exceeded by 21% to 40%, 4 days may be added and so on.
 - 6. The Contractor shall allow for at least fifteen (15) working days between the time the shop drawings are received by the Engineer and the time they are released by the Engineer. Materials shall not be fabricated before shop drawings have been reviewed as noted.
 - 7. Numbering: All shop drawings shall be numbered in a logical and sequential manner.
 - 8. Construction Joints and Shrinkage strips: Submit layout showing proposed location of construction joints and shrinkage strips. Joints shall be located outside wet areas.
 - a. Checking by Contractor: Prior to submission of the shop drawings to the Architect/Engineer, they shall be pre-checked by the contractor for conformity of detail with Contract Documents and as coordinated with other subcontractors. The signature of a representative of the contractor indicating that the drawings have been pre-checked will be required. The contractor shall be wholly responsible for conformity of dimensions and details of the shop drawings with Contract Documents.
 - 9. File: At least one copy of each approved shop drawing shall be kept available in the

contractor's field office and the drawings not bearing evidence of approval and release for construction by the Engineer shall not be kept on the job.

- K. Complete materials lists of items proposed to be furnished and installed under this Section.
 - 1. Sufficient data to demonstrate compliance with specified requirements.
 - 2. Complete information on cement source of supply, physical and chemical characteristics, transportation and intermediate procedures for mill-to-site handling, and site storage procedures.
 - 3. Complete information on aggregate, procurement, processing and storage.
 - 4. Complete description of proposed curing methods.
 - 5. Complete mix designs, prepared in accordance with the provision of the Drawings, Specifications and applicable ACI publications.

1.05 QUALITY ASSURANCE

- A. Field Test and Inspection:
 - 1. Concrete Samples: The Architect reserves the right to take samples from any or every lot of concrete delivered to the job. The tests shall be made as required by the Architect and the expense incurred shall be borne by the owner when the concrete meets specification requirements, and by the contractor when the concrete fails to meet the specification requirements. Any rejected concrete shall be immediately removed from the work.
 - 2. Concrete Placement: All controlled concrete, including the placement of the reinforcing and the placing of the concrete, is to be inspected by the G.C.'s representative and/or testing laboratory. Any concrete rejected to failure to meet specification requirement shall be removed by the contractor at his own expense.
 - 3. Inspections shall include:
 - a. Preparing, curing, transporting, and testing concrete cylinders. For each class of concrete placed, at least four cylinders shall be taken for each 50 cubic yards, or fraction thereof, of each class of concrete placed each day. Cylinders are to be taken in accordance with ASTM C31 and results shall be submitted to the Architect/Engineer, Construction Manager and owner. Two cylinders will be tested at 7 days and two at 28 days.
 - b. Recording air temperature, concrete temperature, unit weight of concrete, amount of entrained air, and slump for each batch of concrete.
 - c. Inspection of placement of reinforcing steel and supporting devices. Contractor shall not be permitted to place concrete until reinforcing steel has been inspected and approved, by Architect/Engineer approved testing agency.
 - d. Inspection of compliance with specification requirements, including proper conveying, protection during periods of hot or cold weather, vibration and curing of concrete.
 - e. Rejection of concrete not meeting specification requirements and immediate reporting to the Construction Manager.
 - f. Obtaining certified mill test results for each load of cement delivered to the concrete producer for use of this project.
 - g. Preparation of daily reports of testing and submission of results in triplicate to the Architect/Engineer, Construction Manager and Owner daily.
 - 4. Intent: The G.C.'s testing laboratory is hired solely by the G.C. for the protection of the Owner and does not relieve the Contractor of his responsibility to provide concrete in accordance with the plans and these specifications.
- B. Tests on Questionable Concrete:
 - 1. If the results of tests and/or inspections indicate the concrete and/or steel reinforcement or construction techniques do not meet the requirements as set forth on the drawings in these

- Specifications and as determined by Architect and/or Engineer, due to inadequate batching, placing, curing or protection. Contractor shall proceed as directed by Architect/Engineer.
2. Additional Tests: The Architect/Engineer shall have the right to order the Contractor to make load tests, compression tests on specimens taken from the in-place concrete, or any other tests of the completed structure or any part thereof. The Contractor, at his own expense shall remove any condemned concrete and replace same with new concrete to the satisfaction of the Architect/Engineer.
 3. Any additional costs resulting from re-testing, load testing, replacement of concrete and/or damage to the work of other trades, inclusive of Architect's/Engineer's costs for the investigation of work, etc., shall be borne by Contractor. If, during the installation of the work, it is determined by Architect and/or Engineer that test results, observation of Architect or his Consultants during inspections, then any investigation and/or tests as may be directed by Architect to verify concrete requirements as related to drawings and Specifications shall be performed at Contractor's expense no matter whether final results meet or do not meet Specification requirements.
 4. Reimbursement by Contractor: Additional architectural and engineering fees, based upon direct personnel expense plus 150% out-of-pocket traveling expenses, shall be borne by the Contractor for redesign and extra supervision due to the above when such concrete tests are required.
- C. Acquire cement from same source and aggregate from same source for entire project.
- D. Perform work of this section in accordance with ACI 301 and ACI 318.
- E. The concrete contractor shall have demonstrated comparable experience in installations of this type, and a record of successful completion, and shall employ labor and supervisory personnel familiar with this type of installation.
- F. Follow recommendations of ACI 306R when concreting during cold weather.
- G. Follow recommendations of ACI 305R when concreting during hot weather.
- H. The cast-in-place concrete contractor shall have comparable experience in installations of this type, and record of successful completion, and shall employ labor and supervisory personnel familiar with this type of installation.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
 2. Earth Cuts: Side forms of footings may be omitted and concrete placed directly against excavation only when requested by the Contractor and accepted by the Architect/Engineer. When omission of forms is accepted, provide additional concrete 2" on each side of the minimum design profiles and dimensions shown. Natural rock formations that maintain a stable vertical edge may be used as side forms.
 3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
 4. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M Grade 60 (420).
 - 1. Type: Deformed billet-steel bars.
 - 2. Finish: Unfinished, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain type.
 - 1. Form: Flat Sheets.
 - 2. Mesh Size and Wire Gage: As indicated on drawings.
- C. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gage.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 - 3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C 33.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Calcined Pozzolan: ASTM C618, Class N.
- E. Concrete moisture proofing admixture for interior slab construction shall be Barrier-1 Inc., 1901 Tumblewater Blvd, Ocoee, Florida 34761.
 - 1. Performance Requirements:
 - a. Sodium silicate based
 - b. Water Vapor Transmission: 0.20 US perms per ASTM D 5084
 - c. Appearance: Colorless
 - d. Odor: None
 - e. Toxicity: None
 - f. Flammability: None
 - g. PH: 11.3
 - h. Shelf Life: Indefinite
 - i. Contains an anti-microbial biocide to inhibit mold and bacteria growth.
 - j. Freeze Temp: 32°F
 - k. Storage Temp: Above 36°F
 - l. Solvent: Water
 - m. Hazardous Vapors: None
 - n. Capillary Break: Calcium Silicate Hydrate Gel
 - o. VOC Levels: Zero
 - 2. Waterproofing Admixture: Add Barrier-1 Admixture in accordance with manufacturer's recommendations to all ready mix concrete to be placed in interior slab-on-grade interior elevated slab construction, vertical cast in place, precast and tilt wall at the batch plant or at the job site.
 - 3. A representative or agent of Barrier-1 Admixture must be present at the jobsite during the placement of all treated concrete. Do not proceed without the Barrier-1 representative being present for the certification of the mix and placement process. Provide minimum 10 days notice of the placement of the treated concrete
- F. Water: Clean and not detrimental to concrete.

2.04 CHEMICAL ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C 260.
- C. Chemical Admixtures: ASTM C 494/C 494M, Type A - Water Reducing, Type C - Accelerating, and Type G - Water Reducing, High Range and Retarding.
 - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.05 ACCESSORY MATERIALS

- A. Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
- B. Bonding Agent: ASTM C 1059, Type II acrylic non-redispersable type.
- C. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E 1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Maintain a permeance of 0.01 US perms (grains/ft²*hr*inHg) or less after the required product conditioning specified in ASTM E 1745-09 Include manufacturer's recommended adhesive or pressure-sensitive tape. Single ply polyethylene is prohibited.
 - 1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder.
 - 2. Products:
 - a. Insulation Solutions, Inc; Viper VaporCheck II 10-mil Class A: www.insulationsolutions.com.
 - b. Stego Industries, LLC; Stego Wrap Vapor Barrier 15-mil (Class A): www.stegoindustries.com.
 - c. W.R. Meadows, Inc.; PERMINATOR Class A - 15 mils: www.wrmeadows.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Contractor shall carefully construct the interface of the vapor barrier at all column isolation points as well as at the edge of slab, in accordance with VB manufacturer's printed instructions and other recommendations.
- E. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,400 psi.
 - 2. Minimum Compressive Strength at 28 Days: 7,000 psi.

2.06 BONDING AND JOINTING PRODUCTS

- A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059 Type II.
- B. Epoxy Bonding System: Complying with ASTM C881/C881M and of Type required for specific application.
- C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 - 1. Material: ASTM D1751, cellulose fiber.
- D. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard or felt, complying with ASTM D 1751, 1/4 inch thick and 4 inches deep; tongue and groove profile.

2.07 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- D. Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 psi.
 - 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
 - 3. Calcined Pozzolan Content: Maximum 10 percent of cementitious materials by weight.
 - 4. Water Cement Ratio: All concrete subjected to exposed to freezing and thawing in moist condition and/or required to be watertight shall have a maximum water-cement ratio of 0.45. All reinforced concrete exposed to deicing salts, brackish water seawater or spray from these sources, shall have a maximum water-cement ratio of 0.40.
 - 5. Air Content: All concrete exposed to freezing and thawing and/or required to be watertight shall have an air content of 4.5% to 7.5%. All other concrete shall have an air content of 3% to 4%, determined in accordance with ASTM C 173/C 173M.
 - 6. Slump: Concrete design mixes shall be proportioned to meet the following slump limitations:
 - a. Concrete without high range superplasticizer:

Beam, Columns	3" Max
All other concrete	4" Max
 - b. Concrete with high range superplasticizer: Concrete shall arrive at job site with a slump of 2" to 3" for normal weight concrete and 4" light weight concrete. Slump shall be verified, then after addition of high range superplasticizer admixture, the concrete shall have a maximum slump of 7" \pm 1" unless otherwise approved by the Engineer.
 - 7. Maximum Aggregate Size: 3/4 inch. Aggregates: The source of supply of the aggregates used throughout the job shall be the same as that employed in the preliminary tests. Should the aggregate characteristics change materially, new water-cement ratios shall be established by additional testing, as herein before outlined, at the Contractor's expense.

2.08 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Coordinate placement of embedded items with erection of concrete formwork and placement of

form accessories.

- D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
 - 1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
 - 2. Use latex bonding agent only for non-load-bearing applications.
- E. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- F. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.
- C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 MIXING AND PLACING CONCRETE

- A. Measurement of Materials: Materials for controlled concrete shall be measured by weighing the aggregates and cement using equipment that is suitable, designed, and constructed for this purpose. Each size of aggregate and the cement shall be weighed separately. The accuracy of all measuring devices shall be such that quantities be measured to within the following percentages of the desired amount: 1% for cement and water, 2% for aggregates, and 3% for admixtures. Mixing water and all admixtures shall be measured by volume. Batching plant shall have a proven performance record as indicated by a standard deviation no greater than 500 psi.
- B. Mixing Concrete: All concrete shall be machine mixed. The time of mixing shall not be less than 1 minute with a peripheral speed of the drum of about 200 feet per minute for batches of one cubic yard. For larger batches, mixing shall be in accordance with ASTM C94.
 - 1. Transit mix concrete may be used provided it conforms to the specifications and tests herein described and ASTM C94, and further provided that the central plant producing the concrete and equipment transporting it are, in the opinion of the Owner's testing laboratory and contractor, suitable for production and transportation of controlled concrete.
 - a. The maximum elapsed time between the time of the introduction of water and discharging shall be 1-1/2 hours and the maximum temperature of the concrete at discharge shall be 90 degrees F.
 - b. The minimum time of mixing shall be one minute per cubic yard after all material, including water, has been placed in the drum. The drum shall be reversed for an additional two minutes.
 - 2. The minimum time of mixing shall be one minute per cubic yard after all material, including water, has been placed in the drum. The drum shall be reversed for an additional two minutes.

3. Mixing water for controlled concrete shall be added only in the presence of the Owner's inspector.
 4. The size of the batch shall not exceed the rated capacity of the mixer as stated by the manufacturer.
 - a. Admixtures: All admixtures shall be used in strict accordance with the directions of the manufacturer. The water reducing and air entraining admixtures shall be accurately dispensed at the ready-mix plant. The high range water reducing admixture (superplasticizer) shall be accurately dispensed from truck mounted tanks at the job site. Where color pigment is used, dry cement and pigment shall be thoroughly blended before they are added to the mix.
- C. Placing Concrete:
1. Preparation: Before placing concrete, all equipment for mixing and transporting the concrete shall be cleaned, all debris and ice shall be removed from the places to be occupied by the concrete, wood forms shall be thoroughly wetted except in freezing weather, and forms shall be oiled. Aluminum chutes or pipes shall not be used to convey or place concrete. Concrete on earth or fill shall not be placed until the earth and fill have been approved.
 2. Conveying: Concrete shall be conveyed from mixer to forms as rapidly as practicable and by methods which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Chutes shall have a slope of less than 1 Vertical to 2 Horizontal and shall be arranged in such fashion that the concrete slides in them and does not flow. Where a vertical drop greater than five feet is necessary, placement shall be through elephant trunks or similar devices to prevent segregation.
 3. Place concrete in accordance with ACI 304R.
 4. Pumping: The pumping operation shall be done in strict accordance with ACI Committee 304 report, "Placing Concrete by Pumping Methods". The mix design, slumps at the pump and at the discharge end of the line, type of pump to be used, and redosage with the high range water reducing (superplasticizer) shall be strictly followed. Lightweight concrete dictates the use of a 5" line and a pump which will produce the required volume at a pumping pressure lower than 1500 psi.
 5. Place concrete for floor slabs in accordance with ACI 302.1R.
 6. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. Finish floors level and flat, unless otherwise indicated, within the tolerances specified in ACI 302.1 R.
- E. Slab Jointing
1. Locate joints as indicated on the drawings.
 2. Anchor joint fillers and devices to prevent movement during concrete placement.
 3. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- F. Protection of Green Concrete: After the concrete has taken its initial set, care shall be exercised to avoid jarring the forms or placing any strain in the end of projecting reinforcement. Materials shall not be placed or loads imposed upon slabs during the period of setting.
- G. Vibrating: All structural concrete including supported slabs and slabs on ground shall be placed with the aid of mechanical vibrators. Use and type of vibrators shall be in strict accordance with ACI 309, "Recommended Practice for Consolidation of Concrete" and with sufficient intensity to visibly affect the concrete over a radius of at least two feet around the point of application. Vibrators shall be used in sufficient quantity to cause all concrete to flow or settle rapidly into place with such length of application to avoid segregation. The vibrators shall be of the internal

type, applied directly to the concrete, except in sections too thin to permit insertion, in which case form vibrations may be employed. A spare vibrator shall be kept on the job during all concrete placing operations. Lower frequency vibrators shall be used with "flowing" concrete.

- H. Rain: Concrete shall not be placed during rain. Sufficient coverings shall be provided and kept on hand for protection during rainstorms.
- I. Wind: Prior to placing concrete Wind speed and Dew point shall be monitored and recorded to control plastic shrinkage cracking. The guidelines of ACI 318-99, ACI 305R-91, and ACI 306R-88 as applicable, shall be followed. The contractor, at a minimum, shall provide wind screens as required to minimize this condition.
- J. Cold Weather Concreting:
 - 1. Refer to ACI 306R-88 "Cold Weathering Concreteing".
- K. Hot Weather Concreting:
 - 1. Refer to ACI 305R-91 "Hot Weathering Concreting".
- L. Construction Joints and Expansion Joints:
 - 1. Joint Preparation: Forms shall be removed in time to permit roughening by chipping and wire brushing to remove all loose and foreign material at construction joints of structural members. The joints shall be dampened and the specified bonding compound applied. New concrete shall be placed after the bonding compound had dried.
 - 2. Floor Slabs on Grade:
 - a. Floor slabs on ground shall be placed to the thickness shown on the drawings on vapor barrier.
 - b. Vapor barriers shall be as specified, free of pinholes and other blemishes and shall be installed in accordance with manufacturer's requirements. All joints shall be lapped 6 inches and taped. Note any areas on the drawings requiring a layer of approved, damp, compactible fill prior to placement of concrete.
 - c. Placement: Slabs on ground shall be placed by the long strip cast method. Refer to appropriate ACI reference standards 302 and 360 of recommended methods of placement. Maximum strip width shall be 20 feet and no greater than 2000 square feet shall be cast in one strip unless otherwise indicated on the drawings or by the Engineer. Note that framed slabs cast on ground span between grade beams and should be cast as panels which are consistent with structural requirements and have structural construction joints. They should not be cast in strips.
 - d. Penetrations: Maximum outside diameter of pipe or conduit placed in slabs on ground shall be limited to one-third the thickness of the slab. The minimum concrete cover top and bottom shall be one-third the thickness of the slab.
 - e. Keying: Provide a continuous key at construction joints and continue reinforcement through joints unless noted otherwise.
 - f. Control Joints: Provide control and isolation joints as indicated on the contract documents.
 - g. Control Joints: Provide control and isolation joints as indicated on the contract documents. Furthermore, place additional control joints at 20 feet maximum so as to limit pour areas (areas bounded by control joints) to 400 square feet maximum. Control joints shall be formed by saw cutting or preplaced plastic strips. Joints shall be at least 1/4 of the slab thickness and shall have discontinuous reinforcement through the joint. Saw cut joints shall be made within 24 hours after the concrete pour. Any joints in areas subjected to vehicular traffic should be sawcut. Pre-placed plastic strips shall not be used there. The Soff-Cut saw shall be used immediately after finishing. The conventional saw as soon as possible without dislodging aggregate.

3. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
4. Place concrete continuously between predetermined expansion, control, and construction joints.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Maximum Variation of Surface Flatness:
 1. Exposed Concrete Floors: 1/4 inch in 10 ft.
 2. Under Seamless Resilient Flooring: 1/4 inch in 10 ft.
 3. Under Carpeting: 1/4 inch in 10 ft.
- B. Correct the slab surface if tolerances are less than specified.
- C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
- D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
 1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 301.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, thin set quarry tile, and thin set ceramic tile.
 2. Other Surfaces to Be Left Exposed: "Steel trowel" as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
- E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.07 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 1. Normal concrete: Not less than 7 days.
 2. High early strength concrete: Not less than 4 days.
- C. Surfaces Not in Contact with Forms:
 1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
 2. Final Curing: Begin after initial curing but before surface is dry.
- D. Protect concrete floors with RAM Board Heavy-Duty floor protection. Tape seams together. Do not tape to concrete floor.

3.08 FLOOR AND SLAB TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Available Products:
 - a. Curecrete Distribution Inc.; Ashford Formula.
 - b. Euclid Chemical Company (The); Euco Diamond Hard.
 - c. L&M Construction Chemicals, Inc.; Seal Hard.
- B. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

3.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.10 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

END OF SECTION

WSH13095

William Sharpe Hospital
50 Bed Addition

Sketch: SKC-3

Corresponding to RFQ Item: 14, 15, 21 & 68



4980 TEAYS VALLEY ROAD
SCOTT DEPOT, WV 25560

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 08 81 00 - Glazing

Corresponding to RFQ Item: 22, 23, 27 & 99

SECTION 08 81 00 - GLAZING

1. GENERAL

1.1 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Curtain wall framing.
 - 2. Factory-glazed window units.
 - 3. Interior borrowed lites.
 - 4. Interior observation windows (one-way glass).
 - 5. Doors, including automatic sliding doors.
 - 6. Glazed entrances.
 - 7. Fire-rated glazing.
- ~~B. All Interior Glass: Nominal 3/8" clear laminated glass (exception fire-rated glass).~~
- C. All laminated glazing must be actual glass. Acrylic or polycarbonate is not acceptable.
- D. Exterior applications: Heat-strengthened lites where required by glass fabricator's thermal analysis and/or performance requirements.

1.2 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1. See General Notes on Structural Drawings for wind load requirements.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: As indicated on Structural Drawings.
 - b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - 1) Load Duration: 60 seconds or less.
 - c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
 - 1) For insulating glass.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
 1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 2. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
 - b. Solar Heat Gain Coefficient: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of 12-inch-square Samples for glass.
 1. Insulating glass for each designation indicated. 12-inch square samples.
 2. Laminated glass. 12-inch square samples.
 3. For each color (except black) of exposed glazing sealant indicated. 12" lengths.
 4. Fire-rated glazing, 6 inch square samples.

- C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Product Certificates: For those products not permanently labeled, provide product certificates signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- E. Qualification Data: For installer.
- F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: coated float glass and insulating glass.
- C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.
- D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- E. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
 - 1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 - 2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
- F. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:
 - 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

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4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
 5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.
- G. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.
1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency.
 2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.
- H. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
- I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
1. Insulating Glass Certification Council.
- J. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Professional.
 2. Build glass mockups by installing insulating glass in mockups specified in Division 08 Sections for aluminum curtainwall, to match glazing systems required for Project, including glazing methods.
 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- K. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
- L. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.8 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years.

2. PRODUCTS

2.1 GLASS PRODUCTS

- A. Manufacturers: ~~Choose from one of the following:~~
 - 1. PPG.
 - 2. Guardian.
 - 3. Pilkington.
 - 4. AFG.
- B. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.
- C. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 - 2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.

3. For uncoated glass, comply with requirements for Condition A.
 4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
 5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is required by Code.
- D. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.
- E. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
 3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
 4. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - a. Manufacturer's standard sealants.
 5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
 - a. Spacer Material: Aluminum with mill or clear anodic finish.
 - b. Desiccant: Molecular sieve or silica gel, or blend of both.
 - c. Corner Construction: Manufacturer's standard corner construction.

2.2 GLAZING GASKETS

- A. Gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
1. EPDM, ASTM C 864.
 2. Silicone, ASTM C 1115.
 3. Thermoplastic polyolefin rubber, ASTM C 1115.
 4. Any material indicated above.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
1. EPDM.
 2. Silicone.

3. Thermoplastic polyolefin rubber.
4. Any material indicated above.

2.3 GLAZING SEALANTS

- A. Provide products of type indicated, complying with the following requirements:
 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
 4. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
- B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 1. Single-Component Silicone Glazing Sealants:
 - a. Products:
 - 1) Dow Corning Corporation; 790.
 - 2) GE Silicones; SilPruf LM SCS2700.
 - 3) Tremco; Spectrem 1 (Basic).
 - b. Type and Grade: S (single component) and NS (nonsag).
 - c. Class: 50.
 - d. Use Related to Exposure: NT (nontraffic).
 - e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
 - 1) Use O Glazing Substrates: Coated glass, color anodic aluminum.
- C. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.4 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
 1. Type 1, for glazing applications in which tape acts as the primary sealant.
 2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.5 MISCELLANEOUS GLAZING MATERIALS

- A. Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.6 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.7 MONOLITHIC FLOAT-GLASS UNITS

- A. Uncoated Clear Float-Glass Units: Class 1 (clear) Kind FT (fully tempered) float glass.
 1. Thickness: 6.0 mm.

2.8 TEMPERED GLASS (GLASS TYPE 4)

- A. Clear, 1/4" thickness, Kind FT (fully tempered).

2.9 LAMINATED SECURITY GLASS PANES WITH POLYMER INTERLAYER (GLASS TYPE 8)

A. Basis of Design: ArmorProtect® as manufactured by Oldcastle BuildingEnvelope, using DuPont™ SentryGlas®, as manufactured by DuPont™ Glass Laminating Solutions.

~~1. Subject to compliance with requirements, equivalent products of alternative manufacturers will be considered for approval.~~

B. Thickness: 0.090 inch.

C. Color: Clear

D. Interlayer Physical Properties:

1. Young's Modulus: 43 kpsi, when tested in accordance with ASTM D5026
2. Tensile Strength: 5.0 kpsi, when tested in accordance with ASTM D638.
3. Elongation: 400%, when tested in accordance with ASTM D638
4. Flex Modulus: 50 kpsi, when tested in accordance with D790.
5. Heat Deflection Temperature at 0.46 MPa: 110 deg F, when tested in accordance with D648.

E. Glass Lites:

1. Insulating units: Float glass.
2. Interior applications: Ultraclear float glass.

2.10 ONE-WAY MIRRORED GLASS (GLASS TYPE 5)

A. This glass is to be a composite of 1/4" one-way mirror laminated to 1/4" clear float glass.

B. Basis of Design, One-Way Mirror: Pilkington Mirropane.

1. Subject to compliance with requirements, equivalent products of alternative manufacturers will be considered for approval.

C. Glass substrate: Grey

D. Reflective pyrolytic coating meets ASTM C 1376.

1. Visible Transmittance: 11%
2. Visible Reflectance, Coated Side: 68%
3. Visible Reflectance, Glass Side: 16%

E. Basis of Design, interlayer: DuPont™ SentryGlas®, as manufactured by DuPont™ Glass Laminating Solutions.

1. Thickness: 0.090 inch.
2. Color: Clear

2.11 LOW-E INSULATING-GLASS UNITS WITH TRIPLE GLAZING ACCESS PANEL (GLASS TYPE 1)

A. Basis of Design: PPG Solarban 60 with Solargray® tint.

1. Subject to compliance with requirements, equivalent products of the following:
 - a. Guardian.

b. AGC.

- B. Overall Unit Thickness and Thickness of Each Lite: 25 and 6.0 mm.
- C. Interspace Content: Air.
- D. Outdoor Lite: Tinted glass, heat-strengthened as required. Low-E coating on 2nd surface.
 - 1. Magnetic Sputter Vacuum Deposition (MSVD) on #2 surface.
 - 2. Tint: Solargray® or approved equal.
- E. Indoor Lite: Class 1 (clear) float glass.
- F. Triple Glazing Pane: 3/8" laminated security pane.

2.12 LOW-E INSULATING-GLASS UNITS (GLASS TYPE 2)

- A. Provide one of the following:
 - 1. Guardian SNX62/27 #2 surface, on Guardian Ultralite.
 - 2. PPG Solarban 70XL, on Solarphire.
 - 3. AGC Comfort TiAC28, on Krystal Klear
- B. Overall Unit Thickness: 1" (25 mm).
- C. Interspace Content: Air.
- D. Outdoor Lite: 1/4" clear glass, heat-strengthened as required. Low-E coating on 2nd surface.
 - 1. Magnetic Sputter Vacuum Deposition (MSVD) on #2 surface.
- E. Indoor Lite: 3/8" laminated security pane, clear.
- F. Properties:
 - 1. Solar Heat Gain Coefficient (SHGC): 0.27
 - 2. Visible Light Transmittance (VLT): 64%
 - 3. Light to Solar Gain (LSG) ratio: 2.37

2.13 LOW-E INSULATING-GLASS UNITS (GLASS TYPE 3)

- A. Basis of Design: PPG Solarban 60 with Solargray tint.
 - 1. Subject to compliance with requirements, equivalent products of the following:
 - a. Guardian.
 - b. AGC.
- B. Overall Unit Thickness: 1" (25 mm).
- C. Interspace Content: Air.
- D. Outdoor Lite: Tinted glass, heat-strengthened as required. Low-E coating on 2nd surface.
 - 1. Magnetic Sputter Vacuum Deposition (MSVD) on #2 surface.
 - 2. Tint: Solargray® or approved equal.
- E. Indoor Lite: 1/4" clear float glass.

2.14 LOW-E INSULATING-GLASS UNITS (GLASS TYPE 6)

- A. Provide one of the following:
 - 1. Guardian SNX62/27 #2 surface, on Guardian Ultralite.
 - 2. PPG Solarban 70XL, on Solarphire.
 - 3. AGC Comfort TiAC28, on Krystal Klear
- B. Overall Unit Thickness: 1" (25 mm).
- C. Interspace Content: Air.
- D. Outdoor Lite: 1/4" clear glass, heat-strengthened as required. Low-E coating on 2nd surface.
 - 1. Magnetic Sputter Vacuum Deposition (MSVD) on #2 surface.
- E. Indoor Lite: 1/4" clear float.
- F. Properties:
 - 1. Solar Heat Gain Coefficient (SHGC): 0.27
 - 2. Visible Light Transmittance (VLT): 64%
 - 3. Light to Solar Gain (LSG) ratio: 2.37

2.15 FIRE-PROTECTION-RATED GLAZING (GLASS TYPE 7)

- A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies.
 - 1. Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch nominal thickness; faced on one surface with a clear glazing film; complying with testing requirements in 16 CFR 1201 for Category II materials.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Vetrotech Saint-Gobain; SGG Keralite FR-F.
 - 2) Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite NT.
 - 3) Safti First; SuperLite C/SP.

3. EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt,

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scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 81 00

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 10 11 00 Visual Display Units

Corresponding to RFQ Item: 39

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Markerboards.
 - 2. Tackboards.
 - 3. Tackboard enclosed in a display case.

1.2 DEFINITIONS

- A. Tackboard: Framed or unframed, tackable, visual display board assembly.
- B. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.
- C. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.[Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.]
- B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of panel joints.
 - 2. Include sections of typical trim members.
- C. Samples for Initial Selection: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:
 - 1. Actual sections of porcelain-enamel face sheet and tackboard assembly.
 - 2. Fabric swatches of polyester-fabric-faced tack assemblies.
 - 3. Include accessory Samples to verify color selected.

- D. Samples for Verification: For each type of visual display surface indicated.
 - 1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
 - 2. Trim: 6-inch-long sections of each trim profile.
 - 3. Accessories: Full-size Sample of each type of accessory.
- E. Product Schedule: For visual display surfaces. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: [25] <Insert value> or less.
 - 2. Smoke-Developed Index: [50] [450] <Insert value> or less.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display surfaces[, **including factory-applied trim where indicated,**] completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display surfaces vertically with packing materials between each unit.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
 - 1. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.
- B. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd.; with surface-burning characteristics indicated.
- C. Hardboard: ANSI A135.4, tempered.
- D. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.
- E. Extruded Aluminum: ASTM B 221, Alloy 6063.

2.2 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch-thick, porcelain-enamel face sheet with high-gloss finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AARCO Products, Inc.
 - b. ADP Lemco, Inc.
 - c. Best-Rite Manufacturing.
 - d. Claridge Products and Equipment, Inc.
 - e. Ghent Manufacturing, Inc.
 - f. Marsh Industries, Inc.; Visual Products Group.
 - g. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - h. Tri-Best Visual Display Products.
 - 2. Hardboard Core: 1/4 inch thick; with 0.015-inch-thick, aluminum sheet backing.
 - 3. Particleboard Core: 3/8 inch thick; with 0.015-inch-thick, aluminum sheet backing.
 - 4. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.3 TACKBOARD ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AARCO Products, Inc.
 - 2. ADP Lemco, Inc.

3. Best-Rite Manufacturing.
 4. Claridge Products and Equipment, Inc.
 5. Ghent Manufacturing, Inc.
 6. Marsh Industries, Inc.; Visual Products Group.
 7. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 8. Tri-Best Visual Display Products.
- B. Polyester-Fabric-Faced Tackboard: 1/4-inch- thick, polyester-fabric-faced cork sheet factory laminated to 1/4-inch- thick hardboard or particleboard backing.

2.4 TACKBOARD ENCLOSED IN DISPLAY CASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AARCO Products, Inc.
 2. ADP Lemco, Inc.
 3. Best-Rite Manufacturing.
 4. Claridge Products and Equipment, Inc.
 5. Ghent Manufacturing, Inc.
 6. Marsh Industries, Inc.; Visual Products Group.
 7. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 8. Tri-Best Visual Display Products.
- B. Factory-fabricated unit consisting of manufacturer's standard wall-mounted cabinet with tackboard assembly on back inside surface and operable glazed doors at front.
- C. Aluminum-Framed Cabinet: Extruded aluminum with clear anodic finish.
- D. Cabinet Corners: Square.
- E. Glazed Sliding Doors: Clear acrylic sheet; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.
1. Thickness: Not less than 6 mm thick.
 2. Number of Doors: Two.
- F. Tack Surface: Polyester-fabric-faced tackboard assembly.

1. Color: As selected by Architect from full range of industry colors.
- G. Width and Height: As indicated on Drawings.
- H. Depth: 2 inches.
- I. Mounting: Surface mounted.

2.5 MARKERBOARD AND TACKBOARD ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.
 1. Factory-Applied Trim: Manufacturer's standard.
- B. Marker tray: Manufacturer's standard, continuous.
 1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
 2. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

2.6 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory assemble visual display boards.
 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
 2. Provide manufacturer's standard vertical-joint spline system between abutting sections of markerboards.
 3. Provide manufacturer's standard mullion trim at joints between markerboards and tackboards of combination units.
- D. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.9 VISUAL DISPLAY SURFACE SCHEDULE

- A. Markerboard: Factory assembled.
 - 1. Porcelain-enamel markerboard assembly.
 - a. Color: White.
 - 2. Corners: Square.
 - 3. Width: As indicated on Drawings.
 - 4. Height: As indicated on Drawings.
 - 5. Mounting: Wall.
 - 6. Mounting Height: 36 inches to bottom of unit..
 - 7. Factory-Applied Aluminum Trim: Manufacturer's standard with clear anodic finish.
 - 8. Accessories: Chalktray.
- B. Tackboard: Factory assembled.
 - 1. Tack Surface: Polyester-fabric-faced tackboard assembly.
 - a. Color: As selected by Architect from full range of industry colors.
 - 2. Corners: Square.
 - 3. Width and Height: As indicated on Drawings.
 - 4. Mounting: Wall.
 - 5. Mounting Height: 36 inches to bottom of unit.

6. Edges: Concealed by trim.
 - a. Factory-Applied Aluminum Trim: Manufacturer's standard style, with clear anodic finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display surfaces.
- C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.

3.3 INSTALLATION, GENERAL

- A. Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
 1. Mounting Height: 36 inches above finished floor to bottom of each unit.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

3.5 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

WSH13095

William Sharpe Hospital
50 Bed Addition

Substitution: BASF Enershield-HP

Corresponding to RFQ Item: 42

Enershield®-HP

Vapor Permeable Air/Water-Resistive Barrier Membrane



 **BASF**

The Chemical Company

Enershield®-HP

DESCRIPTION

ENERSHIELD-HP is a one-component, fluid-applied vapor permeable air/water-resistive barrier. This waterproof, resilient coating may be spray-, roller-, brush-, or trowel-applied directly to approved above grade wall substrates. It provides excellent secondary moisture protection behind wall claddings including brick, siding, metal panels, EIFS and stucco. A slipsheet is required for stucco claddings. **Do not use ENERSHIELD-HP for below-grade applications or on surfaces subject to water immersion.**

USES

For use over the following exterior wall substrates:
 Poured concrete/unit masonry, ASTM C1177 type sheathings, including DensGlass™ exterior sheathing, eXP™ sheathing, GlasRoc® sheathing, Securock™ glass-mat sheathing, Weather Defense™ Platinum sheathing, GreenGlass® sheathing, PermaBase™ cement-board by National Gypsum and other cement-boards (ASTM C1325 Type A Exterior), Untreated Exposure I or exterior plywood sheathing (grade C-D or better), Untreated Exposure I OSB, gypsum sheathing (ASTM C79/ASTM C1396).

Do not use ENERSHIELD-HP for below-grade applications or on surfaces subject to water immersion.

COLOR

Gray

COVERAGE*

Substrate

ASTM C1177 Type Sheathing

41 m² (450 ft²) per pail

Cement Board

46 m² (500 ft²) per pail

Plywood**

41 m² (450 ft²) per pail

Oriented Strand Board (OSB)**

41 m² (450 ft²) per pail

Concrete Masonry Units (CMU)**

32 m² (350 ft²) per pail

Poured Concrete

46 m² (500 ft²) per pail

Embed Sheathing Fabric

4" Sheathing Fabric

192 m (630 ft) per pail

6" Sheathing Fabric

128 m (420 ft) per pail

9" Sheathing Fabric

85 m (280 ft) per pail

PACKAGING

27.2 kg per 19-liter pail (60 lbs per 5-gallon pail)

4" SHEATHING FABRIC: 101.5 mm x 54.8 m (4" x 180 ft.) roll

6" SHEATHING FABRIC: 152.4 mm x 54.8 m (6" x 180 ft.) roll

9" SHEATHING FABRIC: 228.5 mm x 54.8 m (9" x 180 ft.) roll

* Spray Application. Actual results may vary depending on surface porosity, moisture uptake, application and other factors.

** Spray and backroll for optimum coverage rate. Other application methods may provide less coverage.

ENERSHIELD-HP complies with the air barrier requirements of the Massachusetts State Energy Code.

Features	Benefits
<1% of allowable air leakage per ASTM E2357 Air Leakage of Building Assemblies test	Easily meets air tightness requirements defined by ASHRAE 189.1 and ABAA
ICC ESR-3209 Evaluation Report	Demonstrates compliance with ICC-ES AC 148 and AC 212
ABAA certified	Approved for projects requiring ABAA specifications and quality assurance
Meets ASTM D1970 nail sealability requirements with and without Sheathing Fabric	Self sealing performance
One component, low-VOC formulation	Easy to apply, meets VOC requirements in all 50 states
Self-gauging thickness, consistent strength when used to saturate Sheathing Fabric	Extra strength where needed; simplified application and inspection
TF Membrane accessory	Seamless membrane at expansion joints and transitions to roof and foundation, and across dissimilar substrates
Nonflammable as applied	Workplace safety
Mineral oil and plasticizer free	Will not dry out or crack due to loss of oil / plasticizer over time
Water based	Cleans up with water; solvent and citrus based cleaners not required
Tough, abrasion resistant	Rugged membrane resists damage after installation
Approved for use with BASF EIFS and stucco systems	Seamless membrane for buildings with multiple claddings
Low temperature performance with LT Additive	Extends minimum application temperature to 4° C (25° F)
ASTM E 84 Class A fire and smoke performance	Can be used in most noncombustible construction applications
180 day outdoor exposure rating	Flexible construction scheduling

Solids 74% solids. **VOC Content** 11 g/l, or 0.09 lbs/gal less water and exempt solvents per ASTM D2369 (based in part on EPA method 24).



TEST RESULTS

TEST	RESULT
Air Leakage of Air Barrier Assemblies ASTM E 2357	0.0007 l/s-m ² (0.0001 cfm/ft ²) @ 75 Pa (1.57 psf) positive / post conditioning 0.0014 l/s-m ² (0.0003 cfm/ft ²) @ 75 Pa (1.57 psf) negative / post conditioning
Air Permeance of Building Materials ASTM E 2178	0.0049 l/s-m ² @ 75 Pa (0.00098 cfm/ft ² @ 1.57 psf)
Rate of Air Leakage ASTM E 283	0.0185 l/s-m ² @ 75 Pa (0.0037 cfm/ft ² @ 1.57 psf)
Water Vapor Transmission ASTM E 96 Method B	18 Perms (grains/Hr. in Hg. ft ²) @ 10 mils wet film thickness 14 Perms (grains/Hr. in Hg. ft ²) @ 20 mils wet film thickness
Pull-Off Strength of Coatings ASTM D 4541	Pass - Min. 110 kPa (15.9 psi) or substrate failure (Tested over exterior gypsum sheathing, ASTM C1177 glass-mat sheathing, cement board, OSB, plywood; pvc and galvanized flashing)
Nail Sealability (without Sheathing Fabric) ASTM D 1970	Pass - No water penetration at galvanized roofing nail penetration under 127 mm (5") head of water after 3 days at 4° C (40° F)
Compound Stability (Elevated Temperature) ASTM D 5147 Section 15	No flowing, dripping or drop formation up to 177° C (350° F).
Surface Burning ASTM E 84	Class A Flame Spread (<25) Class A Smoke Developed Spread (<450)
Radiant Heat Multi-Story Tests NFPA 268, NFPA 285	Pass (EIFS cladding with 12" EPS insulation)
Fire Resistance ASTM E119/UL 263	Will not add or detract from the rating of a fire resistive wall assembly

ICC-ES AC 212 Acceptance Criteria for Water-Resistive Coatings used as Water-Resistive Barriers over Exterior Sheathing

Sequential Testing - Structural, Racking, Restrained Environmental Conditioning and Water Penetration	
1. Structural: ASTM E 1233 Procedure A	No cracking at joints or interface of flashing
2. Racking: ASTM E 72	No cracking at joints or interface of flashing
3. Restrained Environmental Conditioning: ICC-ES AC 212	No cracking at joints or interface of flashing
4. Water Penetration : ASTM E 331	No water penetration after 90 min @ 299 Pa (6.24 psf) Tested over OSB and gypsum sheathing
Sequential Testing - Weathering	
1. UV Light Exposure: ICC-ES AC 212	No cracking or bond failure to substrate
2. Accelerated Aging: ICC-ES AC 212	No cracking or bond failure to substrate
3. Hydrostatic Pressure Test: AATCC 127-1985	No water penetration
Freeze-Thaw ASTM E 2485 (Method B)	No sign of deleterious effects after 10 cycles (Tested over exterior gypsum sheathing, ASTM C1177 glass-mat sheathing, cement board, OSB, plywood)
Water Resistance ASTM D 2247	No sign of deleterious effects after 14 day exposure (Tested over exterior gypsum sheathing, ASTM C1177 glass-mat sheathing, cement board, OSB, plywood)
Tensile Bond ASTM C 297	>103 kPa (15 psi) Tested over exterior gypsum sheathing, ASTM C1177 glass-mat sheathing, cement board, OSB, plywood, CMU; pvc and galvanized flashing
Tensile Bond (before & after freeze-thaw) ASTM C 297	>103 kPa (15 psi) avg; no failure of the lamina after 10 cycles freeze-thaw (Tested over various substrates)



TEST RESULTS

ICC-ES AC 148 Acceptance Criteria for Flexible Flashing Materials

Sequential Testing - Weathering

- | | |
|--|--|
| 1. UV Light Exposure: ICC-ES AC 148 | No cracking or bond failure to substrate |
| 2. Accelerated Aging: ICC-ES AC 148 | No cracking or bond failure to substrate |
| 3. Hydrostatic Pressure Test:
AATCC 127-1985 | No water penetration |

Peel Adhesion

ASTM D 3330 Method F

Tested over ASTM C1177 glass-mat sheathing, OSB, plywood, pvc and uncoated aluminum

After UV Exposure

Pass

After Accelerated Aging

Pass

After Elevated Temperature Exposure

Pass

After Water Immersion

Pass

Nail Sealability after Thermal Cycling

ASTM D 1970 (Modified), AAMA 711

Pass

Tensile Strength after UV Exposure

ASTM D 5034, AAMA 711

All samples meet the minimum requirement of 3.5 N/mm (20 lbs/in)

Cold Temperature Pliability

ASTM D 1970, AAMA 711

No cracking after bending around a 25 mm (1") mandrel after 2 hour exposure to -18° C (0° F)

Resistance to Peeling

AAMA 711

No signs of distress or failure after 24 hours of exposure at room temperature, 50° C (122° F), 65° C (149° F), 80° C (176° F)

Enershield®-HP

MIXING

1. Use directly from original packaging or prepare in a container that is clean and free of foreign substances. Do not use a container which has contained or been cleaned with a petroleum-based product.
2. Mix ENERSHIELD-HP with a clean, rust-free paddle and drill until thoroughly blended. Dilution of Enershield-HP is not recommended.
3. Additives are not permitted.
4. Close container when not in use.
5. Clean tools and equipment with water immediately after use. Dried material can only be removed mechanically.

APPLICATION

Job Conditions

To apply ENERSHIELD-HP at ambient temperatures below 4°C (40°F) but greater than -4°C (25°F), thoroughly blend 1 full quart container of LT ADDITIVE with one full 5-gallon pail of ENERSHIELD-HP. When using LT ADDITIVE, extended drying time can be expected. Do not apply ENERSHIELD-HP to frozen or frost-laden substrates. Do not apply ENERSHIELD-HP in ambient temperatures below 4°C (40°F) or onto substrates below 4°C (40°F) unless LT ADDITIVE is used.

Limit the weather exposure of ENERSHIELD-HP to a maximum of 180 days.

Surface Preparation

Substrate shall be dry, clean, sound and free of release agents, paint or other residue or coatings. Verify substrate is flat, free of fins or planar irregularities greater than 6.4 mm in 3 m (1/4" in 10'). Unsatisfactory conditions shall be reported to the general contractor and corrected before application of ENERSHIELD-HP.

Equipment

Use a 20 mm (3/4") nap roller or paint brush. If spraying, refer to *Spray Application* technical bulletin for spray application equipment and application instructions.

Note: If using roller application, it is necessary to pre-wet the synthetic roller pad with water and spin out the excess water. The pre-wetting only needs to be done once at the start of application.

Procedure

1. Substrate shall be of a type acceptable by BASF and shall be installed per substrate manufacturer's instructions and local code requirements.
2. Wrap openings with SHEATHING FABRIC by applying a generous amount of mixed ENERSHIELD-HP to all surfaces and immediately embedding SHEATHING FABRIC, completely saturating the SHEATHING FABRIC. If necessary, apply a second coat of ENERSHIELD-HP to ensure a complete, void-free membrane.
3. Spot all fasteners and precoat sheathing joints, terminations, inside and outside corners with mixed ENERSHIELD-HP using a 101 mm (4") wide by 20 mm (3/4") nap roller, brush or spray.

- 4.a. Immediately place and center SHEATHING FABRIC over wet ENERSHIELD-HP at all sheathing joints, terminations, inside and outside corners, as well as knot holes and check cracks that may exist in plywood or OSB. Ensure Fabric extends evenly on both sides of the sheathing joint. Completely saturate SHEATHING FABRIC with ENERSHIELD-HP.
 - b. Lap SHEATHING FABRIC 63.5 mm (2 1/2") minimum at intersections.
 - c. If using roller, brush, or trowel application, allow to dry to the touch before applying ENERSHIELD-HP to entire wall surface. If spraying, "wet on wet" application is acceptable.
- 5.a. Apply ENERSHIELD-HP to DensGlass™ exterior sheathing, e²XP™ sheathing, GlasRoc® sheathing, Securock™ glass-mat sheathing, Weather Defense™ Platinum sheathing, GreenGlass® sheathing, PermaBase™ cement-board by National Gypsum and other cement-boards (ASTM C1325 Type A Exterior) and gypsum sheathing (ASTM C79/ASTM C1396) with a 20 mm (3/4") nap roller, stainless steel trowel, brush or spray gun to a consistent, minimum 10 wet mil thickness that is free of voids and pin holes. A fully loaded roller pad is required to obtain a consistent, minimum 10 wet mil thickness. For spray application, backrolling may be needed to produce a pinhole-free film. **Note: Refer to *Spray Application* technical bulletin for spray application equipment and application instructions.**
 - b. Apply ENERSHIELD-HP to plywood, OSB or CMU substrate(s) with a 20 mm (3/4") nap roller or spray to a consistent, minimum 10 wet mil thickness. Prior to application of the second coat, visually inspect to assure sheathing surface is blister free and coating is free of voids and pinholes. Repair if needed and then apply a second coat after the initial coating is sufficiently dry.
Note: A minimum of two (2) 10 mil wet coats of ENERSHIELD-HP is required over OSB, plywood and CMU. ENERSHIELD-HP may be sprayed to a 20 mil pinhole-free thickness over OSB and plywood in one wet application. Backrolling may be needed to produce a pinhole-free film.

Drying Time

Allow to dry completely, typically 2 to 10 hours. Protect from rain and from temperatures less than 4°C (40°F) for 24 hours.

For Best Performance

Visually inspect the ENERSHIELD-HP for voids, pinholes, surface deficiencies, etc. Repair deficiencies and areas that are not intact. Apply additional ENERSHIELD-HP as necessary such that ENERSHIELD-HP is free of voids, pinholes, etc. All sheathing joints, terminations, inside and outside corners must be reinforced with 4" or 9" SHEATHING FABRIC or TF MEMBRANE 4 or 9. Reference *Air/Vapor/Water-Resistive Barrier Guidelines* technical bulletin for proper treatment of rough openings and sheathing joints.

LIMITATIONS

Shipping & Storage

Protect BASF materials during transportation and installation to avoid physical damage. Store BASF materials in a cool, dry place protected from freezing. Store at no less than 4°C (40°F). Protect from extreme heat and direct sunlight.

Stacking

Do not stack pallets.

Shelf Life

Approximately 2 years, properly stored in original containers.

TECHNICAL SUPPORT

Consult the BASF Wall Systems Technical Services Department for specific recommendations concerning all other applications. Consult the Enershield website, www.enershield.basf.com, for additional information about products and systems and for updated literature.

HEALTH AND SAFETY

Caution

May be harmful if vapors or mist are inhaled, if absorbed through skin, or if swallowed. May cause eye, skin and respiratory tract irritation. Swallowing this product can cause kidney damage.

Precautions

Avoid getting in eyes, on skin, or on clothing. Avoid breathing vapors or mist. Wear safety glasses or goggles, impervious gloves, and clothing with long sleeves and pants. If TLV or PEL can be exceeded, wear respirator selected by a technically qualified person. Wash thoroughly after handling. Wash contaminated clothing before reuse.

Spills

Wipe up small spills with rags. Absorb larger spills with sand, vermiculite, or kitty litter; sweep up and place in a suitable container for disposal.

First Aid

Eyes: For eye contact, rinse eyes with water. Remove any contact lenses, and continue flushing with plenty of water for several minutes. Seek medical attention if irritation develops and persists.

Skin: For skin contact, wash affected areas with plenty of water, and soap if available, for several minutes. Seek medical attention if irritation develops and persists.

Internal: If inhaled, remove from area to fresh air. Seek medical attention if respiratory irritation develops or if breathing becomes difficult. If swallowed, give 3-4 glasses of water, but do not induce vomiting unless directed to do so by a physician. Do not give anything by mouth to an unconscious or convulsing person. Get medical attention.

Read Material Safety Data Sheet before using this product.

Solids

74% solids

VOC Content

11 g/l, or 0.09 lbs/gal less water and exempt solvents per ASTM D2369 (based in part on EPA method 24).

For medical emergencies only call CHEMTREC at (800) 424-9300.



NOTE

BASF Wall Systems is an operating unit of BASF Corporation (herein referred to as "BASF Wall Systems")

DISCLAIMER

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Enershield™-HP

Specification for Fluid-Applied, Vapor-Permeable Air/Water-Resistive Barriers

NOTES TO SPECIFIER

The guide specification has been assembled to assist design professionals in the development of project specifications for fluid-applied, vapor-permeable air/water-resistive barriers. This Guide Specification uses ENERSHIELD-HP and accessory products as the Basis of Design. It is intended for use in conjunction with BASF Corporation - Wall Systems (hereinafter referred to as "BASF Wall Systems") product and technical bulletins. Please note that more than one subcontractor may be involved in the scope of work defined by this Guide Specification, as indicated in Section 1.01 B. If the intention is for one subcontractor to assume responsibility for the entire air/water-resistive barrier, Section 1.01 B should be omitted.

DESIGN RESPONSIBILITY

It is the responsibility of both the specifier and the purchaser to determine if a product is suitable for its intended use. The designer selected by the purchaser shall be responsible for all decisions pertaining to design, detail, structural capability, attachment details, shop drawings and the like. BASF Wall Systems has prepared guidelines in the form of specifications, typical application details, and product bulletins to facilitate the design process only. BASF Wall Systems is not liable for any errors or omissions in design, detail, structural capability, attachment details, shop drawings or the like, whether based upon the information provided by BASF Wall Systems or otherwise, or for any changes which the purchasers, specifiers, designers or their appointed representatives may make to BASF Wall Systems published comments.

Please note that air seals at any joints/gaps between adjoining components (penetrations, etc.) are of primary importance to maintain continuity of an air barrier system and must be considered by the design professional in the overall wall assembly design. Stucco claddings require the use of a slipsheet installed over ENERSHIELD-HP to prevent adhesion of stucco.

SECTION 072726

FLUID-APPLIED, VAPOR-PERMEABLE AIR AND WATER-RESISTIVE BARRIER

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

- A. General Conditions, Supplementary Conditions, Instructions to Bidders and Division One General Requirements shall be read in conjunction with and govern this section.
- B. This specification shall be read as a whole by all parties concerned. Each Section may contain more or less than the complete Work of any trade. The Contractor is solely responsible to make clear to the Subcontractors the extent of their Work.

1.02 SECTION INCLUDES

- A. Ready mixed resilient, fluid applied, vapor permeable, air/water-resistive barrier for use behind most exterior wall claddings.
- B. Materials and installation methods to bridge and seal air leakage pathways and gaps including:
 - 1. Connections of walls to foundations
 - 2. Connections of walls to the roof air barrier
 - 3. Seismic and expansion joints
 - 4. Openings and penetrations in the building envelope
 - 5. Masonry ties, screws, bolts and similar penetrations
 - 6. All other leakage pathways through opaque walls
- C. Materials and installation methods to create a water-resistive barrier suitable for use as part of a secondary drainage system for brick, natural and manufactured stone veneers, EIFS, metal composite, siding and most other cladding systems.
- D. Refer to all drawings and other sections of this specification to determine the type and extent of work therein affecting the work of this section, whether or not such work is specifically mentioned herein.

Enershield-HP

1.03 RELATED SECTIONS

- A. Section 03 00 00 Concrete substrate
- B. Section 04 00 00 Masonry substrate
- C. Section 05 40 00 Cold-formed metal framing
- D. Section 06 11 00 Wood framing
- E. Section 06 16 00 Sheathing
- F. Section 07 62 00 Sheet metal flashing and trim
- G. Section 07 65 00 Flexible flashing
- H. Section 07 90 00 Joint protection
- I. Section 08 00 00 Openings
- J. Section 08 50 00 Windows
- K. Section 09 22 16 Non-structural metal framing
- L. Section 09 29 00 Gypsum board

1.04 DEFINITIONS

- A. Air Barrier Material: A building material that is designed and constructed to provide the primary resistance to airflow through an air barrier assembly.
- B. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.
- C. Water-Resistive Barrier Assembly: The collection of water-resistive materials and accessories that direct incidental water that may pass the primary rainscreen out of the wall cladding while providing protection for underlying sheathing materials.

1.05 REFERENCES

- A. Building Codes
 - 1. ICC-ES Acceptance Criteria for Water Resistive Coatings used as Water Resistive Barrier Over Exterior Sheathing, AC 212
 - 2. ICC-ES Acceptance Criteria for Flexible Flashing Materials, AC 148/AAMA 711-07
 - 3. Massachusetts Building Code
- B. American Society for Testing and Materials (ASTM) Standards
 - 1. C920 Specifications for Elastomeric Joint Sealants
 - 2. C1177 Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 - 3. C1396 Standard Specification for Gypsum Board
 - 4. C1193 Guide for Use of Joint Sealants
 - 5. D412 Standard Test Methods for Rubber Properties in Tension
 - 6. D4258 Practice for Surface Cleaning Concrete for Coating
 - 7. D4263 Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
 - 8. D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
 - 9. D5147 Standard Test Method for Sampling and Testing Modified Bituminous Sheet Material
 - 10. E84 Test Method for Surface Burning Characteristics of Building Materials
 - 11. E96 Test Methods for Water Vapor Transmission of Materials
 - 12. E283 Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors under Specified Pressure Differences across the Specimen
 - 13. E330 Standard Test Method for the Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Pressure Difference
 - 14. E331 Standard Test Method for Water Penetration of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure
 - 15. E1105 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Doors, Skylights and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference
 - 16. E2178 Standard Test Method for Air Permeance of Building Materials
 - 17. E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

1.06 PERFORMANCE REQUIREMENTS

- A. General: Air/water-resistive barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. At wall cladding transitions, the air/water-resistive barrier shall form a continuous air barrier and shall make provision for water drainage, either by creation of an unobstructed drainage plane that extends across the cladding transition or by flashing to discharge to the exterior at the transition. Air barrier assemblies shall be capable of accommodating substrate movement and sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits, or interruption of the drainage plane.

- B. Commonwealth of Massachusetts Building Code Requirements: Comply with the following subsections of 780 CMR 13, Section 1304.3 Air Leakage.
- 1304.3.1 Air Barriers:
- The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50% of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:*
1. It must be continuous, with all joints made airtight.
 2. It shall have an air permeability not to exceed 0.02 l/m² under a pressure differential of 75 Pa (equal to 0.004 cfm/ ft² @ 1.57 psf) when tested in accordance with ASTM E2178.
 3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
 4. It shall be durable or maintainable.
 5. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
 - a. Foundation and walls.
 - b. Walls and windows or doors.
 - c. Different wall systems.
 - d. Wall and roof.
 - e. Wall and roof over unconditioned space.
 - f. Walls, floor and roof across construction, control and expansion joints.
 - g. Walls, floors and roof to utility, pipe and duct penetrations.
 6. All penetrations of the air/water-resistive barrier and paths of air infiltration/exfiltration shall be made airtight.
- C. Fluid-Applied Membrane Performance Requirements

TEST	REQUIREMENTS
Air Leakage of Air Barrier Assemblies ASTM E 2357	Maximum 0.007 l/s·m ² (0.0014 cfm/ft ²)
Air Permeance of Building Materials ASTM E 2178	Maximum 0.02 l/s·m ² @ 75 Pa (0.004 cfm/ft ² @ 1.57 psf)
Rate of Air Leakage ASTM E 283	Maximum 0.02 l/s·m ² @ 75 Pa (0.004 cfm/ft ² @ 1.57 psf)
Water Vapor Transmission ASTM E 96 Method B	Minimum 10 perms
Pull-Off Strength of Coatings ASTM D 4541	Minimum 110 kPa (15.9 psi) adhesion or substrate failure
Nail Sealability ASTM D 1970	No water penetration at galvanized roofing nail penetration under 127 mm (5") head of water after 3 days at 4° C (40° F)
Surface Burning ASTM E 84	Flame spread <25 Smoke developed < 450
Volatile Organic Compounds (VOC) ASTM D 2369	Maximum 50 g/l
Compound Stability (Elevated Temperature) ASTM D 5147 Section 15	No flowing, dripping or drop formation up to 177° C (350° F).

ICC-ES AC 212 Acceptance Criteria for Water-Resistive Coatings used as Water-Resistive Barriers over Exterior Sheathing

Sequential Testing - Structural, Racking, Restrained Environmental Conditioning and Water Penetration

1. Structural: ASTM E 1233 Procedure A	No cracking at joints or interface of flashing after 90 min @ 137 Pa (2.86 psf)
2. Racking: ASTM E 72	No cracking at joints or interface of flashing after 90 min @ 137 Pa (2.86 psf)
3. Restrained Environmental Conditioning: ICC-ES AC 212	No cracking at joints or interface of flashing after 90 min @ 137 Pa (2.86 psf)
4. Water Penetration : ASTM E 331	No water penetration after Structural, Racking and Restrained Environmental Conditioning

Sequential Testing - Weathering

1. UV Light Exposure: ICC-ES AC 212	No cracking or bond failure to substrate
2. Accelerated Aging: ICC-ES AC 212	No cracking or bond failure to substrate
3. Hydrostatic Pressure Test: AATCC 127-1985	No water penetration

Freeze-Thaw ASTM E 2485 (Method B)	No visible effects (cracking checking, delamination, erosion) after 10 cycles when viewed at 5X magnification
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Water Resistance ASTM D 2247	No sign of deleterious effects after 14 day exposure
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Tensile Bond ASTM C 297	>103kPa (15 psi) avg; no failure of the lamina after 10 cycles
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Tensile Bond (before & after freeze-thaw) ASTM C 297	>103 kPa (15 psi) avg; no failure of the lamina after 10 cycles freeze-thaw
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ICC-ES AC 148 Acceptance Criteria for Flexible Flashing Materials

Sequential Testing - Weathering

1. UV Light Exposure: ICC-ES AC 148	No visible surface or structural changes when observed under 5X magnification
2. Accelerated Aging: ICC-ES AC 148	No visible surface or structural changes when observed under 5X magnification
3. Hydrostatic Pressure Test: AATCC 127-1985	No signs of failure after UV and Accelerated Aging

Peel Adhesion ASTM D 3330 Method F	All samples meet the minimum requirement of .263 N/mm (1.5 lbs/in)
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UV Exposure	No visible surface or structural changes when observed under 5X magnification
Accelerated Aging	No visible surface or structural changes when observed under 5X magnification
After Elevated Temperature Exposure	No visible surface or structural changes when observed under 5X magnification
After Water Immersion	No signs of failure after UV and Elevated Temperature Exposure

Nail Sealability after Thermal Cycling ASTM D 1970 (Modified), AAMA 711	No water penetration at galvanized roofing nail penetration under 32 mm (1.25") head of water after 24 hours at 4° C (40° F)
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Tensile Strength after UV Exposure ASTM D 5034, AAMA 711	All samples meet the minimum requirement of 3.5 N/mm (20 lbs/in)
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Cold Temperature Pliability ASTM D 1970, AAMA 711	No cracking after bending around a 25 mm (1") mandrel after 2 hour exposure to -18° C (0° F)
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Resistance to Peeling AAMA 711	No signs of distress or failure after 24 hours of exposure at room temperature, 50° C (122° F), 65° C (149° F), 80° C (176° F)
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1.07 SUBMITTALS

- Submit under provisions of Section [01 33 00]
- Manufacturer's technical data sheets and material safety data sheets for products and accessories.
- Shop drawings showing locations and extent of air/water-resistive barrier system including details of typical conditions, intersection and transitions with other envelope systems and materials.

1.08 QUALITY ASSURANCE

- A. Manufacturer: Minimum 10-years experience in the production and marketing of waterproofing materials.
- B. Air/water-resistive barrier membrane manufacturer shall provide an ICC-ES Evaluation Report confirming compliance with AC 212 Acceptance Criteria for Water-Resistive Coatings used as Water-Resistive Barriers over Exterior Sheathing.
- C. Applicator Qualifications: An applicator experienced in applying air barrier materials similar in material, design and extent to those indicated for this project, whose work has resulted in applications with a record of successful in-service performance.
 - 1. Knowledgeable in the proper use and handling of BASF Wall Systems products.
 - 2. Employ skilled installers who are experienced and knowledgeable in air/water-resistive barrier application, and familiar with the requirements of the specified work.
 - 3. Provide the proper equipment, manpower and supervision on the job site to install the system in compliance with BASF Wall Systems published specifications.
- D. Regulatory Requirements: Conform to applicable code requirements for air/water-resistive barriers.
- E. Primary materials including fluid-applied air/water-resistive barrier membrane, sheathing fabric, flashing primer and transition membranes shall be sourced from one manufacturer regularly engaged in production of air barrier materials.
- F. Mockups: Before beginning installation of air/water-resistive barrier, provide air/water-resistive barrier work for exterior wall assembly mockups, incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.
 - 1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air/water-resistive barrier before external insulation and cladding is installed.
 - 2. If Architect determines mockups do not comply with project requirements, reconstruct mockups and apply air/water-resistive barrier until mockups are approved.
- G. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Preinstallation conference shall include the Architect, General Contractor and Applicator. Agenda for meeting shall include but not be limited to the following:
 - 1. Review of submittals.
 - 2. Review of surface preparation, minimum curing period and installation procedures.
 - 3. Review of special details and flashings.
 - 4. Sequence of construction, responsibilities and schedule for subsequent operations.
 - 5. Review of mock-up requirements.
 - 6. Review of inspection, testing, protection and repair procedures.
- H. Coordination of trades
 - 1. The Architect, General Contractor and Applicator shall evaluate adjacent materials such as windows, doors, etc. for conformance to project details. Adjacent trades shall provide scaled shop drawings for review by the Architect.
 - 2. The General Contractor shall make provision for installation of air seals between the primary air barrier and other wall components (penetrations, etc.) in order to maintain continuity of an air barrier system.
 - 3. The Applicator shall provide protection of rough openings before installing windows, doors, and other penetrations through the wall.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle products under provisions of Section [01 65 00] [01 66 00] [].
- B. Deliver all materials in original unopened packages with manufacturer's labels intact.
- C. Protect all materials during transportation and installation to avoid physical damage.
- D. Store materials in cool, dry place protected from freezing. Store at no less than 4°C (40°F).
- E. Store materials away from direct sunlight and extreme heat.
- F. Store all accessory products in a cool, dry place protected from exposure to moisture.

1.10 PROJECT/SITE CONDITIONS

- A. Do not apply materials in ambient temperatures below 4°C (40°F). Provide properly vented, supplementary heat during installation and drying period when temperatures less than 4°C (40°F) prevail.
- B. Do not apply materials to frozen surfaces.
- C. Maintain ambient temperature at or above 4°C (40°F) during and at least 24 hours after application of all materials and until dry.

1.11 WARRANTY

- A. Provide the Manufacturer's minimum 5-year Limited Materials warranty under provisions of Section [01 70 00] [].
 - 1. Comply with Manufacturer's applicator registration requirements and notification procedures to assure qualification for warranty.

Enershield-HP

PART 2 – PRODUCTS

2.01 MANUFACTURERS

The fluid applied vapor-permeable, air/water-resistive barrier membrane, sheathing fabric, transition membrane and flashing primer shall be obtained or approved as a single-source from the membrane manufacturer to ensure system compatibility and integrity.

- A. Basis of Design: ENERSHIELD-HP air/water-resistive barrier manufactured by BASF Corporation - Wall Systems, Jacksonville, Florida.
- B. BASF Wall Systems' products are listed in this specification to establish a standard of quality. Any substitutions to this specification shall be submitted to and receive approval from the Architect at least 10 days before bidding. Proof of equality shall be borne by the submitter. To be considered equal, products must meet or exceed performance requirements shown in Section 1.06.

2.02 MATERIALS

- A. ENERSHIELD-HP fluid-applied air/water-resistive barrier membrane.
- B. SHEATHING FABRIC reinforced non-woven polyester fabric.
- C. Transition membranes: TF MEMBRANE polyester-faced 30-mil thick self-sealing, self-healing rubberized asphalt coating; TF WRAP 20-mil thick self-sealing rubberized asphalt coating laminated to polyethylene film.
- D. Flashing Primer: FLASHING PRIMER water-based primer.

2.03 AUXILIARY MATERIALS

- A. General: Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Flashing: provide flashing that complies with prevailing local building codes.
- C. Sealant: Sonneborn Sonolastic 150 with VLM Technology manufactured by BASF Corporation. Alternate sealants must meet ASTM C920 criteria and be approved for this application by the sealant manufacturer.
- D. Polyurethane Foam Sealant: Approved by polyurethane foam sealant manufacturer for compatibility with air/water-resistive barrier materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. General Contractor shall verify project site conditions under provisions of Section [01 00 00].
- B. Walls
 - 1. Substrates
 - a. Air/water-resistive barrier acceptable substrates: ASTM C1177 type sheathings, including DensGlass™ exterior sheathing, e²XP™ sheathing, GlasRoc® sheathing, Securock™ glass-mat sheathing, Weather Defense™ Platinum sheathing, GreenGlass® sheathing, PermaBase™ cement-board by National Gypsum and other cement-boards (ASTM C1325 Type A Exterior), untreated Exposure I or exterior plywood sheathing (grade C-D or better), untreated Exposure I OSB, Gypsum sheathing (ASTM C79/ASTM C1396), poured concrete/unit masonry. Consult the BASF Wall Systems Technical Services Department for all other applications.
 - b. Wall sheathing must be securely fastened per applicable building code and sheathing manufacturer's requirements.
 - c. Examine surfaces to receive air/water-resistive barrier and verify that substrate and adjacent materials are dry, clean, sound, and free of releasing agents, paint, or other residue or coatings. Verify substrate is flat, free of fins or planar irregularities greater than 6.4 mm in 3 m (1/4" in 10'). Verify that no excess mortar exists on masonry ties, shelf angles and other obstructions.
 - d. Verify that concrete is visibly dry and free of moisture.
 - e. Verify that masonry joints are struck flush and completely filled with mortar.
 - 2. Flashings
 - a. All flashings must be installed in accordance with specific design and building code requirements. Where appropriate, end-dams must be provided.
 - b. Openings must be flashed prior to window/door, HVAC, etc. installation. Windows and openings shall be flashed according to design and building code requirements.
 - c. Individual windows that are ganged to make multiple units require continuous head flashing and the joints between the units must be fully sealed.
 - 3. Kick-out flashing
 - Kick-out flashing must be installed leak-proof and angled (min 100°) to allow for proper drainage and water diversion.
 - 4. Air Seals
 - Install between the primary air/water-resistive barrier and other wall components (penetrations, etc.) in order to maintain continuity of the air barrier system.
- C. Report all unsatisfactory conditions to the General Contractor. Application of fluid-applied air/water-resistive barrier shall not proceed until all unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protect all surrounding areas and surfaces from damage and staining during application of air/water-resistive barrier.
- B. Protect finished work at end of each day.

3.03 MIXING

General: No additives are permitted unless specified in product mixing instructions. Close containers when not in use. Prepare in a container that is clean and free of foreign substances. Do not use a container which has contained or been cleaned with a petroleum-based product. Clean tools and equipment with water immediately after use. Dried material can only be removed mechanically.

- A. Air/water-resistive barrier
 - 1. ENERSHIELD-HP
Mix ENERSHIELD-HP with a clean, rust-free paddle and drill until thoroughly blended. Do not add water to ENERSHIELD-HP.
 - 2. FLASHING PRIMER
Mix FLASHING PRIMER for approximately 1-minute, to a uniform consistency. Do not add water to FLASHING PRIMER.

3.04 APPLICATION

General: Apply products in accordance with current application procedures and in accordance with project requirements. Refer to Wall Systems *Air/Water-Resistive/Vapor Barrier Application Guidelines* technical bulletin

- A. Air/water-resistive barrier
 - 1. Substrate shall be installed per substrate manufacturer's instructions. Substrate shall be dry, clean, sound and free of release agents, paint or other residue or coatings. Verify substrate is flat, free of fins or planar irregularities greater than 6.4 mm in 3 m (1/4" in 10'). Unsatisfactory conditions shall be reported to the general contractor and corrected before application of the air/water-resistive barrier materials.
 - 2. Wrap openings with SHEATHING FABRIC by applying mixed ENERSHIELD-HP to all surfaces and immediately embedding SHEATHING FABRIC. If necessary, apply a second coat of ENERSHIELD-HP over the SHEATHING FABRIC ensuring a continuous, void-, pinhole- and wrinkle- free membrane application (wet-on-wet spray application is acceptable).
 - 3. Spot all fasteners and precoat sheathing joints, terminations, inside and outside corners with mixed ENERSHIELD-HP using a 101 mm (4") wide by 20 mm (3/4") nap roller, brush or spray.
 - 4.
 - a. Immediately place and center SHEATHING FABRIC over wet ENERSHIELD-HP at all sheathing joints, terminations, inside and outside corners, as well as knot holes and check cracks that may exist in plywood or OSB. Ensure SHEATHING FABRIC extends evenly on both sides of the sheathing joint.
 - b. Lap SHEATHING FABRIC 63.5 mm (2 1/2") minimum at intersections.
 - c. Allow to dry to the touch before applying ENERSHIELD-HP to entire wall surface. If spraying, wet-on-wet application is acceptable.
 - 5.
 - a. Apply ENERSHIELD-HP to DensGlass™ exterior sheathing, e²XP™ sheathing, GlasRoc® sheathing, Securock™ glass-mat sheathing, Weather Defense™ Platinum sheathing, GreenGlass® sheathing, PermaBase™ cement-board by National Gypsum and other cement-boards (ASTM C1325 Type A Exterior) and gypsum sheathing (ASTM C79/ASTM C1396) with a 20 mm (3/4") nap roller, stainless steel trowel, brush or spray gun to a consistent, minimum 10 wet mil thickness that is free of voids and pinholes. A fully loaded roller pad is required to obtain a consistent, minimum 10 wet mil thickness. Backrolling may be needed to produce a pinhole-free film. **Note: Refer to *Spray Application* technical bulletin for spray application equipment and application instructions.**
 - b. Apply ENERSHIELD-HP to plywood, OSB or CMU substrate(s) with a 20 mm (3/4") nap roller or spray to a consistent, minimum 10 wet mil thickness. Prior to application of the second coat, visually inspect to assure sheathing surface is blister free and coating is free of voids and pinholes. Repair if needed and then apply a second coat after the initial coating is sufficiently dry. **Note: A minimum of two (2) 10-mil wet coats of ENERSHIELD-HP is required over OSB, plywood and CMU. ENERSHIELD-HP may be sprayed to a 20-mil thickness over OSB and plywood in one wet application. For spray application, backrolling may be needed to produce a pinhole-free film.**
 - 6. Limit the weather exposure of ENERSHIELD-HP to a maximum of 180 days. Verify surfaces are free of dirt, contaminants, or other deleterious conditions before application of cladding. Report and correct any such conditions prior to cladding application. Dry/cure times of adhesively applied EPS insulation board installed over ENERSHIELD-HP may be prolonged, particularly in cool and/or damp weather. Non-cementitious adhesives are not recommended for EPS insulation board attachment to ENERSHIELD-HP. Proper application is the responsibility of the user.
- B. Transition material installation
 - 1. Install ENERSHIELD-HP / SHEATHING FABRIC and/or TF WRAP/TF MEMBRANE and sealant in accordance with project details & specifications to form a seal with adjacent construction and maintain a continuous air/water-resistive barrier.
 - a. General Contractor shall make provision to coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - b. General Contractor shall make provision to install strip on roofing membrane or base flashing so that a minimum of 75 mm (3") of coverage is achieved over both substrates.
 - 2. Apply FLASHING PRIMER to substrates scheduled to receive transition membrane as required and at required amount.

Apply TF WRAP OR TF MEMBRANE as soon as possible after FLASHING PRIMER is dry and tacky. Limit priming to areas that will be covered with TF WRAP or TF MEMBRANE on the same day. Re-prime areas exposed for more than 24 hours. Using a wallpaper roller, extension-handled counter top roller or weighted hand roller, firmly roll the TF WRAP OR TF MEMBRANE to the area being sealed. As the TF WRAP OR TF MEMBRANE is applied, pull more of the release film from the TF WRAP OR TF MEMBRANE, exposing the adhesive surface, pressing down on the TF WRAP OR TF MEMBRANE with a roller and keeping the TF WRAP OR TF MEMBRANE smooth.

3. General Contractor shall make provision to:
 - a. Connect and seal exterior wall air/water-resistive barrier membrane continuously to roofing membrane air/water-resistive, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction interfaces used in exterior walls, using accessory materials.
 - b. Apply joint sealants forming part of air/water-resistive barrier assembly within sealant manufacturer's recommended application procedures.
 - c. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air/water-resistive barrier membrane with foam sealant.
4. Flashing Membranes: As required by project design, prime perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply TF WRAP or TF MEMBRANE transition strip so that a minimum of 75 mm (3") of coverage is achieved over both.
5. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 150 mm (6") beyond repaired areas in strip direction.

3.05 CLEANING AND PROTECTION

- A. Clean and protect completed construction under provisions of Sections [01 74 00] [01 76 00]
- B. Applicator shall protect air/water-resistive barrier system from damage during application. General Contractor shall make provision to protect air/water-resistive barrier during the remainder of construction period. Repair any damage that may occur after installation in a manner consistent with the scope and intent of this specification.
- C. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- D. Remove masking materials after installation.

NOTE

BASF Wall Systems is an operating unit of BASF Corporation (herein referred to as "BASF Wall Systems")

DISCLAIMER

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Enershield™-I / Enershield™-HP

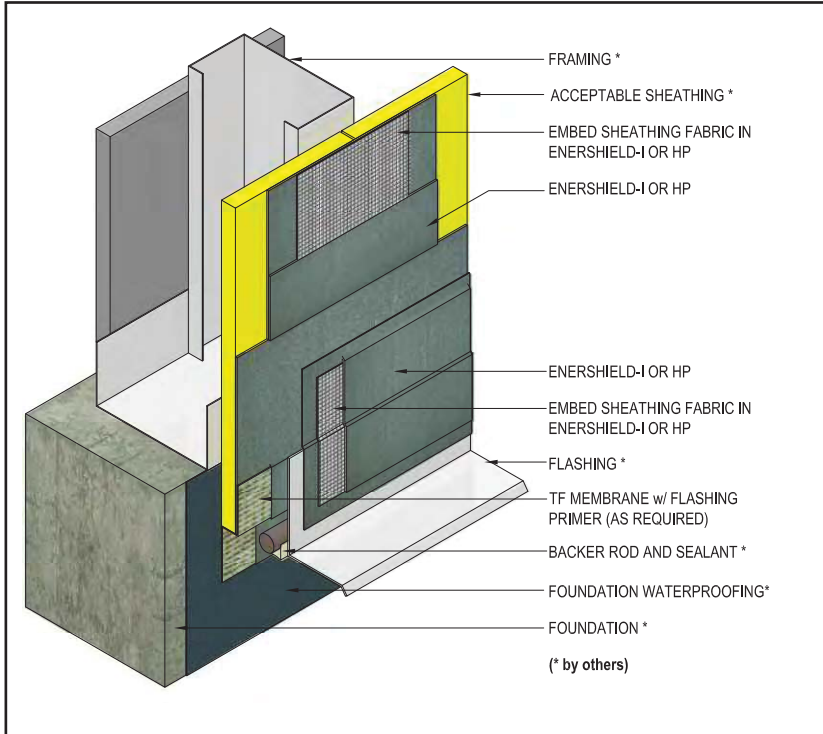
Typical Details for Vapor Impermeable and Permeable Air / Water-Resistive Barriers



1. Termination at Grade - Sheathing Overlapping Foundation
2. Termination at Grade - Sheathing Overlapping Foundation with EIFS
3. Termination at Grade - Sheathing Overlapping Foundation with Siding
4. Termination at Grade - Sheathing Flush with Foundation
5. Termination at Grade - Sheathing Flush with Foundation and EIFS
6. Termination at Grade - Sheathing Flush with Foundation and Siding
7. Termination at Grade - Brick
8. Termination at Grade - Masonry Veneer
9. Typical Window Head
10. Typical Window Jamb
11. Typical Window Sill
12. Typical EIFS Abutment to Brick with Drainage at Floorline
13. Typical EIFS Abutment to Brick
14. Typical EIFS Abutment to Siding
15. Typical EIFS Abutment to Masonry Veneer
16. Typical Inside Corner Change in Substrate
17. Typical Brick Anchor Treatment
18. Typical Brick Expansion Joint
19. Typical Joint and Fastener Treatment
20. Typical Vertical Expansion Joint
21. Typical Rough Opening Corner Reinforcement
22. Typical Rough Opening Reinforcement
23. Typical Pan Flashing
24. Typical Saddle Application
25. Typical Kick-Out Flashing
26. Typical Roof Edge Flashing
27. Typical Parapet Cap Flashing
28. Typical Penetration through Wall Construction (Rough Cut)
29. Typical Penetration through Wall Construction
30. Typical CMU Rough Opening
31. Typical Window Flange Treatment

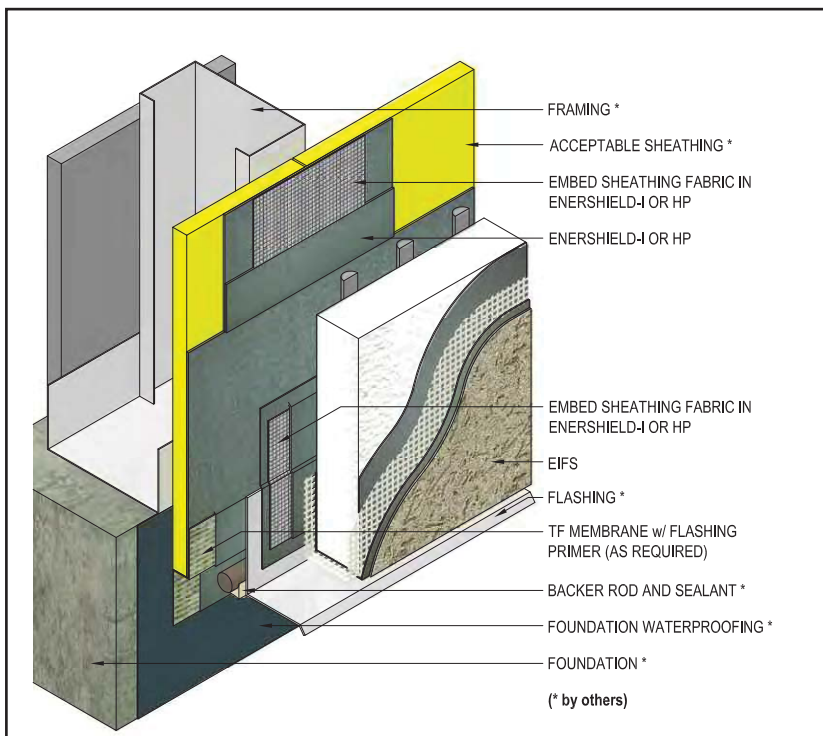
Enershield™-I / Enershield™-HP

TERMINATION AT GRADE - SHEATHING OVERLAPPING FOUNDATION



AWRB-01 1110

TERMINATION AT GRADE - SHEATHING OVERLAPPING FOUNDATION WITH EIFS



AWRB-02 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure Enershield-I / Enershield-HP fully covers TF Membrane at overlap.
- Extend flashing over coated TF Membrane on foundation.

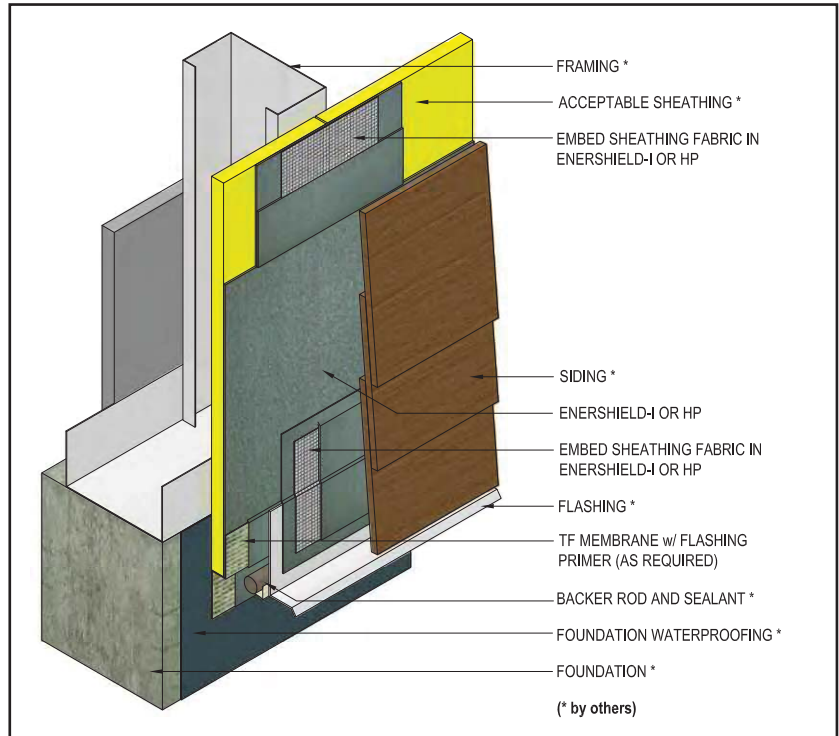
Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure Enershield-I / Enershield-HP fully covers TF Membrane at overlap.
- Extend flashing over coated TF Membrane on foundation.

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure Enershield-I / Enershield-HP fully covers TF Membrane at overlap.
- Extend flashing over coated TF Membrane on foundation.
- Contact siding manufacturer for installation instructions.

TERMINATION AT GRADE - SHEATHING OVERLAPPING FOUNDATION WITH SIDING

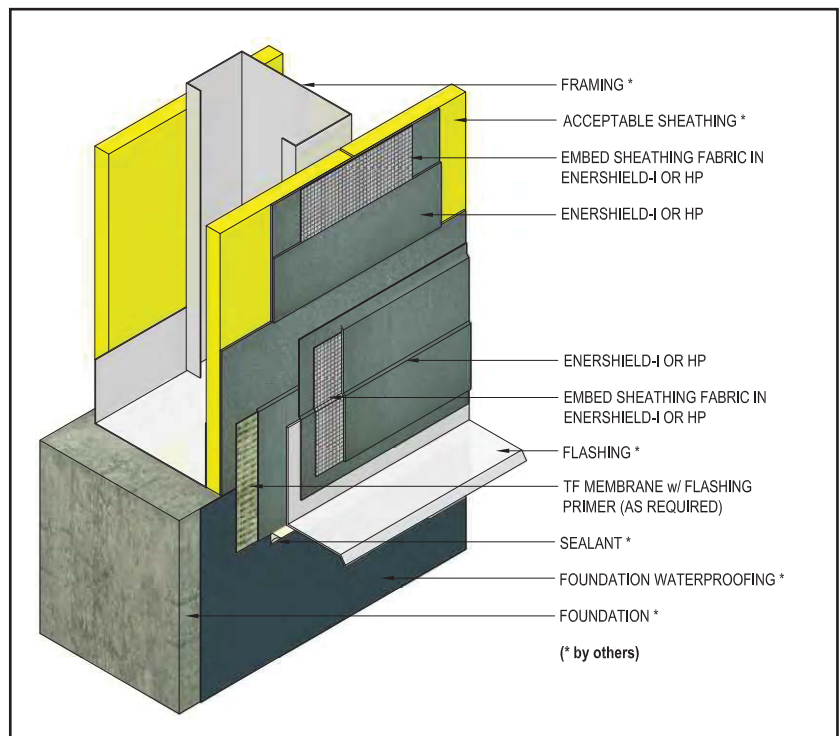


AWRB-03 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure Enershield-I / Enershield-HP fully covers TF Membrane at overlap.
- Extend flashing over coated TF Membrane on foundation.

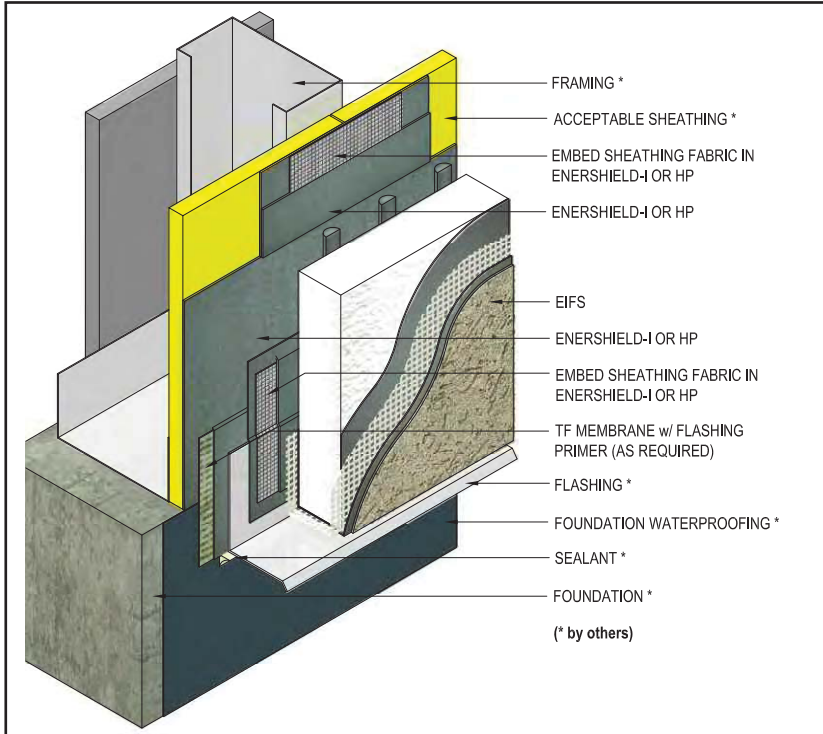
TERMINATION AT GRADE - SHEATHING FLUSH WITH FOUNDATION



AWRB-04 1110

Enershield™-I / Enershield™-HP

TERMINATION AT GRADE - SHEATHING FLUSH WITH FOUNDATION AND EIFS

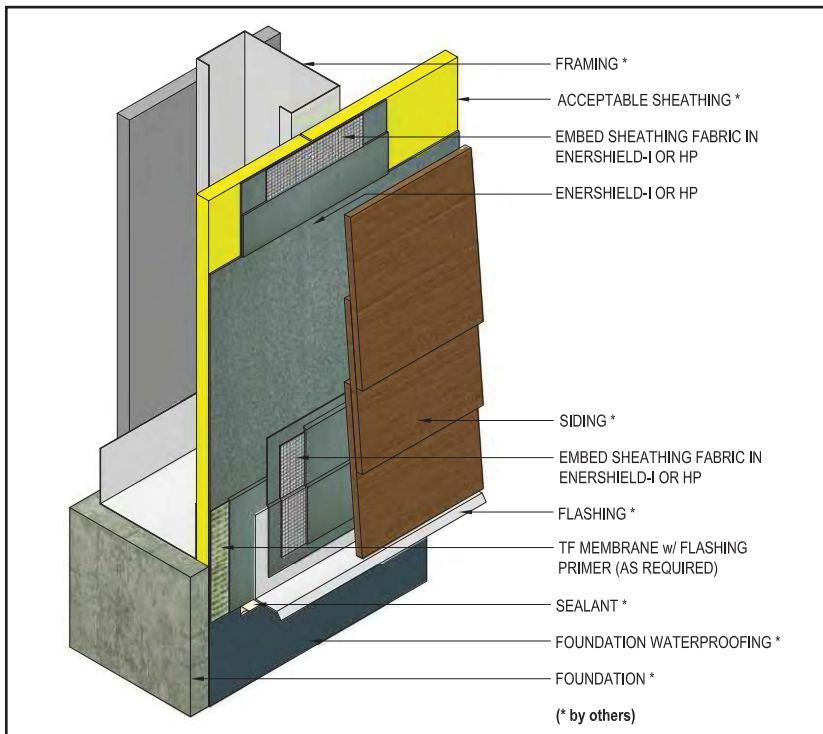


AWRB-05 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure Enershield-I / Enershield-HP fully covers TF Membrane at overlap.
- Extend flashing over coated TF Membrane on foundation.

TERMINATION AT GRADE - SHEATHING FLUSH WITH FOUNDATION AND SIDING



AWRB-06 1110

Notes:

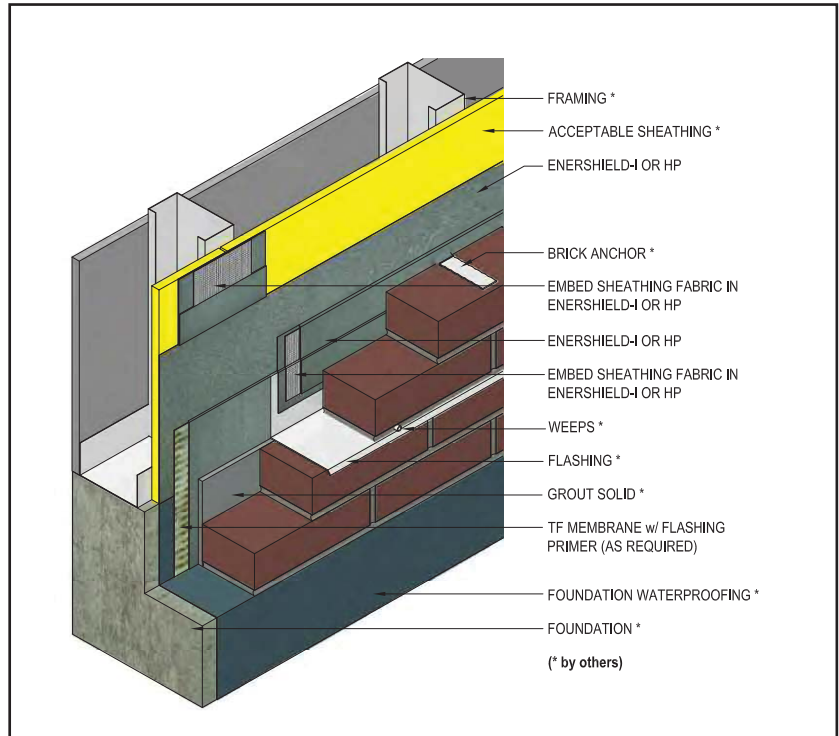
- Install BASF materials in accordance with current installation instructions.
- Ensure Enershield-I / Enershield-HP fully covers TF Membrane at overlap.
- Extend flashing over coated TF Membrane on foundation.
- Contact siding manufacturer for installation instructions.

Air/Water-Resistive Barrier Details

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure Enershield-I / Enershield-HP fully covers TF Membrane at overlap.

TERMINATION AT GRADE - BRICK

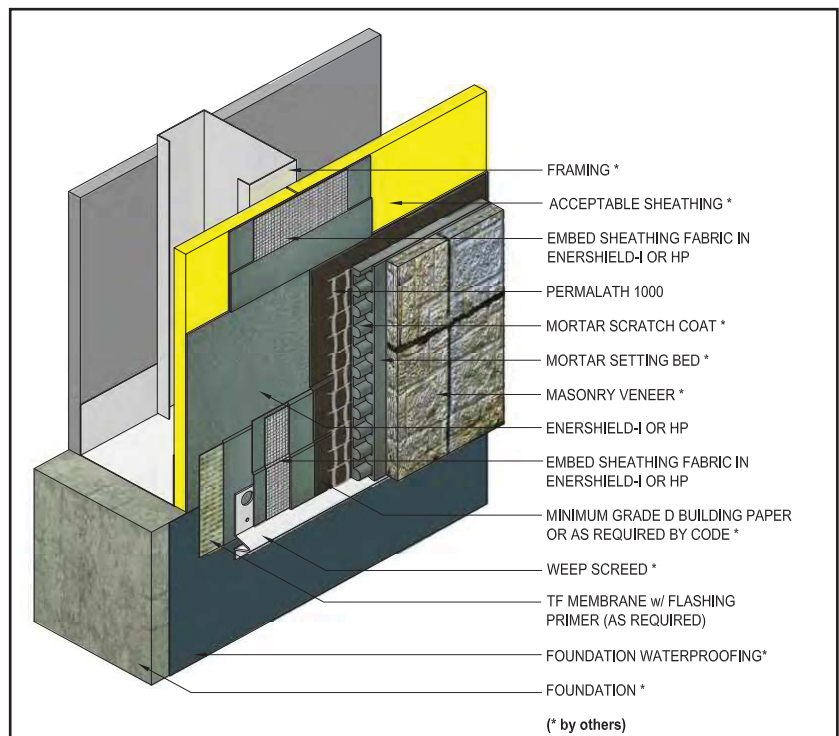


AWRB-07 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure Enershield-I / Enershield-HP fully covers TF Membrane at overlap.

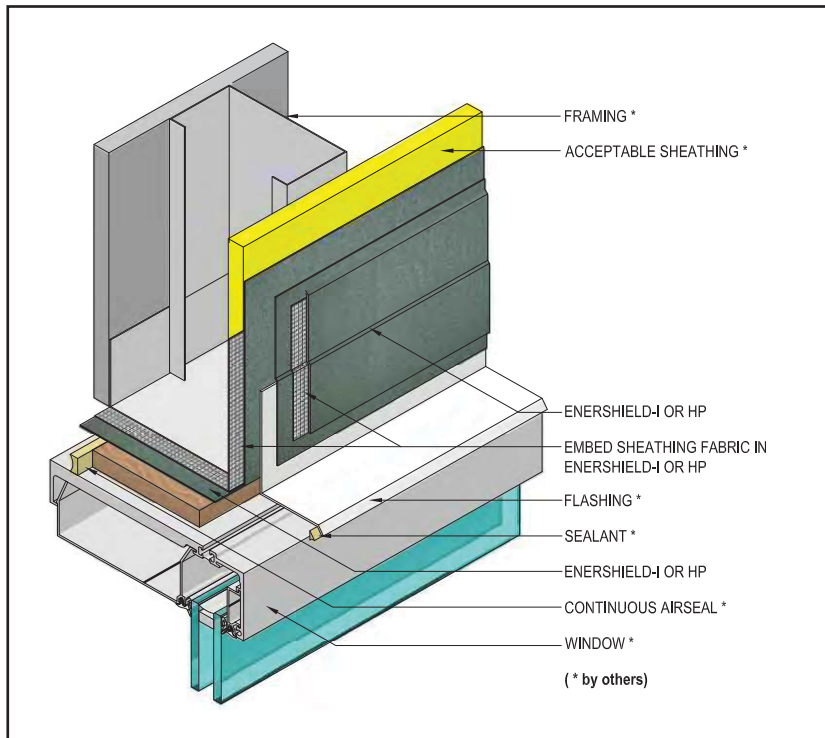
TERMINATION AT GRADE - MASONRY VENEER



AWRB-08 1110

Enershield™-I / Enershield™-HP

TYPICAL WINDOW HEAD

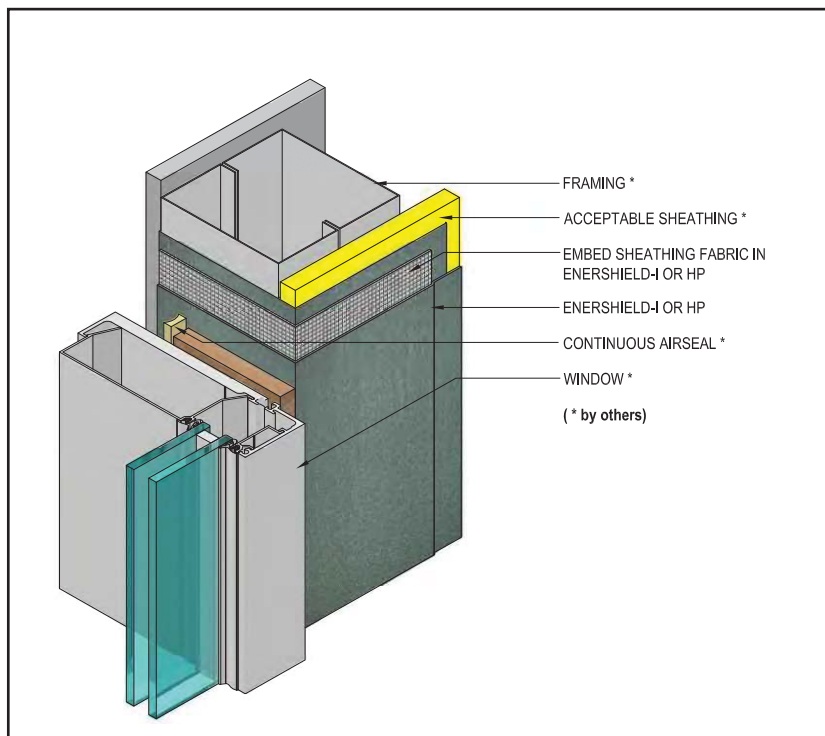


AWRB-09 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure continuity of air/water-resistive barrier is maintained.
- Provide end-dams at flashing terminations
- Install end/back dams as required.

TYPICAL WINDOW JAMB



AWRB-10 1110

Notes:

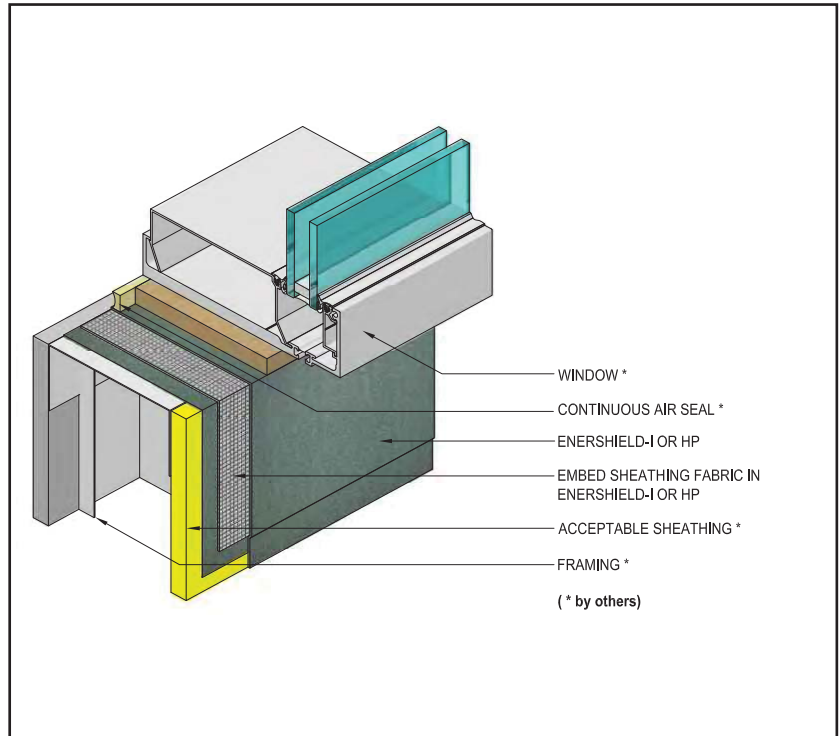
- Install BASF materials in accordance with current installation instructions.
- Ensure continuity of air/water-resistive barrier is maintained.
- Apply TF Membrane over punched stud openings.

Air/Water-Resistive Barrier Details

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure continuity of air/water-resistive barrier is maintained.
- Install end/back dam as required.
- See Detail AWRB-23 for pan flashing installation

TYPICAL WINDOW SILL

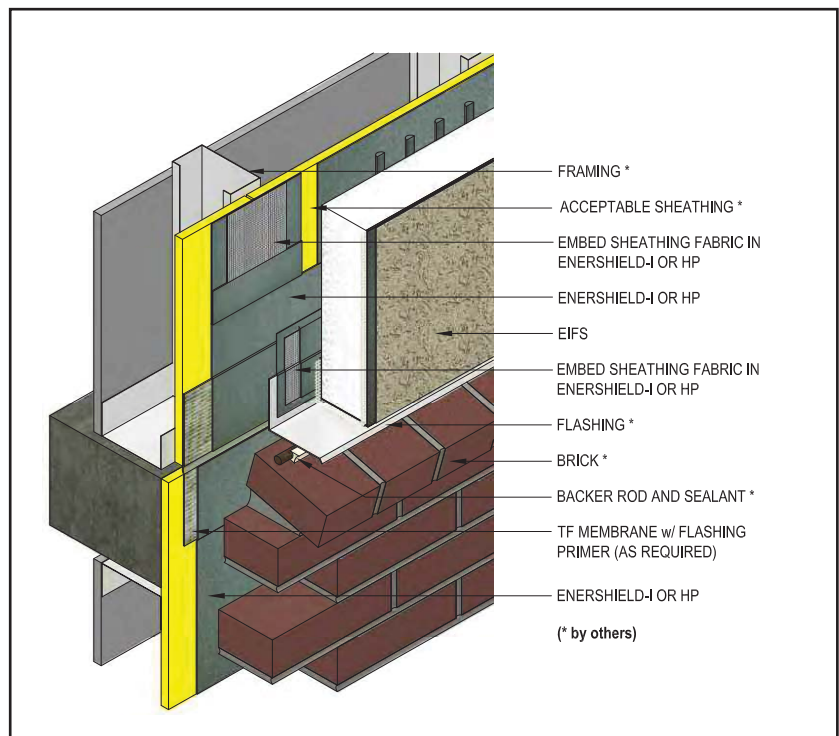


AWRB-11 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure Enershield-I / Enershield-HP fully covers TF Membrane at floorline.
- Provide sufficient slack in the TF Membrane at expansion joint to allow for movement.

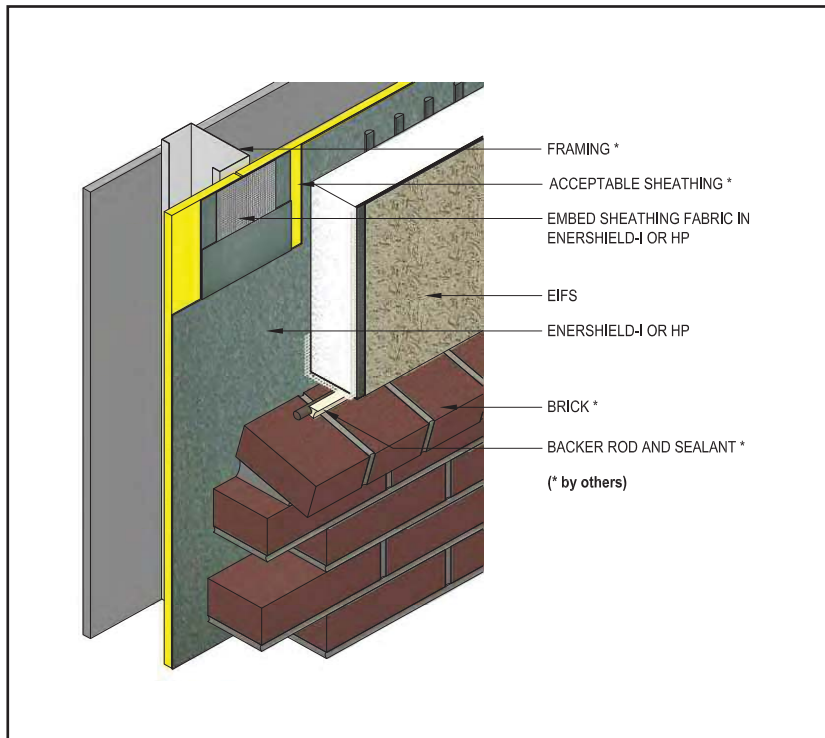
TYPICAL EIFS ABUTMENT TO BRICK WITH DRAINAGE AT FLOORLINE



AWRB-12 1110

Enershield™-I / Enershield™-HP

TYPICAL EIFS ABUTMENT TO BRICK

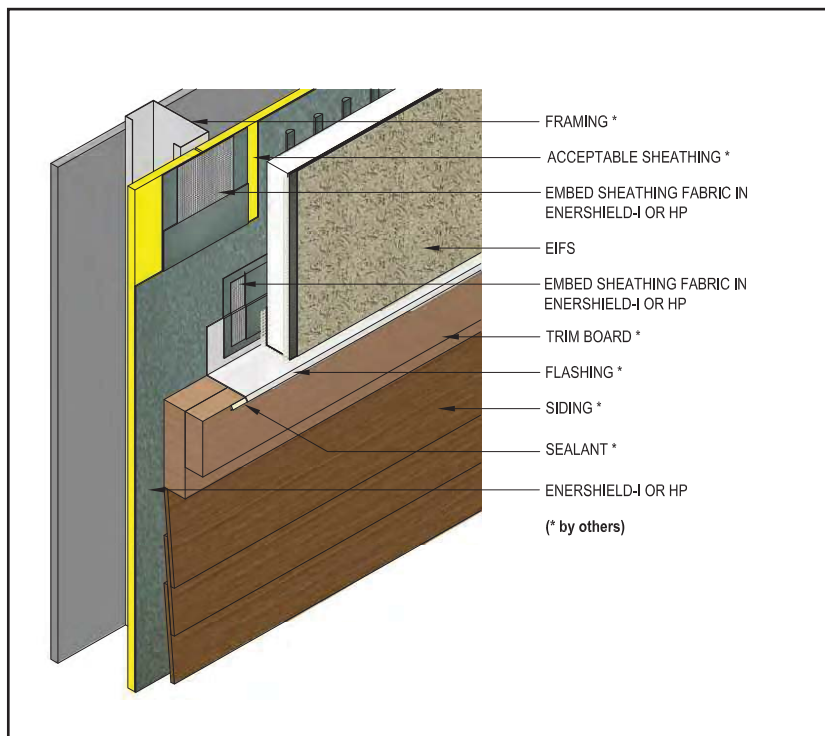


AWRB-13 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure drainage plane is continuous (unblocked); otherwise install flashing with drainage provision as show in Detail AWRB-12.

TYPICAL EIFS ABUTMENT TO SIDING



AWRB-14 1110

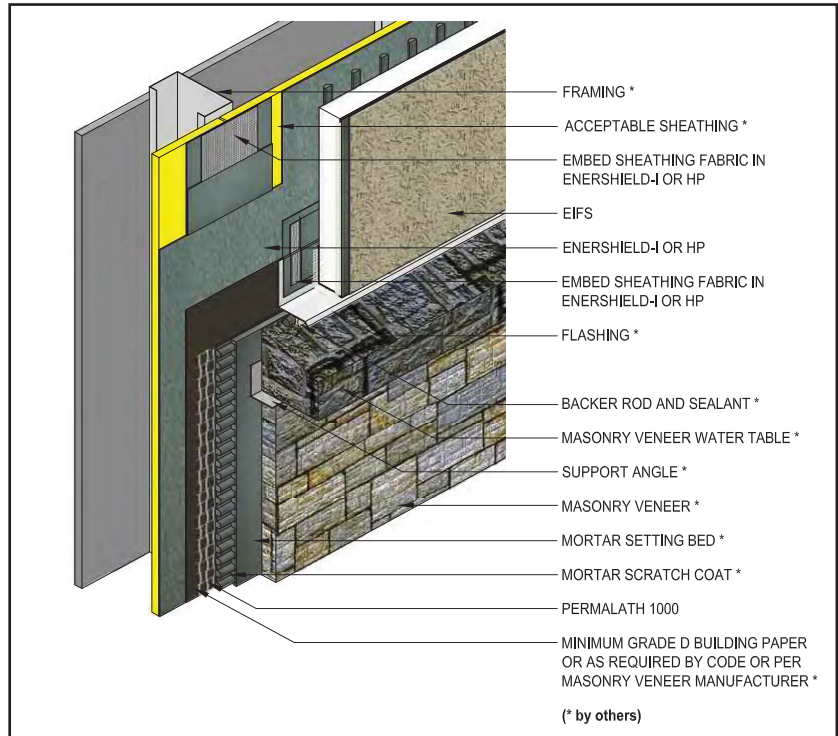
Notes:

- Install BASF materials in accordance with current installation instructions.

TYPICAL EIFS ABUTMENT TO MASONRY VENEER

Notes:

- Install BASF materials in accordance with current installation instructions.

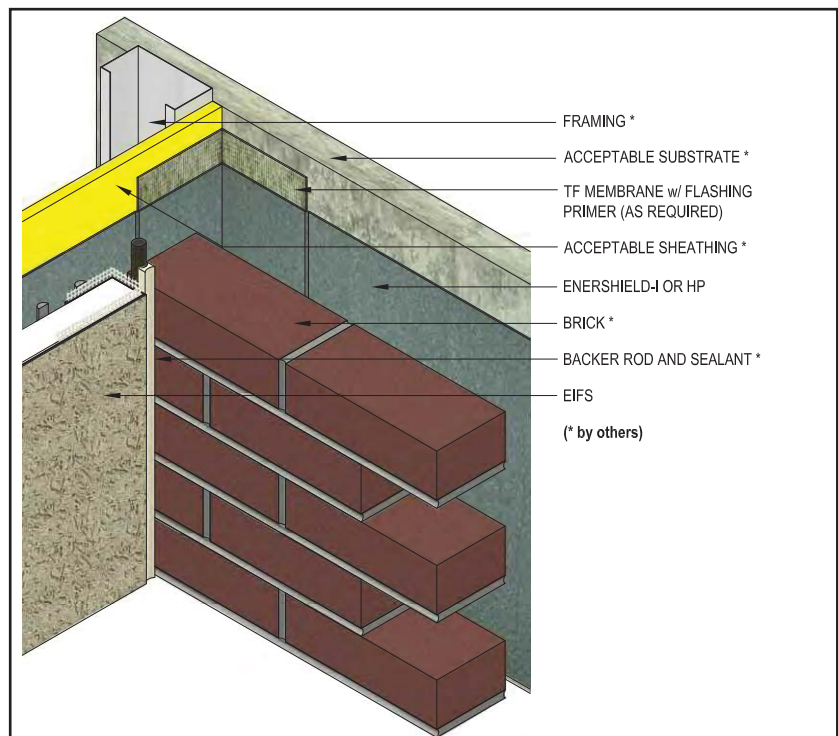


AWRB-15 1110

TYPICAL INSIDE CORNER CHANGE IN SUBSTRATE

Notes:

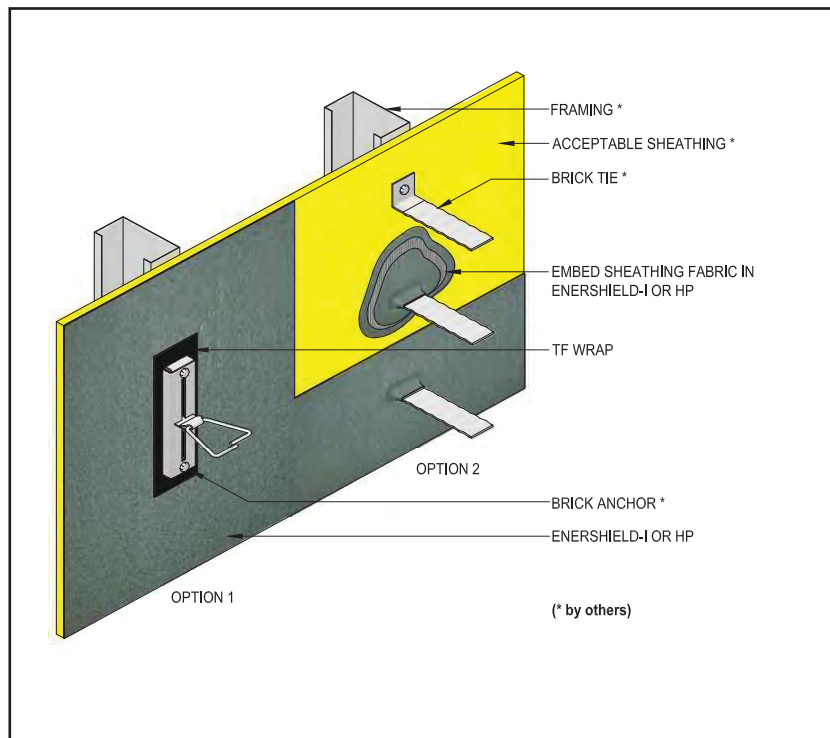
- Install BASF materials in accordance with current installation instructions.
- Enershield-I / Enershield-HP and Sheathing Fabric may be used as an alternate to provide an air/water-resistive barrier at transition.



AWRB-16 1110

Enershield™-I / Enershield™-HP

TYPICAL BRICK ANCHOR TREATMENT

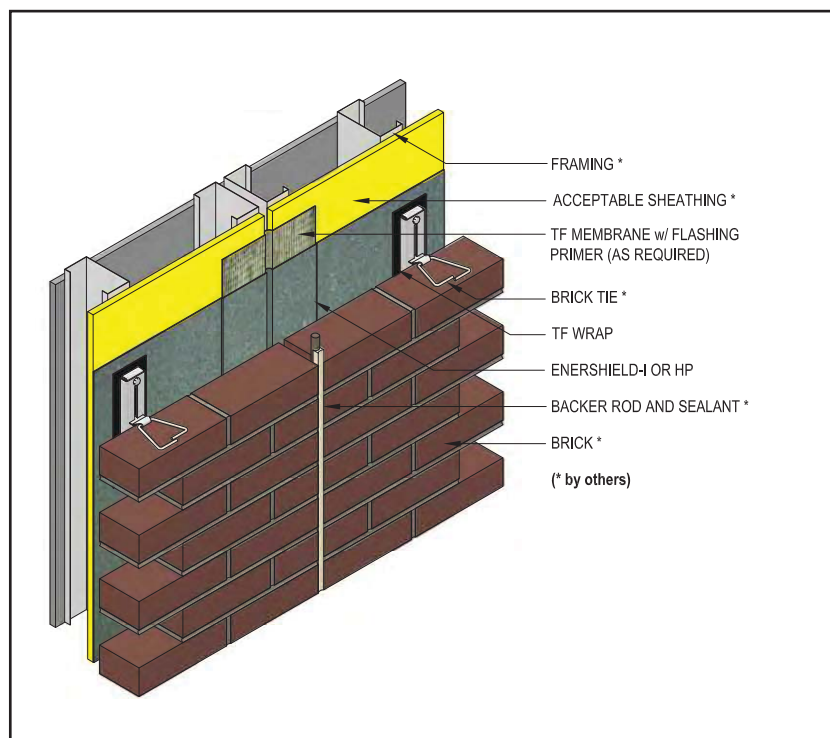


AWRB-17 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Option 1: Apply TF Wrap to Enershield-I / Enershield-HP prior to application of brick anchor.
- Option 2: Seal brick anchor by embedding Sheathing Fabric in Enershield-I / Enershield-HP .
- Consult brick anchor manufacturer for proper attachment.

TYPICAL BRICK EXPANSION JOINT



AWRB-18 1110

Notes:

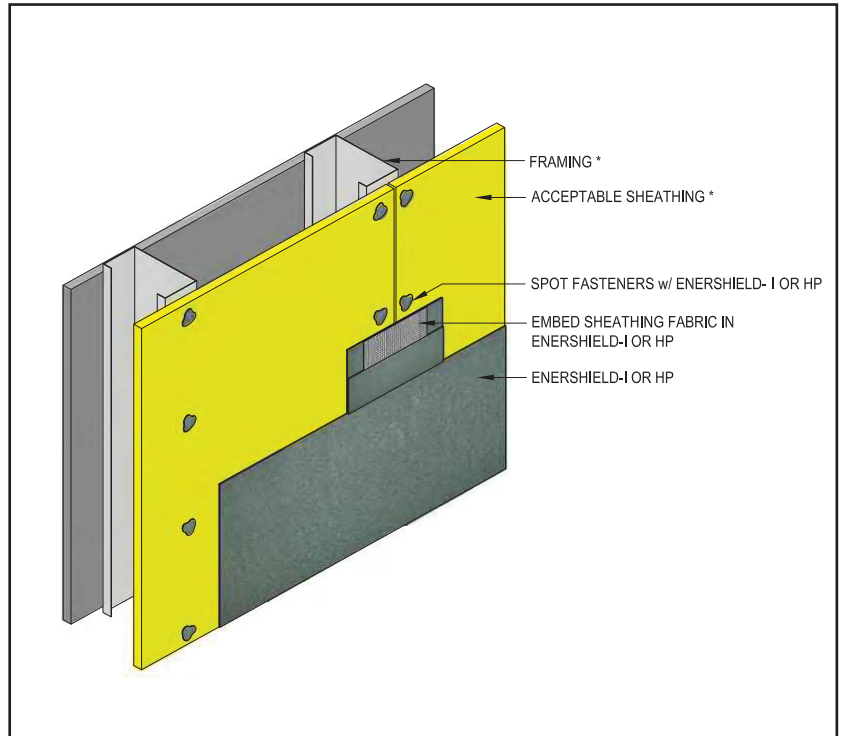
- Install BASF materials in accordance with current installation instructions.
- See detail AWRB-17 for typical brick anchor treatment.

Air/Water-Resistive Barrier Details

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure all fastener heads are spotted with Enershield-I / Enershield-HP .

TYPICAL JOINT AND FASTENER TREATMENT

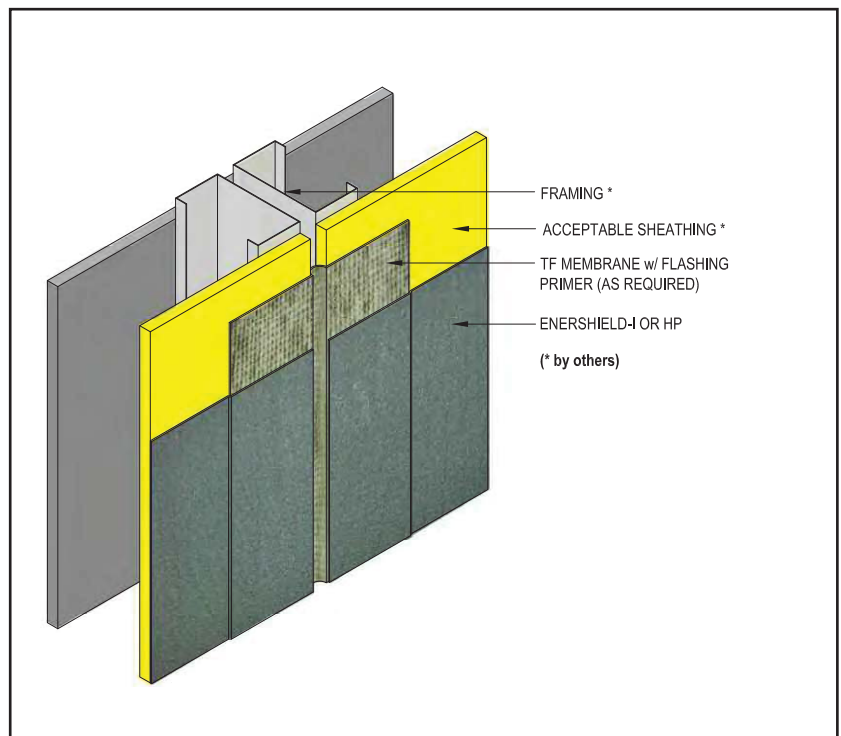


AWRB-19 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Provide sufficient slack in the TF Membrane at expansion joint to allow for movement.

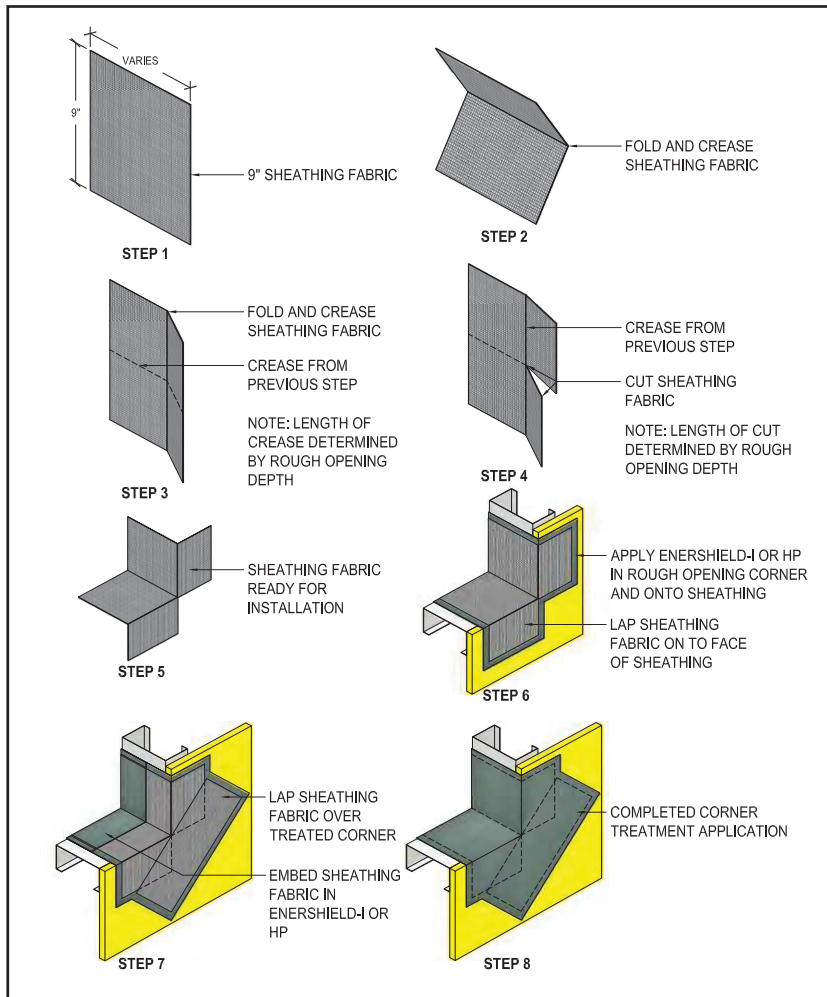
TYPICAL VERTICAL EXPANSION JOINT



AWRB-20 1110

Enershield™-I / Enershield™-HP

TYPICAL ROUGH OPENING CORNER REINFORCEMENT



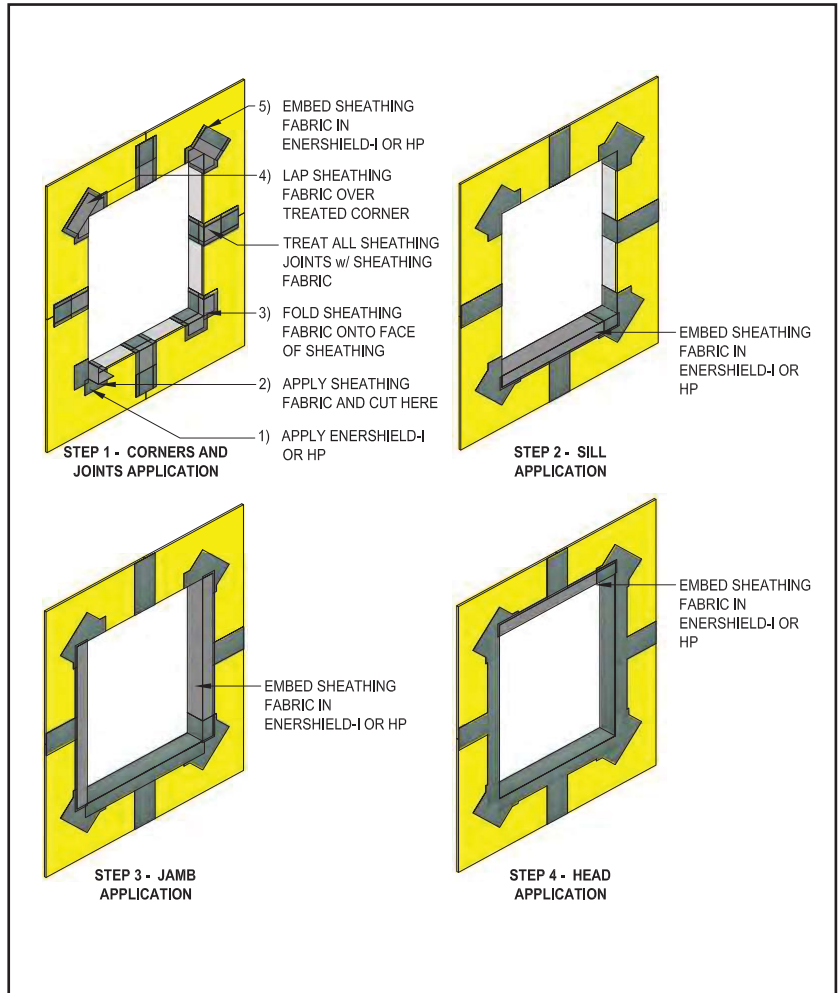
Notes:

- Install BASF materials in accordance with current installation instructions.
- Wrap rough opening in accordance with AWRB-22.

Notes:

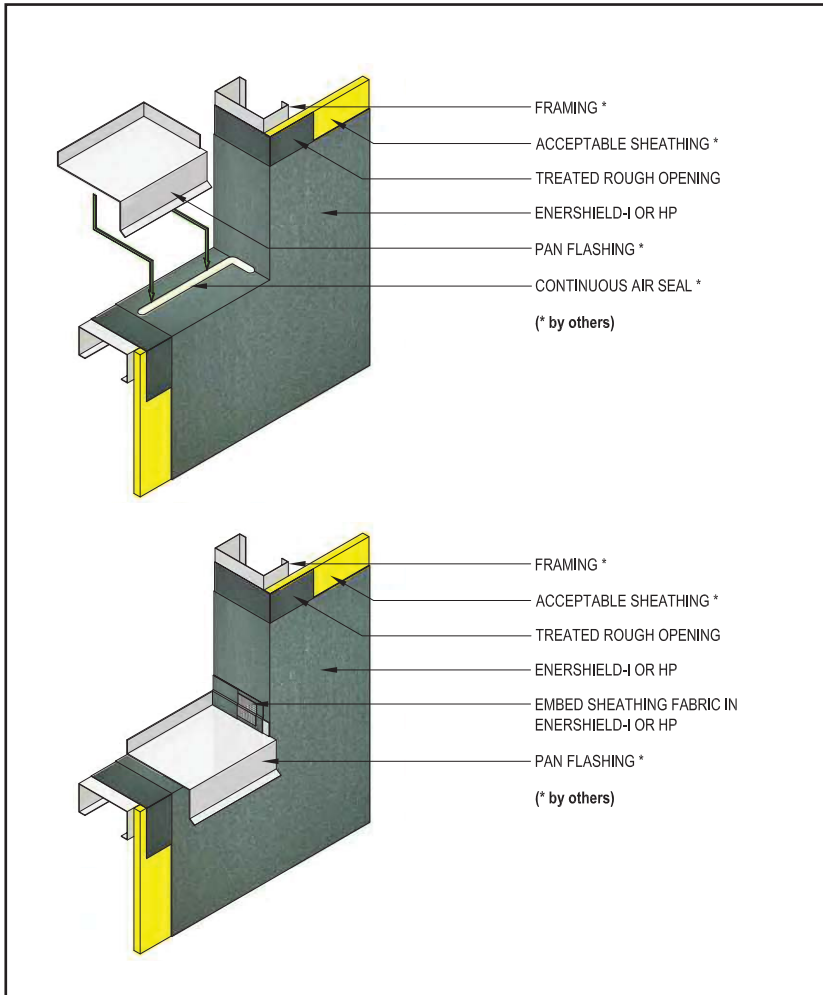
- Install BASF materials in accordance with current installation instructions.
- Ensure Sheathing Fabric is embedded in Enershield-I / Enershield-HP.
- Ensure Enershield-I / Enershield-HP and Sheathing Fabric are installed without voids.
- Apply TF Membrane over punched stud openings.

TYPICAL ROUGH OPENING REINFORCEMENT



Enershield™-I / Enershield™-HP

TYPICAL PAN FLASHING



Notes:

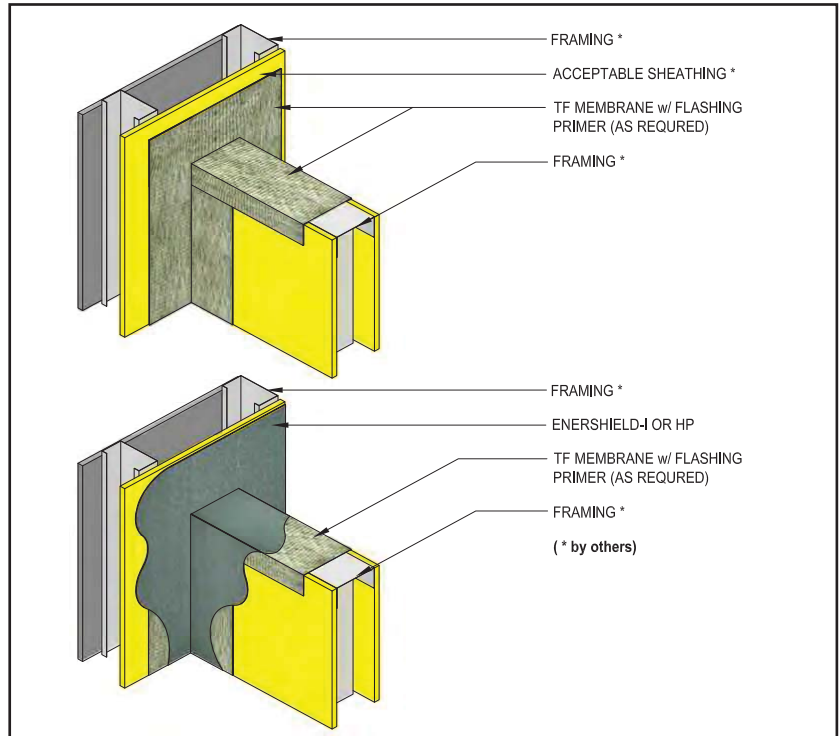
- Install BASF materials in accordance with current installation instructions.
- Wrap rough opening in accordance with AWRB-22.
- Install sealant as depicted onto the sill and jamb.
- Install pan flashing into the wet sealant. Remove excess sealant as required.
- Install Sheathing Fabric into wet Enershield-I / Enershield-HP at the jamb end dams.

AWRB-23 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure TF Membrane is continuous without voids.
- Completely coat TF Membrane with Enershield-I / Enershield-HP.

TYPICAL SADDLE APPLICATION

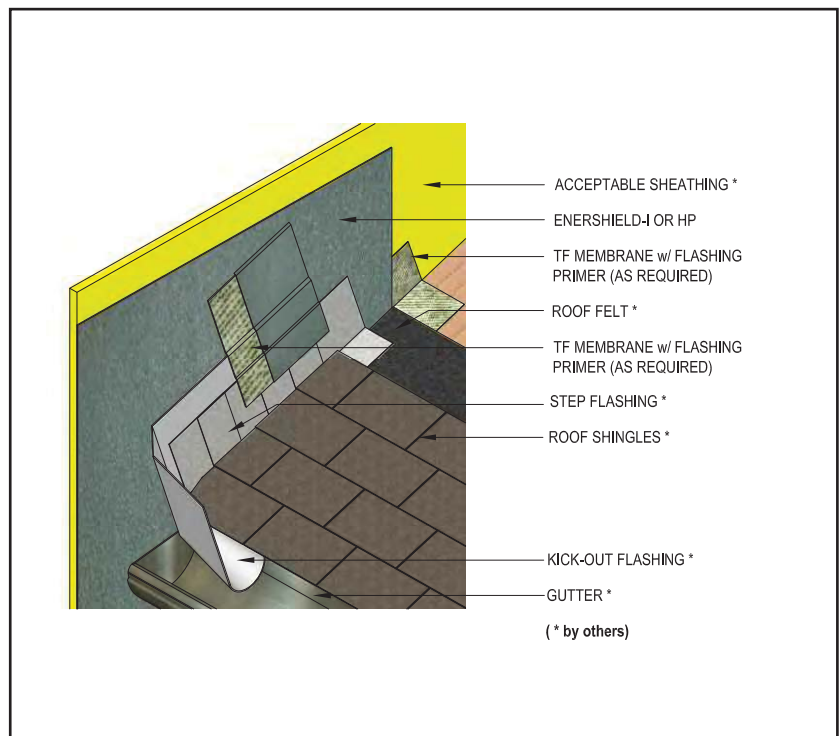


AWRB-24 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure Enershield-I / Enershield-HP fully covers TF Membrane.
- Where TF Membrane is installed over the flashing, ensure termination occurs a minimum of 2" above the roof.

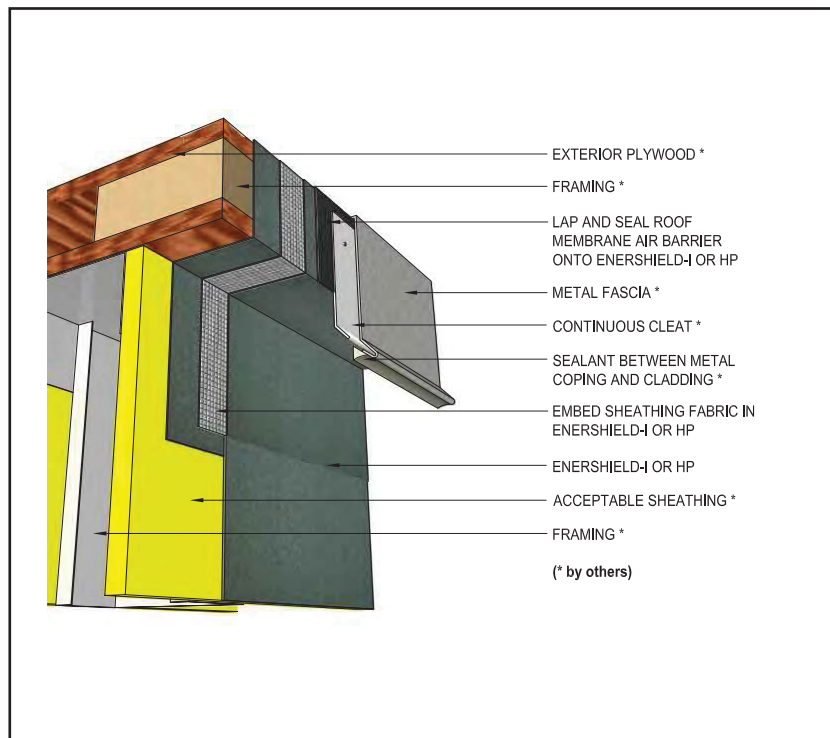
TYPICAL KICK-OUT FLASHING



AWRB-25 1110

Enershield™-I / Enershield™-HP

TYPICAL ROOF EDGE FLASHING

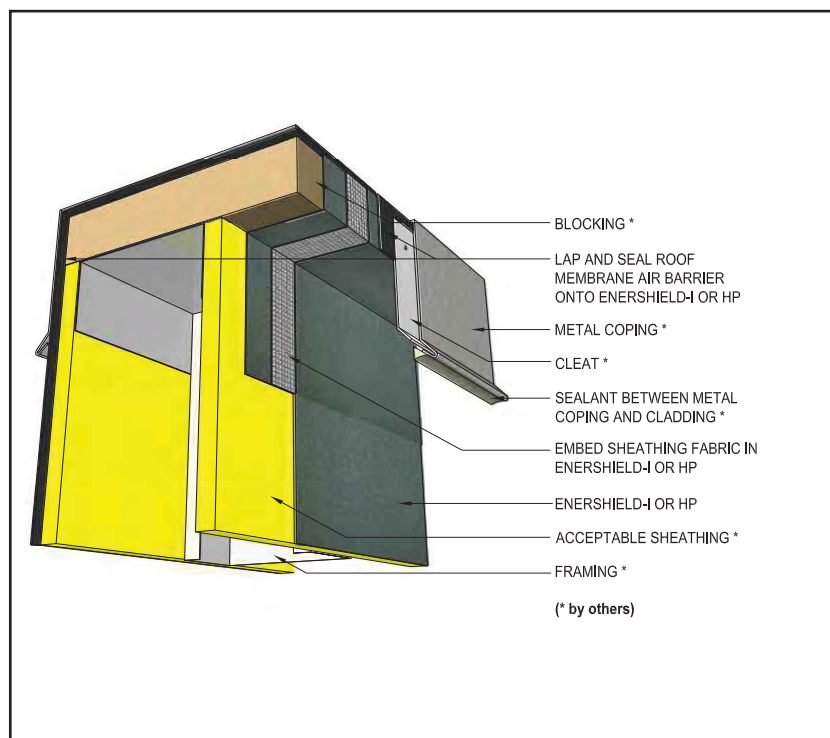


AWRB-26 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- TF Membrane may be used as an alternate to provide an air/water-resistive barrier at transition of sheathing to blocking.

TYPICAL PARAPET CAP FLASHING



AWRB-27 1110

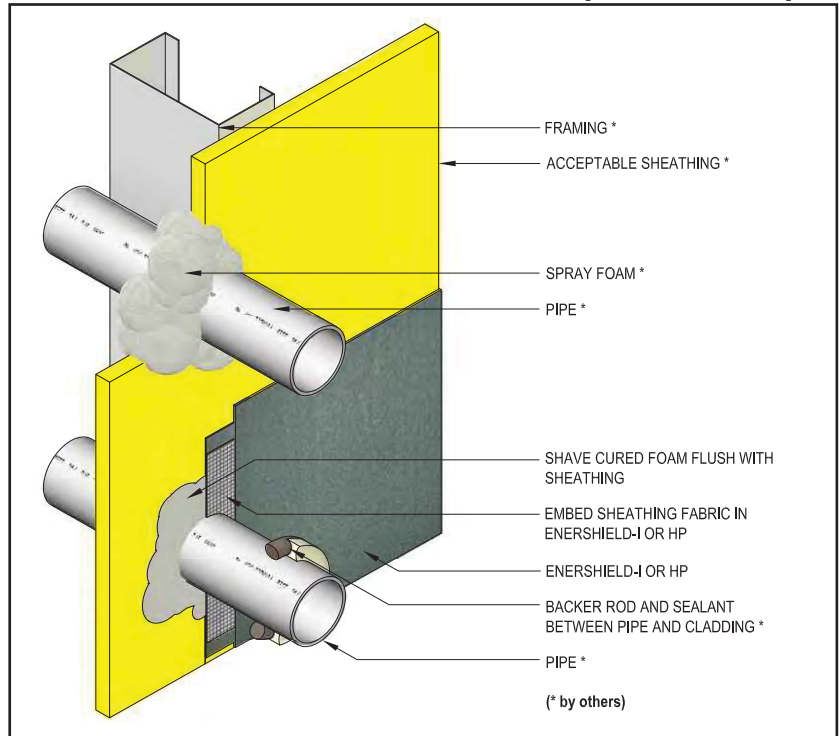
Notes:

- Install BASF materials in accordance with current installation instructions.
- TF Membrane may be used as an alternate to provide an air/water-resistive barrier at transition of sheathing to blocking.

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure spray foam is low expansion.

TYPICAL PENETRATION THROUGH WALL CONSTRUCTION (ROUGH CUT)

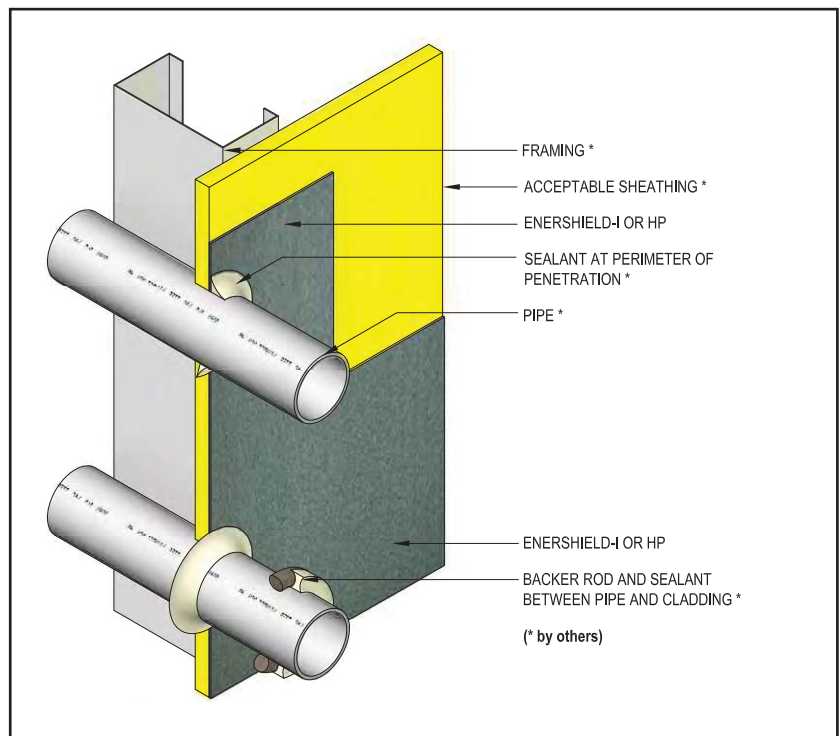


AWRB-28 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- TF Membrane may be used as an alternate to provide air/water-resistive barrier around pipe.

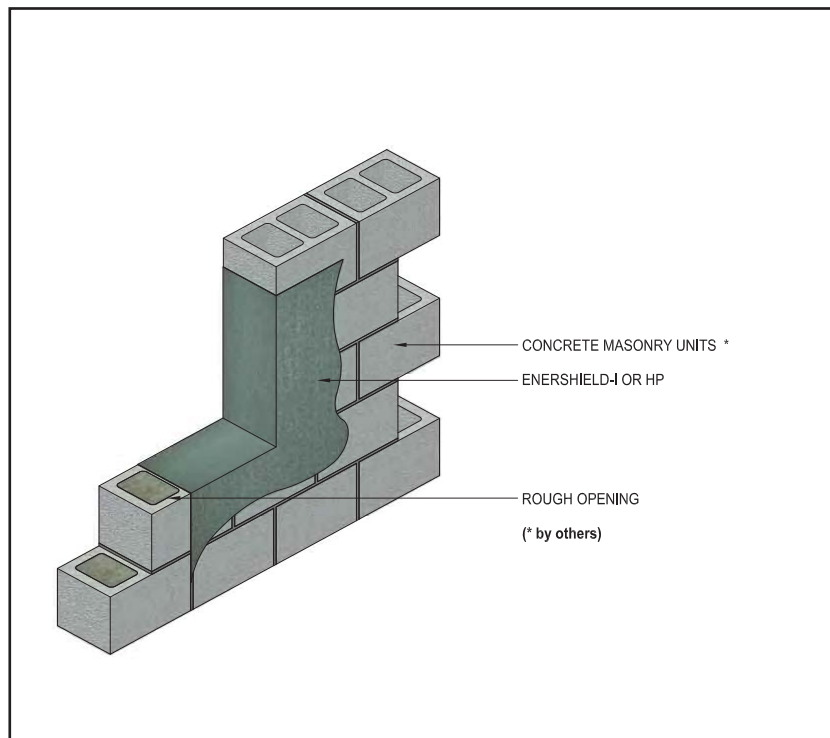
TYPICAL PENETRATION THROUGH WALL CONSTRUCTION



AWRB-29 1110

Enershield™-I / Enershield™-HP

TYPICAL CMU ROUGH OPENING

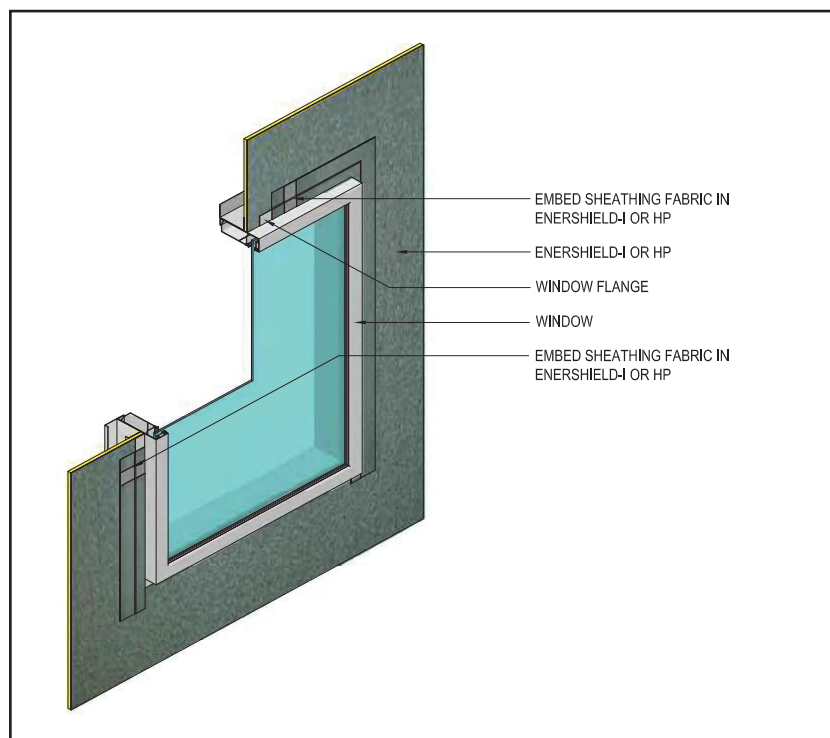


AWRB-30 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure a continuity of air/water-resistive barrier is maintained.
- Ensure a pinhole free Enershield-I / Enershield-HP application is achieved
- Sheathing Fabric application is optional at rough opening

TYPICAL WINDOW FLANGE TREATMENT



AWRB-31 1110

Notes:

- Install BASF materials in accordance with current installation instructions.
- Ensure continuity of air/water-resistive barrier is maintained.
- Install end/back dams as required.
- Verify rough opening is properly treated prior to window installation.
- Do not treat window flange at window sill.

NOTES

Note

BASF Wall Systems is an operating unit of BASF Corporation (herein referred to as "BASF Wall Systems")

Residential Policy

Apply wall systems in accordance with local building codes in force at the time of construction. On one and two-family residential framed construction, BASF Wall Systems requires that the wall system selected be one that includes provisions for moisture drainage.

Disclaimer

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TF Membrane / WS Flashing Primer

Product Bulletin

Uses

1. Used as an air barrier accessory to connect different air barrier materials or assemblies together to make the air barrier continuous.
2. Flashing at sills, approved sheathing joints, rough openings, and terminations.
3. As an expansion joint seal.

WS Flashing Primer is to be used under TF MEMBRANE on these acceptable substrates and other surfaces:

1. Wood framing (Note: Verify adhesion before applying to wood that has been treated in any way.)
2. ASTM C1177 sheathings, e.g. e³XP™, GlasRoc®, Securock™ and DensGlass™
3. Water-resistant core gypsum sheathing (ASTM C79/ASTM C1396)
4. Cement-board (ASTM C1325 Type A Exterior)
5. Masonry
6. Exposure 1 or exterior plywood sheathing
7. Exposure 1 OSB
8. Steel framing
9. TF MEMBRANE (itself)
10. ENERSHIELD™-HP
11. ENERSHIELD™-I

Technical Information

Consult the BASF Wall Systems Technical Services Department for specific recommendations concerning all other applications. Consult the website, www.enershield.basf.com, for additional information about products and systems and for updated literature.

Preparation

1. Acceptable substrate shall be dry, clean, sound and free of releasing agents, paint, contaminants, residue or other coatings. Verify substrate is flat, free of fins or anything that would hinder the adhesion of the membrane.
2. Unsatisfactory conditions shall be reported to the general contractor and corrected before application of the BASF Wall System materials.
3. Wrap openings in accordance with BASF Wall System's *Air/Water-Resistive/ Vapor Barrier Application Guidelines* technical bulletin.

Advantages

Self-sealing, self-healing; maintains a seal when penetrated by fasteners

ENERSHIELD-HP, ENERSHIELD-I and BASF Base Coats can be applied to polyester face of TF MEMBRANE; use as part of adhesively applied EIFS - no mechanical fasteners are required

Description

TF MEMBRANE is a patented, 30-mil thick, self-adhering, self-sealing, self-healing composite membrane of polyester fabric and rubberized asphalt. TF MEMBRANE is supplied in rolls, on release paper, for easy application.

WS Flashing Primer is a single component, water-based primer specially formulated for use with TF MEMBRANE and TF WRAP.

Color

WS Flashing Primer is pinkish during application, drying to semi-transparent.

Packaging

TF MEMBRANE 4:
10.2 cm x 30.5 m (4" x 100') rolls
9 rolls per carton

TF MEMBRANE 9:
22.9 cm x 30.5 m (9" x 100') rolls
4 rolls per carton

WS FLASHING PRIMER:
19-liter (5-gallon) pails
3.8-liter (1-gallon) bottles
4 bottles per carton

Coverage

TF MEMBRANE 4:
274.3 Lin m (900 Lin ft) per carton

TF MEMBRANE 9:
121.9 Lin m (400 Lin ft) per carton

FLASHING PRIMER:
Coverage rates will vary depending on the texture, porosity of the existing substrate. Approximate coverages:

ASTM C1177 exterior sheathing:
11.6–13.9 m² (125–150 ft²)
per 3.8 L (1-gallon) bottle,
58–69.5 m² (625–750 ft²)
per 19 L (5-gallon) pail

Gypsum sheathing:
14.9–17.7 m² (160–190 ft²)
per 3.8 L (1-gallon) bottle,
74.5–88.5 m² (800–950 ft²)
per 19 L (5-gallon) pail

Exterior plywood sheathing & cement-board (ASTM C1325):
16.7–20.4 m² (180–220 ft²)
per 3.8 L (1-gallon) bottle,
83.5–102 m² (900–1100 ft²)
per 19 L (5-gallon) pail

TF Membrane / WS Flashing Primer

Application

WS FLASHING PRIMER/TF MEMBRANE application

1. Shake or stir WS FLASHING PRIMER until uniform consistency, approximately one minute.
2. Apply WS FLASHING PRIMER with a brush or roller to achieve an average coverage rate of 11.6 – 20.4 m² per 3.8 liter (125–220 ft² per gallon). Coverage rate will vary according to substrate.
3. Apply WS FLASHING PRIMER evenly. Surfaces shall be uniformly coated, free from voids, pinholes or blisters.
4. Protect primed surface from dust to prevent adhesion problems.
5. A second coat of primer may be required for porous surfaces or if the initial adhesion is not optimal.
6. Apply TF MEMBRANE as soon as the WS FLASHING PRIMER is dry and tacky. Additional WS FLASHING PRIMER will be required over areas that are no longer tacky.
7. Cut TF MEMBRANE roll to desired length with a utility knife or scissors.
8. Remove usable size of the release film immediately before application and center the TF MEMBRANE over the area to be sealed.
9. Using a wallpaper roller, extension-handled countertop roller or weighted hand roller, firmly roll the TF MEMBRANE to the area being sealed. As the TF MEMBRANE is applied, pull more of the release film from the TF MEMBRANE, exposing the adhesive surface, pressing down on the TF MEMBRANE with a roller and keeping the TF MEMBRANE smooth.
10. If blisters occur, they can be slit with a utility knife and the TF MEMBRANE pressed flat with a roller. Ensure no voids or holes are present. Repair as necessary.
11. Installed materials should be checked for delamination of edges before final system application. Repair as necessary.
12. Overlap TF MEMBRANE a minimum of 50 mm (2") horizontally and 150 mm (6") vertically.
13. Clean tools as soon as possible with warm water and soap. Dried WS FLASHING PRIMER is difficult to remove from tools.
14. Install exterior cladding system in accordance with manufacturer's current specifications and details.

Limitations

1. Store material in a well ventilated, clean, dry area where temperatures will not exceed 32°C (90°F).
2. Do not apply BASF Wall System materials in ambient temperatures below 4°C (40°F). Provide supplementary heat during installation and drying period (at least 24 hours after installation and until dry) when temperatures less than 4°C (40°F) are anticipated.
3. When applying the membrane in cooler temperatures, store material for 24 hours inside at room temperature for better adhesion. Adhesion properties of TF MEMBRANE during application in cooler temperatures may also be improved by the use of a heat gun.
4. Do not store rolls on end.
5. Protect from rain and physical damage until installation of exterior cladding system.
6. Do not apply the material to any surfaces not listed as an acceptable substrate/surface, including silicone caulk or other solvent base products.
7. Do not expose material to sunlight for over 30 days.
8. Apply TF MEMBRANE only to dry surfaces. Allow surfaces to dry a minimum of 24 hours after precipitation.
9. Do not apply BASF Wall Systems' materials to frozen surfaces.
10. Shelf life is one year when stored in original container or factory sealed packaging as directed.

TECHNICAL DATA

Property	ASTM Test Method	Result
Peel Adhesion (To primed Steel)	D1000	10 lbs/in. width
Elongation at Break	D882 Method A	(Modified) > 100%
Low Temperature Pliability	D146 modified	No cracking -26°C (-15°F)

Note

BASF Wall Systems is an operating unit of BASF Corporation (herein referred to as "BASF Wall Systems")

Disclaimer

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Enershield™ Air / Water-Resistive Barriers

Three essential tests to establish high performance

One Air Barrier Material for Seamless Protection

Air/water-resistive barriers are vital systems that minimize air and moisture intrusion throughout the entire building envelope. Transitions between air/water-resistive barrier materials used for different wall claddings can be challenging because specifications for these transitions may not exist, and responsibility for constructing transitions may be left undefined. As a result, most air/water-resistive barrier specifications call for use of compatible products sourced from one manufacturer, behind all wall claddings.

ENERSHIELD by BASF Wall Systems gives architects the ability to design seamless, monolithic air/water-resistive barrier assemblies and eliminate unnecessary material transitions. This important design decision is supported with a complete set of third-party test data, described in this bulletin, that demonstrates full compliance with relevant performance requirements.

ASTM E2357 *Air Leakage of Air Barrier Assemblies* test results demonstrate that ENERSHIELD air barrier products, when used with other typical wall components, collectively function as an air barrier assembly. Tests performed according to Acceptance Criteria established by the International Code Council demonstrate the effectiveness of ENERSHIELD assemblies as water-resistive barrier and flexible flashing materials. These rigorous tests have been supplemented by testing required by the Air Barrier Association of America.

The result is an air/water-resistive barrier system that offers unprecedented effectiveness, economy and ease of installation, backed by a complete data set. ENERSHIELD products are fully approved for use behind most wall claddings including brick, vinyl and cementitious siding, EIFS, stone, stucco (with a slip sheet), and metal composite. Vapor permeable Enershield-HP and vapor impermeable Enershield-I are ready-mixed flexible coatings that are roller-, brush-, or spray-applied directly to approved wall substrates.

ASTM E2357 Air Leakage of Air Barrier Assemblies

Purpose:

The ASTM E2357 test method is designed to evaluate performance of air barrier assemblies.

Test Procedure:

Construct a mockup assembly that simulates common details such as transitions to the roof and foundation wall; duct, pipe and electrical outlet penetrations; brick ties; and window openings.

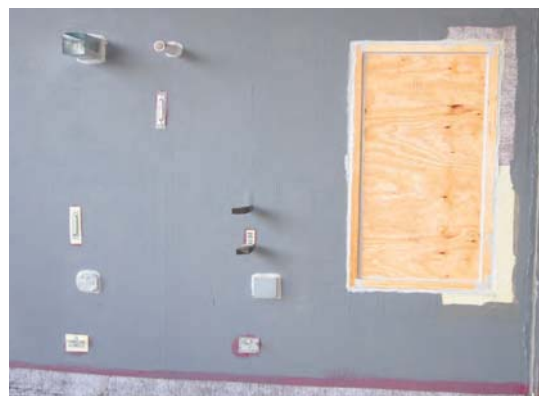
Test the mockup for initial air leakage rate. Next, subject the mockup to sustained positive and negative loading of 12.5 psf (600 Pa) for one hour in each direction, followed by a combined 2000 cycles of 16.7 psf (800 Pa) simulated wind loading, and finally subject the mockup to simulated wind gust loadings of 25 psf (1200 Pa). Retest the conditioned mockup for air leakage rate.

Results:

Both ENERSHIELD-HP and ENERSHIELD-I easily exceeded test requirements, providing results less than one percent of the maximum allowable air leakage rate specified by the Air Barrier Association of America (ABAA) and the prescriptive requirements listed in ASHRAE 189.1: 0.04 cfm/ft² (0.2 L/s·m²).

Discussion:

The initial air leakage test value required by ASTM E2357 establishes baseline air barrier assembly performance. Exposure to cyclic loading simulates the effect of long-term service. Passing air leakage testing after cyclic loading demonstrates long-term air barrier assembly performance.



Mockup testing per ASTM E2357 evaluates the ability of air barrier assemblies to withstand air leakage.

ENERSHIELD™ three essential tests to establish high performance

International Code Council (ICC) Acceptance Criteria

Building materials that are specifically listed in the International Building Code (IBC) and International Residential Code (IRC) are considered code-compliant. To qualify as an alternate to materials specifically listed in the code, Acceptance Criteria created through the ICC Evaluation Service (ICC-ES) define test criteria that must be met.

Two ICC-ES Acceptance Criteria play a key role in air/water-resistive barrier qualification and specification: AC148 and AC212.

ICC-ES AC148 Acceptance Criteria for Flexible Flashing Materials

Purpose:

This Acceptance Criteria was developed because "...the cited codes do not provide procedures for evaluating flashing materials for use at wall penetrations and roof hips and ridges." ICC-ES AC148 answers this need. Since flashing can be a source of air and moisture leakage, ICC-ES AC148 plays a key role in defining air/water-resistive barrier performance.

Test Procedure:

First, the flexible flashing material is tested for weather resistance (UV light exposure, accelerated aging). Next, hydrostatic pressure testing is performed on the weathered sample. Peel adhesion is evaluated after the weathering, after elevated temperature exposure and after water immersion. Additional tests include nail sealability after thermal cycling, tensile strength after UV exposure, cold temperature pliability and resistance to peeling.

Results:

ENERSHIELD-HP and ENERSHIELD-I reinforced with SHEATHING FABRIC met or exceeded all ICC-ES AC148 requirements.

Discussion:

Rough window openings treated with ENERSHIELD and SHEATHING FABRIC meet flexible flashing test requirements in addition to air barrier and water-resistive barrier requirements. Using one fluid-applied material as the primary air barrier material and as a flexible flashing eliminates the need to transition dissimilar materials, improving performance and creating application efficiencies.



ENERSHIELD and SHEATHING FABRIC combine to create self gauging window flashings custom molded for each window and seamlessly integrated into the air/water-resistive barrier.



Fluid-applied ENERSHIELD air/water-resistive barrier systems seamlessly protect walls, penetrations and rough window openings from air and moisture infiltration.

ICC-ES AC212 Acceptance Criteria for Water-Resistive Coatings used as Water-Resistive Barriers over Exterior Sheathing

Purpose:

This Acceptance Criteria defines testing that demonstrates performance of water-resistive barriers applied to exterior sheathing. ICC-ES AC212 is relevant because air barriers applied to exterior sheathing must also act as water-resistive barriers.

Test Procedure:

The water-resistive barrier is applied to an exterior sheathing mockup and sequentially tested for resistance to structural then racking loads, followed by restrained environmental conditioning, then water penetration testing. A separate sample is sequentially tested for resistance to UV light exposure, then accelerated aging, followed by a hydrostatic pressure test. Additional tests include freeze-thaw resistance, water resistance, and tensile bond performance.

Results:

ENERSHIELD-HP and ENERSHIELD-I fluid-applied air/water-resistive barriers met or exceeded all test requirements and are specifically qualified for use under all cladding materials.

Discussion:

By successfully meeting the rigorous testing required by ICC-ES AC212, ENERSHIELD-HP and ENERSHIELD-I have demonstrated suitability for use as a water-resistive barrier over the field of the wall and at penetrations and rough openings.

Note

BASF Wall Systems is an operating unit of BASF Corporation (herein referred to as "BASF Wall Systems")

Disclaimer

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Side by Side Comparison of Specified Products Vs. Enershield-HP

Physical Properties	Test Method	BASF Enershield-HP	Grace Perm-A-Barrier VP	Tremco ExoAir 230	Henry Air Bloc 31	Carlisle Barritech VP
Application Type		Fluid-Applied --spray, roller, brush or trowel. Back rolling possible	Fluid-Applied	Fluid Applied - Roller or Trowel Applied	Fluid-Applied --spray, trowel, brush. No back rolling	Fluid-Applied --spray or roller.
Air Leakage of Air Barrier Assemblies	ASTM E2357	0.0001 cfm/ft2 @ 75 Pa (1.57 psf) positive / post conditioning 0.0003 cfm/ft2 @ 75 Pa (1.57 psf) negative / post conditioning	<.0008 cfm/ft2	Pass	Meets ASTM E2357	Not Reported
Air Permeance of Building Materials	ASTM E2178	.00098 cfm/ft2 @ 1.57 psf	<.0004 cfm/ft2	0.00805 CFM/ft ²	0.00024 CFM/ft ²	≤0.001 L/s*m2 @ 75 Pa (<0.0002 CFM/ft 2 @ 1.57 PSF)
Rate of Air Leakage	ASTM E 283	.0185 l/s m2 @75 Pa(.00337 cfm/ft2@1.57 psf	Not Reported	Not Reported	Not Reported	Not Reported
Water Vapor Transmission	ASTM E 96	18 Perms @ 10 mils wet film thickness Perms @ 20 mils wet film thickness	11.2 Perms	11.71 Perms	21 Perms @ 100 Mils wet film thickness	12 Perms
Pull-off Strenth of Coatings	ASTM D 4541	Pass	Not Reported	Not Reported	Not Reported	Not Reported
Nominal Wet Film Thickness on Sheathing	C1177	10 Mils	90 Mils	70 Mils	72 Mils	60 Mils
Nail Sealability (without Sheathing Fabric)	ASTM D 1970	Pass	Pass	Pass		Pass
Flame Spread	ASTM E 84	15 (class 1)	Not Reported	Flame Spread = 10	Burns	Not Reported
Acceptance for Flexible Flashing Materials	ICC-E AC 148	Pass - Single Component System	Requires Separate Component - Detail Membrane	Yes	Requires Separate Component - Detail Membrane	
Maximum exposure period		180 days	180 days	168 days	90 Days	180 days
LEED IEQ 4.2 - VOC Content		11 g/l	20 g/l	37 g/l	100g/l	52 g/l
Contains Plasticizer		No	No	No	No	No
Single Component		Yes	Yes	Yes	Yes	Yes
Cure Time		2-10 Hours (depending on ambient conditions)	24 Hours	24 Hours	24 Hours	48 Hours
ABAA Approved		Yes	Yes	No	Yes	No
Warranty		Manufacturer's minimum 5-year Limited Materials warranty	Not Reported	Yes - no time period stated	Not published	Limited Warranty

The Wall systems business of BASF Corporation has made every effort to provide accurate, complete, usable and timely information however we cannot guarantee that there will be no errors or omissions.

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 10 51 26 – Plastic Lockers

Corresponding to RFQ Item: 47

SECTION 10 51 26 – PLASTIC LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes plastic lockers.
 - 1. HDPE lockers.
 - 2. Accessories including tops, vertical fillers, and recess trim as indicated.
- B. Lockers in Staff Loung 1323 will have hasp for padlock. (Padlock N.I.C.)
- C. Lockers in Social Noisy 1141 and 1217 (Patient areas) shall have no locking capability.

1.2 ACTION SUBMITTALS

- A. Product Data: For plastic lockers.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for type of locker.
- B. Shop Drawings: For plastic lockers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locker fillers, trim, base, and accessories.
- C. Samples for Initial Selection: For the following:
 - 1. HDPE color selections.
- D. Samples for Verification: For the following products:
 - 1. HDPE sheet, for color.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

- A. Coordinate sizes and locations of support bases.
 - 1. Staff Lounge: Plastic laminate clad base is specified in Division 06 Section "Interior Architectural Woodwork."
 - 2. Social Noisy (Patient Areas): Concealed wood base is specified in Division 06 Section "Miscellaneous Rough Carpentry."
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

1.8 WARRANTY

- A. Manufacturer agrees to repair or replace plastic components of lockers that fail in materials or workmanship within specified warranty period.
 - 1. 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLASTIC LOCKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ASI Storage Solutions.
 - 2. Hallowell.
 - 3. Remcon Plastics, Inc.
- B. Locker Body: Fabricated from HDPE.

2.2 MATERIALS

- A. HDPE: Solid plastic sheet in manufacturer's standard thickness, minimum 1/4 inch.
- B. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts.

2.3 HARDWARE

- A. Provide manufacturer's standard locker hardware complying with the requirements in this Section.
- B. Cam Padlock Hasp (Staff lockers only): Surface mounted, steel; finished to match other locker hardware.
- C. Butt Hinges: Steel hinges; back mounted.
- D. Latch Handle: Manufacturer's standard.
- E. Exposed Hardware Finishes: Satin chrome unless otherwise indicated.

2.4 ACCESSORIES

- A. Number Plates: Blank aluminum plates.

2.5 FABRICATION

- A. Fabricate each locker with an individual door and frame, an individual top, a bottom, and a back.
 - 1. Fabricate lockers to dimensions, profiles, and details indicated.
- B. Fabricate components square, rigid, without warp, and with finished faces flat and free of scratches and chips. Accurately factory machine components for attachments. Make joints tight and true.
- C. Venting: Manufacturer's standard louver configuration.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

- A. Condition lockers to average prevailing humidity conditions in installation areas before installation.
- B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

- A. Install lockers level, plumb, and true; use concealed shims.
- B. Connect groups of lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames.
- C. Install lockers without distortion so doors fit openings properly and are accurately aligned. Adjust hardware to center doors in openings, providing unencumbered operation.
 - 1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.
- D. Locker Anchorage: Fasten lockers through wood locker base, at ends, and not more than 36 inches o.c. with screws sized for 1-inch penetration into wood base and penetration into metal studs or reinforcing behind gypsum board.
- E. Scribe and cut filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.
- F. Attach sloping-top units to lockers, with end panels covering exposed ends.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding.
- B. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 51 26

WSH13095

William Sharpe Hospital
50 Bed Addition

Pre-bid Meeting Sign-in Sheet

Corresponding to RFQ Item: 48

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Rep: <u>Curt Ringo</u>		TOLL FREE
Email Address: <u>Curtis@FKEVEREST.COM</u>		FAX <u>304-363-8946</u>
Company: <u>F.K. Everest Inc</u>		PHONE <u>304-376-9364</u>
Rep: <u>Dave Casto</u>		TOLL FREE
Email Address: <u>dcasto@fkeverest.com</u>		FAX <u>304-363-8946</u>

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Page 9 of 13

Request for Proposal No. WSH13095

PLEASE PRINT

Date: 1/16/13

* PLEASE BE SURE TO PRINT LEGIBLY - IF POSSIBLE, LEAVE A BUSINESS CARD

FIRM & REPRESENTATIVE NAME	MAILING ADDRESS	TELEPHONE & FAX NUMBERS
Company: <u>Lombardi Development</u>	<u>649 Virginia Ave</u>	PHONE <u>304-748-5920</u>
Rep: <u>Jason Nuzum</u>	<u>Follonsbee WV 26037</u>	TOLL FREE
Email Address: <u>Bernie@LombardiDevelopment.com</u>		FAX <u>304-748-8488</u>
Company: <u>Hayslett Construction Co Inc</u>	<u>PO Box 447</u>	PHONE <u>304-757-9308</u>
Rep: <u>Tim Hayslett</u>	<u>Hurricane WV 25526</u>	TOLL FREE
Email Address: <u>Whyslett@ADL.com</u>		FAX
Company: <u>McKamish Inc.</u>	<u>50 55th Street</u>	PHONE ^{cell} <u>412-287-6607</u>
Rep: <u>Robert W. Tennant II</u>	<u>Pittsburg PA 15201</u>	TOLL OFFICE FREE <u>1800 626-7608</u>
Email Address: <u>robt@mcKamish.com</u>		FAX <u>412-781-6161</u>
Company: <u>Wayne Crouse inc.</u>	<u>3370 Stafford ST.</u>	PHONE <u>412-771-5176</u>
Rep: <u>Jeff Wilburn</u>	<u>PITT PA. 15204</u>	TOLL FREE
Email Address: <u>PROJ@WayneCrouse.com</u>		FAX <u>412-771-2357</u>
Company: <u>Lighthouse Electric</u>		PHONE <u>724-916-0244</u>
Rep: <u>Chad Jones</u>		TOLL FREE
Email Address: <u>Chad.jones@lighthouseelectric.com</u>		FAX

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Request for Proposal No. WSH13095

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Date: 1/16/13

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TELEPHONE & FAX
NUMBERS

FIRM & REPRESENTATIVE NAME

MAILING ADDRESS

Company: <u>FK EVEREST</u>	<u>140 BUSINESS PARK DR</u>	PHONE <u>304-363-8830</u>
Rep: <u>RYAN EDDY</u>	<u>FAIRMONT WV 26554</u>	TOLL FREE
Email Address: <u>ryan@fkeverest.com</u>		FAX
Company: <u>IBEW Local 596</u>	<u>1001 N 12th Street</u>	PHONE <u>304-203-1204</u>
Rep: <u>RICK LAWSON</u>	<u>P.O. Box 1508</u>	TOLL FREE
Email Address: <u>RLawson@IBEW596.com</u>	<u>CLARKSBURG WV 26301</u>	FAX <u>304-622-2099</u>
Company: <u>ENERFAB ELECTRIC</u>	<u>1100 CHARLES AVE</u>	PHONE <u>304 768 6407</u>
Rep: <u>GEORGE ROSS</u>	<u>DUNBAR WV 26064</u>	TOLL FREE
Email Address: <u>george.ross@ENERFAB.com</u>		FAX <u>304 767 0424</u>
Company: <u>MON VALLEY ELECTRIC</u>	<u>1609 GAMMAL ST.</u>	PHONE <u>304-366-2340</u>
Rep: <u>CHRIS BUSH</u>	<u>FAIRMONT, WV 26554</u>	TOLL FREE
Email Address: <u>MVE@CHRIS@FRONTIER.com</u>		FAX <u>304-366-2342</u>
Company: <u>G.A. BROWN & SON</u>	<u>215 MILL ST</u>	PHONE <u>304-363-4500</u>
Rep: <u>JAMES E BROWN II</u>	<u>FAIRMONT WV 26554</u>	TOLL FREE
Email Address: <u>jbrown@gabrown.com</u>		FAX <u>304-366-9456</u>

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Request for Proposal No. WSH13095

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* PLEASE BE SURE TO PRINT LEGIBLY - IF POSSIBLE, LEAVE A BUSINESS CARD

FIRM & REPRESENTATIVE NAME	MAILING ADDRESS	TELEPHONE & FAX NUMBERS
Company: <u>EATON</u>	<u>600 A PRESTIGE PARK</u>	PHONE <u>304-610-0594</u>
Rep: <u>RICK RODA</u>	<u>SUITE 2</u>	TOLL FREE
Email Address: <u>RICK.RODA@EATON.COM</u>	<u>HURRICANE WV 25526</u>	FAX <u>-</u>
Company: <u>G & G BUILDERS INC.</u>	<u>500 CORPORATE CENTERS DR.</u>	PHONE <u>304-757-9196</u>
Rep: <u>MIKE DAVIS</u>	<u>SUITE 550</u>	TOLL FREE
Email Address: <u>MDAVIS@GANDGBUILDERS.COM</u>	<u>SCOTT DEPOT, WV 25560</u>	FAX <u>304-757-0993</u>
Company: <u>Adurer Inc</u>	<u>425 Industrial Ave</u>	PHONE <u>304-826-0225</u>
Rep: <u>Dave Haught</u>	<u>Morgantown WV 26505</u>	TOLL FREE
Email Address: <u>CMyers@Adurer.com</u>		FAX
Company: <u>KONE</u>	<u>735 Cross Pointe Rd.</u>	PHONE <u>(614) 866-1251</u> X217
Rep: <u>Jeff Havens</u>	<u>Suite G</u>	TOLL FREE
Email Address: <u>jeff.havens@Kone.com</u>	<u>Gahanna, Ohio 43230</u>	FAX
Company: <u>dck worldwide</u>	<u>ONE PPL PLACE</u>	PHONE <u>412 384 1195</u>
Rep: <u>TOOD M. PETERS</u>	<u>27TH FL</u>	TOLL FREE
Email Address: <u>tpeters@dckwr.com</u>	<u>PITTSBURGH, PA 15222</u>	FAX

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FIRM & REPRESENTATIVE NAME	MAILING ADDRESS	TELEPHONE & FAX NUMBERS
Company: <u>Turner Construction</u>	<u>620 Liberty Ave. 27th Floor</u>	PHONE <u>412 255 5400</u>
Rep: <u>Brian Peglowski</u>	<u>Pittsburgh PA 15227</u>	TOLL FREE
Email Address: <u>bpeglowski@tccc.com</u>		FAX <u>412 255 0210</u>
Company: <u>GRAYBAR ELECTRIC</u>	<u>900 Dodge Ave</u>	PHONE <u>(412) 332-5200</u>
Rep: <u>GARY RODGERS</u>	<u>Pittsburgh PA 15212</u>	TOLL FREE
Email Address: <u>gary.rodgers@graybar.com</u>		FAX <u>(412) 323 8685</u>
Company: <u>MARCC</u>	<u>609 Broadway</u>	PHONE <u>304-842-5431</u>
Rep: <u>Mike Jenkins</u>	<u>Bridgeport, WV 26330</u>	TOLL FREE
Email Address: <u>MSSCarp.org@gmail.com</u>		FAX <u>304-842-5125</u>
Company: <u>DAVID DAVIS HEATING, A/C & E/EC</u>	<u>P.O. Box 2301 ELKINS</u>	PHONE <u>304-10364669</u>
Rep: <u>DAVID DAVIS</u>		TOLL FREE
Email Address: <u>LESLIE.DAVIS@johnd.com</u>		FAX <u>304-1037-4669</u>
Company: <u>FRANK HOPSON</u>		PHONE
Rep: <u>CITY ELECTRIC</u>		TOLL FREE
Email Address: <u>Fhopson@cityelectricwv.com</u>		FAX

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Page 13 of 13

Request for Proposal No. WSH13095

PLEASE PRINT

Date: 1/16/13

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FIRM & REPRESENTATIVE NAME	MAILING ADDRESS	TELEPHONE & FAX NUMBERS
Company: <u>RAT C. LAPP</u>	<u>226 BUILDERS WAY</u>	PHONE <u>301-334-3600</u>
Rep: <u>JUSTIN T. PAULMAN</u>	<u>P.O. Box 377</u>	TOLL FREE
Email Address: <u>JTPAULMAN@GMAIL.COM</u>	<u>OAKLAND, MD 21550</u>	FAX <u>301-334-2667</u>
Company: <u>Venture 1 Const.</u>	<u>3883 Virginia Ave</u>	PHONE <u>3AM CEN 304 777 7886</u>
Rep: <u>Rocky Townsend / Sam Kline</u>	<u>Cincinnati, OH. 45227</u>	TOLL <u>office 513-527 527-5055</u>
Email Address: <u>SAK@V1CINC.</u>		FREE FAX <u>513 527-4066</u>
Company: _____	_____	PHONE TOLL FREE
Rep: _____	_____	_____
Email Address: _____	_____	FAX
Company: _____	_____	PHONE TOLL FREE
Rep: _____	_____	_____
Email Address: _____	_____	FAX
Company: _____	_____	PHONE TOLL FREE
Rep: _____	_____	_____
Email Address: _____	_____	FAX

WSH13095

William Sharpe Hospital
50 Bed Addition

Substitution: Acorn Engineering Plumbing Fixtures

Corresponding to RFQ Item: 49



2 Cameron Road
Clarksburg, WV 26301
Phone: (304) 623-4712 Fax: (304) 623-4713
WV Contractor License: 030541
Email: mainlinemechinc@aol.com

January 23, 2013

CITY CONSTRUCTION COMPANY
Route 2, Box 285
Clarksburg, WV 26301

Attention: Beau Henderson

Re: Wm. R. Sharpe Hospital 50-Bed Addition
Request for Substitution on Plumbing Fixtures

Beau:

We formally request to substitute the following Acorn Engineering products to be approved as an acceptable equal on the William Sharpe Hospital 50-Bed Addition Project, IKM Project #11-170. The items we are requesting can be found on drawing P501 labeled WC-1 and WC-1H on the Plumbing Fixture Schedule. Additionally, they can be found on pages 2 and 3 of Section 224700, 2.1,B written specifications.

If approved, the items would not require any changes in materials, equipment or any other portion of work, including any other contracts that incorporate the proposed substitution. Please see the model numbers below as well as the attached Submittals and Installation instructions.

(WC-1) 2120-T-3-FVBO1.6-CN
(WC-1H) 2120-T-3-FVBO1.6-ADA-CN
(WC-1, WC-1H) 2802-FVH1.6-SLPT

Sincerely,

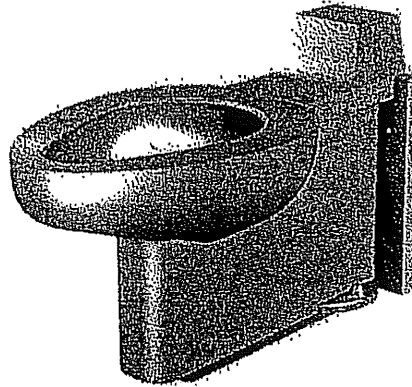
MAINLINE MECHANICAL, INC.

Dennis Gwinn

DENNIS GWINN
President



Dura-Ware® 2120 Series
Siphon Jet Toilet - On Floor - Floor Outlet



2120-W-3-CN

Fixture May Show Some Available Options

Please visit www.acorneng.com for most current specifications.

Siphon Jet Toilet - On Floor - Floor Outlet

Fixture is arranged to be installed on finished wall from the front side. It is fabricated from 16 gage, type 304 stainless steel and is seamless welded construction. Exterior has a satin finish with an integral contoured seat. The inside of the toilet bowl also has a satin finish. Wall flange is reinforced for maximum strength.

Toilet is Siphon Jet type with elongated bowl manufactured to comply with ASME A112.19.3-2008 and CSA B45.4-2008 standards. Toilet requires a minimum of 25 PSI flow pressure and uses a minimum water consumption of 1.28 GPF. Trap has a minimum 3-1/2" seal, will pass a 2-1/8" ball and is fully enclosed. Toilet has a 1-1/2" NPT flushing inlet connection and a 7-1/2" gasketed waste with 6" mounting centers. Connecting hardware provided by Installer.

Flush Valve supply is additionally available for exposed or concealed flush valve styles in 1.28 GPF, 1.6 GPF or 3.5 GPF with 1-1/2" NPT connection.

GUIDE SPECIFICATION

Provide and Install Acorn Dura-Ware Siphon Jet Toilet (specify model number and options). Fixture shall be fabricated from 16 gage, type 304 stainless steel. Construction shall be seamless welded and exposed surfaces shall have a satin finish with an integral contoured toilet seat. Toilet shall be concealed siphon jet type with an elongated bowl and a self-draining flushing rim. Toilet shall be ASME A112.19.3-2008 and CSA B45.4-2008 compliant. Toilet requires a minimum of 25 PSI flow pressure and uses a minimum water consumption of 1.28 GPF. Toilet trap shall have a minimum 3-1/2" seal that shall pass a 2-1/8" diameter ball and be fully enclosed. Toilet waste outlet shall be 7-1/2" Gasketed Waste with 6" mounting centers. Connecting hardware provided by installer.

Dura-Ware®: 2120 Siphon Jet Toilet - On Floor - Floor Outlet



WALL THICKNESS AND TYPE (Must Specify)

Thickness: _____ Type: ☐ Concrete ☐ Block ☐ Steel

MODEL NUMBER AND OPTIONS SELECTION:

BASE MODEL NUMBER

☒ 2120 Siphon Jet Toilet

SUPPLY (Must Specify)

☐ -T Top (Exposed)
☐ -W Wall (Concealed)

FIXTURE MOUNTING AND WASTE (Must Specify)

☒ -3 On-Floor, Floor Outlet

FLUSH VALVE GPF'S (Must Specify)

☐ -HET 1.28 GPF
☐ -ULF 1.6 GPF
☐ -3.5 GPF

FLUSH VALVE OPTIONS (Must Specify)

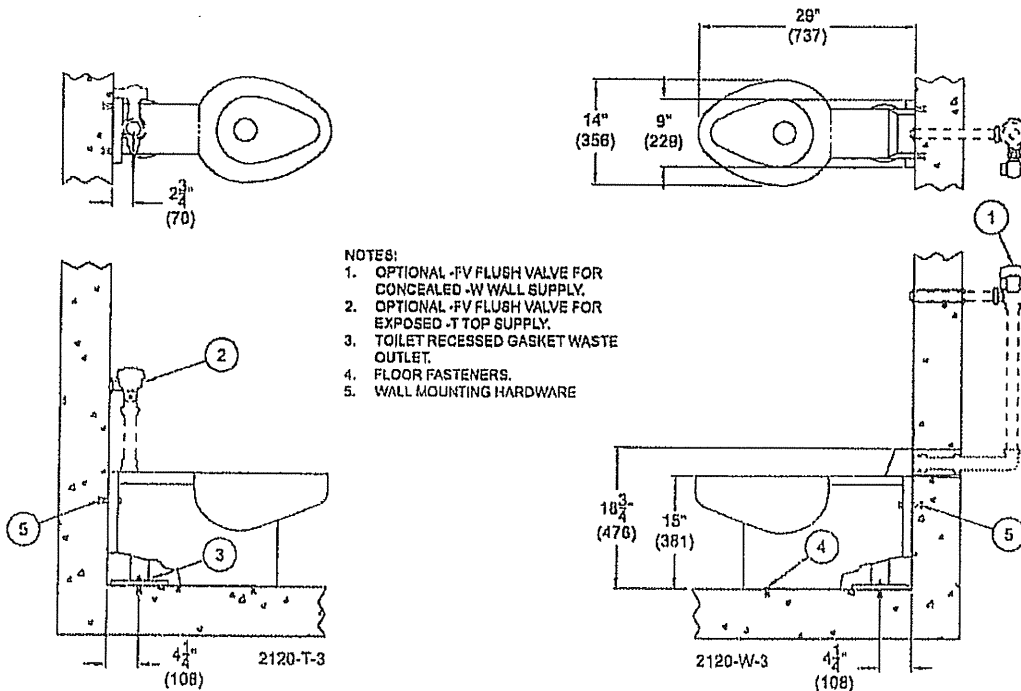
Refer to Acorn Dura-Ware Supplementary for Box cover(s) and Access Panel(s)

- ☐ -FV Flush Valve, Mechanical (N/A for ADA)
- ☐ -FVBO Flush Valve by Others
- ☐ -FVH Flush Valve, Hydraulic (N/A for Top Supply)
- ☐ -FVL Flush Valve, ADA Lever Handle
- ☐ -MVCV Time-Trol Flush Valve (N/A for Top Supply)

PRODUCT OPTIONS (Must Specify)

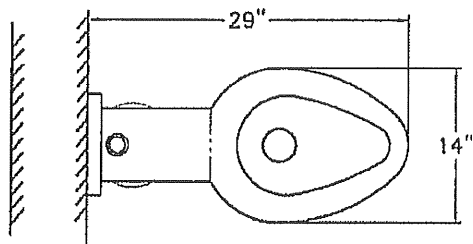
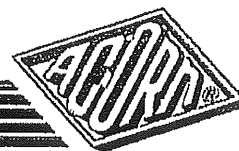
- ☐ -ADA 18" Integral Seat Height
- ☐ -BCN Blind Cap Nuts
- ☐ -BL Bedpan Lugs
- ☐ -CN Cap Nuts (2) (For 5/16"-18 UNC Hardware By Others)
- ☐ -EG Enviro-Glaze: Specify Color: _____
- ☐ -Toilet Exterior Only
- ☐ -Toilet Interior
- ☐ -FG 14 Gage Housing
- ☐ -FT Flood-Trol (N/A for Top Supply)
- ☐ -FTA Flood-Trol Auto-Reset (N/A for Top Supply)
- ☐ -FTE Flood-Trol Electronic
- ☐ -FVT Flush Valve Thru Wall Connection
- ☐ -HET High Efficiency Toilet Design
- ☐ -HPS High Polish Integral Seat
- ☐ -HS-OFCL Hinged Seat, Open Front Less Cover
- ☐ -HS-OFWC Hinged Seat w/ Cover
- ☐ -PE Plain End Toilet Waste 2-3/8" In Lieu of Standard Gasket
- ☐ -PFS Punched for Seat by Others
- ☐ -TF Transformer, 120VAC to 24VAC
- ☐ -TSC Toilet Shipping Cover
- ☐ -VAC AcornVAC System
- ☐ -WO3 3" O.D. Toilet Waste Outlet (3.5 GPF Only)

Please visit www.acorneng.com for most current specifications.



Important: Installation instructions and current rough-in are furnished with each fixture. Do not rough in without certified dimensions. Dimensions are subject to manufacturer's tolerance of plus or minus 1/4" and change without notice. Acorn assumes no responsibility for use of void or superseded data. © Copyright 2009 Acorn Engineering Company

<p>Selection Summary</p> <p>Model No. & Option _____</p> <p>Quantity _____</p>	<p>Approved for Manufacturing</p> <p>Company _____ Title _____</p> <p>Signature _____ Date _____</p>
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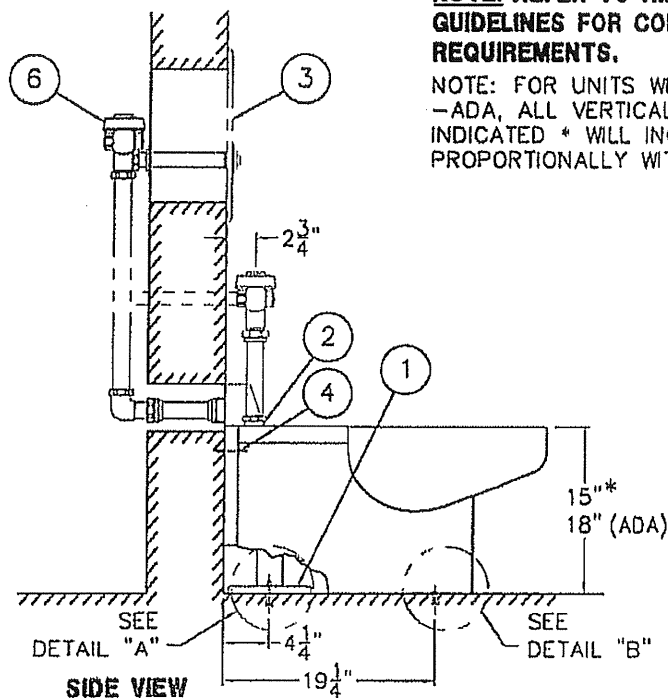


TOP VIEW

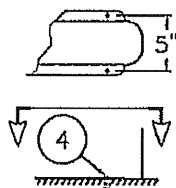
FOR -ADA MODELS -FLUSH VALVE MUST BE HYDRAULICALLY ACTUATED OR SUPPLIED WITH A SPECIAL HANDLE. MAX. CONTROL HEIGHT IS 44" ABOVE FINISHED FLOOR. CONTROLS MUST BE LOCATED ON WIDE SIDE OF TOILET.

NOTE: REFER TO A.D.A. ACCESSIBILITY GUIDELINES FOR COMPLETE INSTALLATION REQUIREMENTS.

NOTE: FOR UNITS WITH SUFFIX OPTION -ADA, ALL VERTICAL DIMENSIONS INDICATED * WILL INCREASE PROPORTIONALLY WITH ADA SEAT HEIGHT.



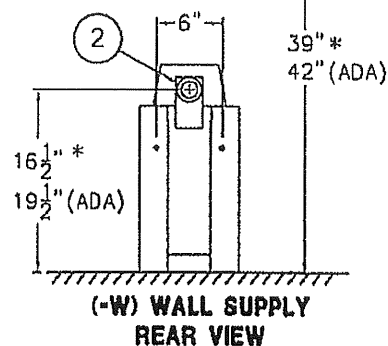
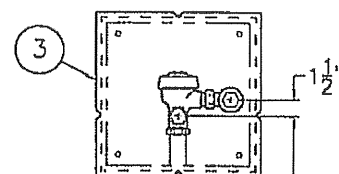
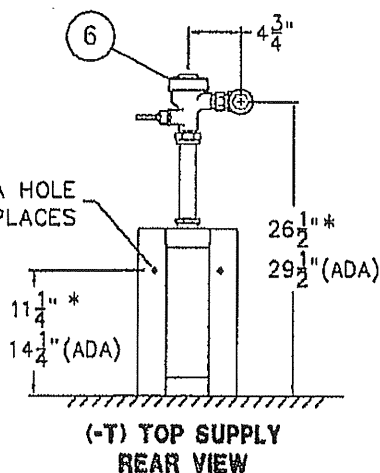
SIDE VIEW



DETAIL "B"



DETAIL "A"

(-W) WALL SUPPLY
REAR VIEW(-T) TOP SUPPLY
REAR VIEW

NOTE: FOR UNITS WITH -W WALL SUPPLY FLUSH VALVE, ACCESS FOR CONNECTING AND SERVICING FLUSH VALVE IS REQUIRED.

INSTALLATION INSTRUCTIONS

A-ROUGH-IN FOR THE FOLLOWING:

- 7-1/2" DIAMETER GASKET WASTE ①.
- 1-1/2" NPT FLUSHING INLET ②.

B-FOR DURA-WARE FLUSH VALVE ACCESS PANELS ③, FOR CONCEALED FLUSH VALVE INSTALLATION REFER TO DRAWING #9908-399-001.

C-PLACE TOILET AGAINST WALL AND OVER WASTE OUTLET ROUGH-IN. ATTACH FIXTURE TO FLOOR AND WALL WITH 1/4-20 FASTENERS ④ PROVIDED. SEE DETAIL "B". WASTE GASKET CONNECTION FASTENERS ⑤ (BY OTHERS). SEE DETAIL "A". WALL AND FLOOR ANCHORS ARE PROVIDED BY INSTALLER.

D-FLUSH SUPPLY LINE. MAKE-UP WASTE CONNECTION AND MOUNT FLUSH VALVE ⑥ PER MANUFACTURERS' RECOMMENDATIONS.



ACORN ENGINEERING COMPANY
P.O. Box 3527 Industry, CA 91744
15125 Proctor Ave. Industry, CA 91746
(626) 336-4561 FAX (626) 961-2200

TITLE

SIPHON JET TOILET - ON FLOOR (CAT. #2120 & #2120-ADA)

MANUFACTURE DATE

FEBRUARY 1975
TO PRESENT

DATE ISSUED

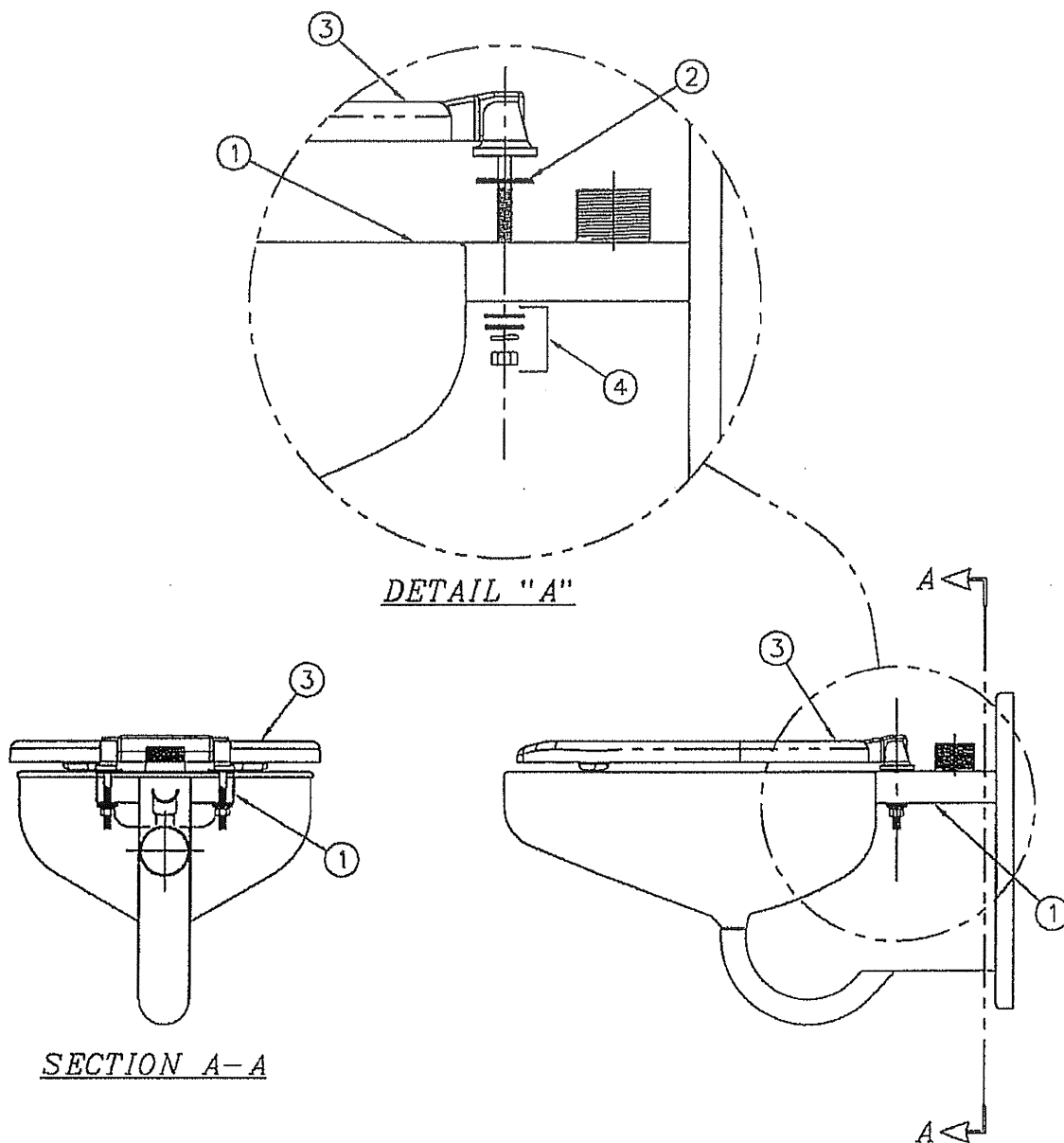
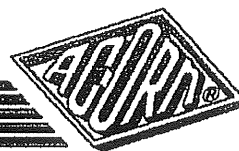
10/19/92

DATE REVISED

02/09/12

DRAWING NUMBER

9908-407-001



**INSTALLATION INSTRUCTIONS-HINGED
SEAT AFTER MOUNTING FIXTURE ON WALL**

- A-LOCATE HINGED SEAT MOUNTING HOLES
IN FIXTURE ①.
- B-INSERT WASHERS ② BETWEEN TOP OF
TOILET AND HINGE SEAT ③.

- C-POSITION HINGED SEAT ③ ON TOP OF
UNIT.
- C-ASSEMBLE HARDWARE ④ AS SHOWN IN
MOUNTING DETAIL "A".

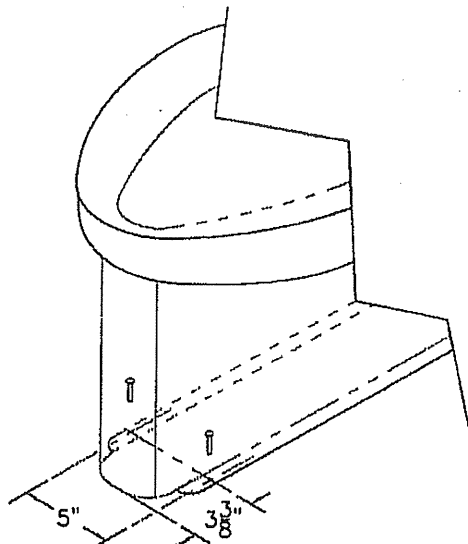
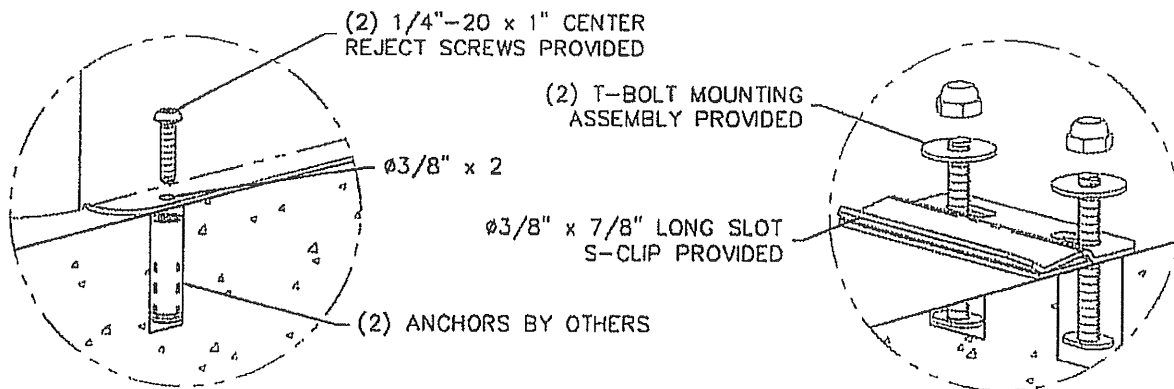
ACORN ENGINEERING COMPANY
P.O. BOX 3527 INDUSTRY, CA. 91744
(626) 330-4561 FAX (626) 961-2200

TITLE -HS HINGED SEAT OPTION INSTALLATION DETAIL - TOILETS

MANUFACTURE DATE
APRIL 2008
TO PRESENT

DATE ISSUED
04/09/08
DATE REVISED

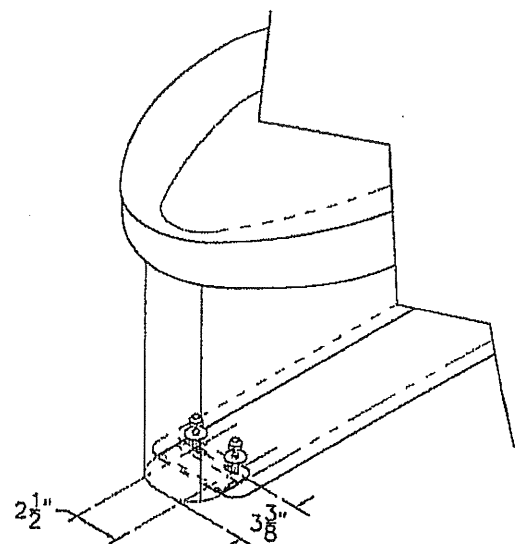
DRAWING NUMBER
9908-415-001

**FLANGE MOUNTING**

-SS-SPS SUICIDE RESISTANT SKIRT OPTION IS PROVIDED WITH ADDITIONAL MOUNTING POINTS NOT NORMALLY PROVIDED WITH OUR STANDARD FIXTURES AND COME IN TWO STYLES AS INDICATED BELOW.

**FIXTURES w/ FLANGE MOUNTING
(DURA-WARE, REPLACE-WARE):**

- A-AFTER ROUGHING IN AS REQUIRED, PLACE FIXTURE IN POSITION AND USE AS TEMPLATE TO LOCATE AND MARK FLANGE POINTS ON FLOOR.
- B-REMOVE FIXTURE AND INSTALL FLOOR ANCHORS BY OTHERS FOR 3/8" DIAMETER FLANGE PUNCHING.
- C-ALIGN WALL AND FLOOR ANCHORING POINTS AND COMPLETE FIXTURE INSTALLATION AS INDICATED BY THE FIXTURE INSTALLATION SHEET PROVIDED.

**S-CLIP MOUNTING**

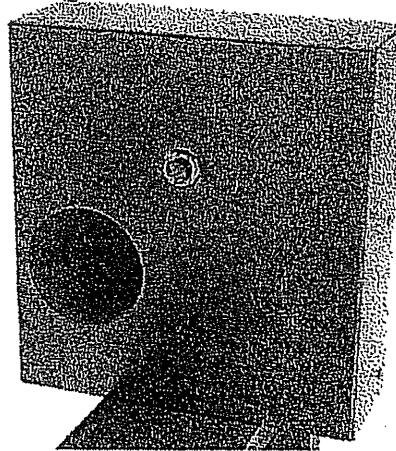
FIXTURES w/ S-CLIP (PENAL-WARE, MERIDIAN):

- A-AFTER ROUGHING IN AS REQUIRED, PLACE FIXTURE IN POSITION AND USE AS A TEMPLATE TO LOCATE AND MARK S-CLIP MOUNTING LOCATION ON FLOOR AS INDICATED.
- B-REMOVE FIXTURE AND INSTALL FLOOR ANCHORS FOR S-CLIP 3/8" x 7/8" LONG MOUNTING SLOTS
- C-INSTALL S-CLIP.
- D-PLACE FIXTURE ON FLOOR POSITIONING THE "NOSE" OF THE SKIRT SEVERAL INCHES IN FRONT OF S-CLIP MOUNTING LOCATION, SLIDE FIXTURE INTO PLACE ENGAGING THE S-CLIP AND ALIGNING WALL MOUNTING LOCATIONS. COMPLETE FIXTURE INSTALLATION AS INDICATED BY THE FIXTURE INSTALLATION SHEET PROVIDED.

<p>ACORN ENGINEERING COMPANY P.O. BOX 3527 Industry, CA 91744 15125 Proctor Ave. Industry, CA 91746 (626) 336-4501 FAX (626) 961-2200</p>	<p>TITLE -SPS MOUNTING DETAIL</p>		
	<p>MANUFACTURE DATE AUGUST 2012</p>	<p>DATE ISSUED 08/15/12</p>	<p>DRAWING NUMBER 9925-007-001</p>
	<p>TO PRESENT</p>	<p>DATE REVISED</p>	



Flush Valve Cover with Flush Valve



2802-FV-PHL

Graphic May Show Some Available Options

Please visit www.acorneng.com for most current specifications.

Flush Valve Cover with Flush Valve

Acorn Flush Valve Cover with Flush Valve is recommended for flushing conventional toilets, urinals and floor drains with top supply (exposed) flush valve connections where vandal resistance is a concern.

Flush Valve is exposed type with cast bronze body. Flush valve features quiet operation and includes non-hold open metal pushbutton, union angle stop and code approved vacuum breaker. All exposed parts are polished chrome plated.

Flush Valve Cover is 16 gage, type 304 stainless steel with interior having a glass blast satin finish. It is furnished with six removable wall brackets secured with vandal resistant screws.

GUIDE SPECIFICATION

Provide and Install Acorn Flush Valve Cover with Flush Valve. Flush Valve Cover fabricated from 16 gage, type 304 stainless steel. All exposed stainless steel surfaces shall have a satin finish. Flush valve shall be pushbutton operated with cover secured with stainless steel vandal resistant fasteners. Wall anchors and anchoring hardware by others.

Dura-Ware® 2802: Flush Valve Cover with Flush Valve



MODEL OF FIXTURE FOR APPLICATION: _____

MODEL AND OPTIONS SELECTION

BASE MODEL NUMBER

☒ 2802 Flush Valve Cover with Flush Valve

TOILET VALVE SELECTION (Must Specify)

- ☐ -FV Flush Valve (Pushbutton Centered Only)
☐ HET 1.28 GPF ☐ ULF 1.6 GPF ☐ 3.5 GPF
- ☐ -FVH Hydraulic Flush Valve
☐ HET 1.28 GPF ☐ ULF 1.6 GPF ☐ 3.5 GPF
 Pushbutton Location
☐ RH Right Hand ☐ LH Left Hand
- ☐ -EVS-FV Master-Trol Electronic Flush Valve
☐ HET 1.28 GPF ☐ ULF 1.6 GPF ☐ 3.5 GPF
 Pushbutton Location
☐ RH Right Hand ☐ LH Left Hand
- ☐ -MVCFV Time-Trol Electronic Flush Valve
☐ HET 1.28 GPF ☐ ULF 1.6 GPF ☐ 3.5 GPF
 Pushbutton Location
☐ RH Right Hand ☐ LH Left Hand

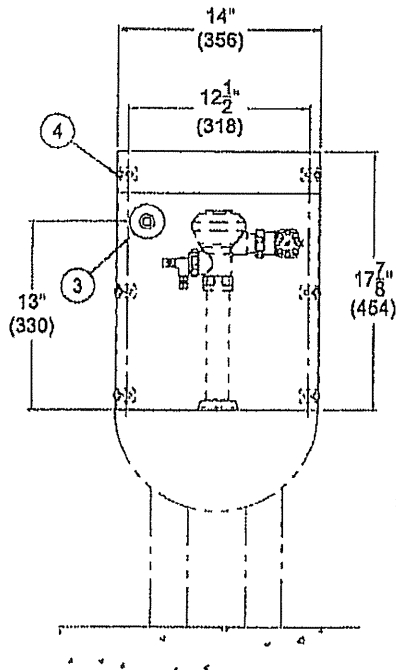
URINAL VALVE SELECTION (Must Specify)

- ☐ -FV Flush Valve (Pushbutton Centered Only)
☐ 0.5 GPF ☐ 1.0 GPF ☐ 1.5 GPF ☐ 3.5 GPF
- ☐ -FVH Hydraulic Flush Valve
☐ 0.5 GPF ☐ 1.0 GPF ☐ 1.5 GPF ☐ 3.5 GPF
 Pushbutton Location
☐ RH Right Hand ☐ LH Left Hand
- ☐ -EVS-FV Master-Trol Electronic Flush Valve
☐ 0.5 GPF ☐ 1.0 GPF ☐ 1.5 GPF ☐ 3.5 GPF
 Pushbutton Location
☐ RH Right Hand ☐ LH Left Hand
- ☐ -MVCFV Time-Trol Electronic Flush Valve
☐ 0.5 GPF ☐ 1.0 GPF ☐ 1.5 GPF ☐ 3.5 GPF
 Pushbutton Location
☐ RH Right Hand ☐ LH Left Hand

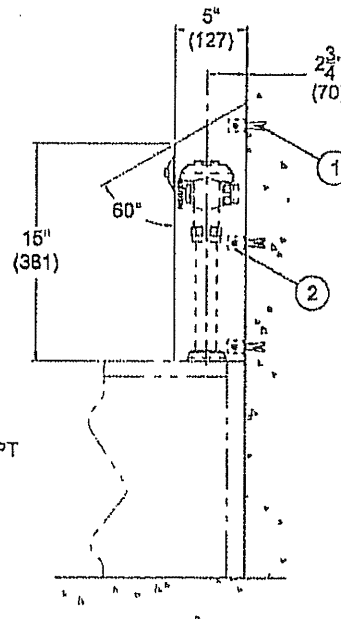
Product Options

- ☐ -EG Enviro-Glaze, Specify Color: _____
- ☐ -PH Paper Holder
☐ PHL Paper Holder Left
☐ PHR Paper Holder Right
- ☐ -SLPT Sloping Top
- ☐ -TF Transformer

Please visit www.acorneng.com
 for most current specifications.



MODEL #2802-FVH-LH-SLPT

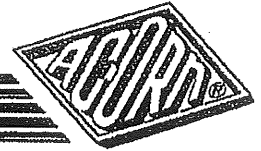


1. Wall Anchors And Anchoring Hardware By Others
2. Mounting Clips

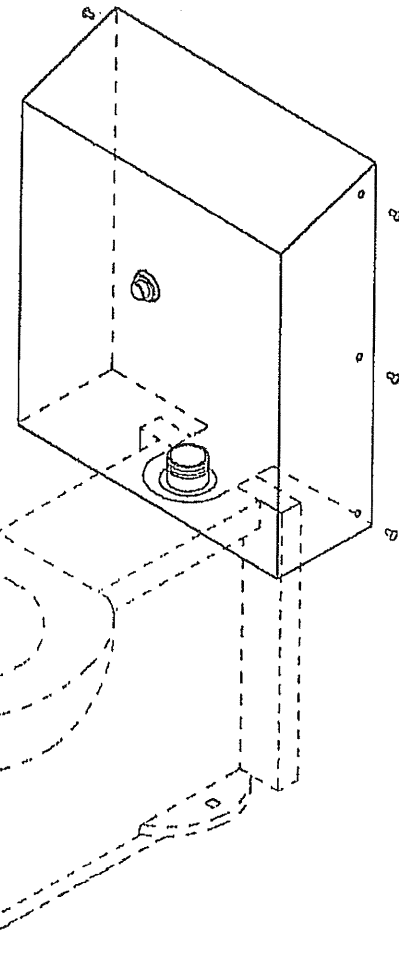
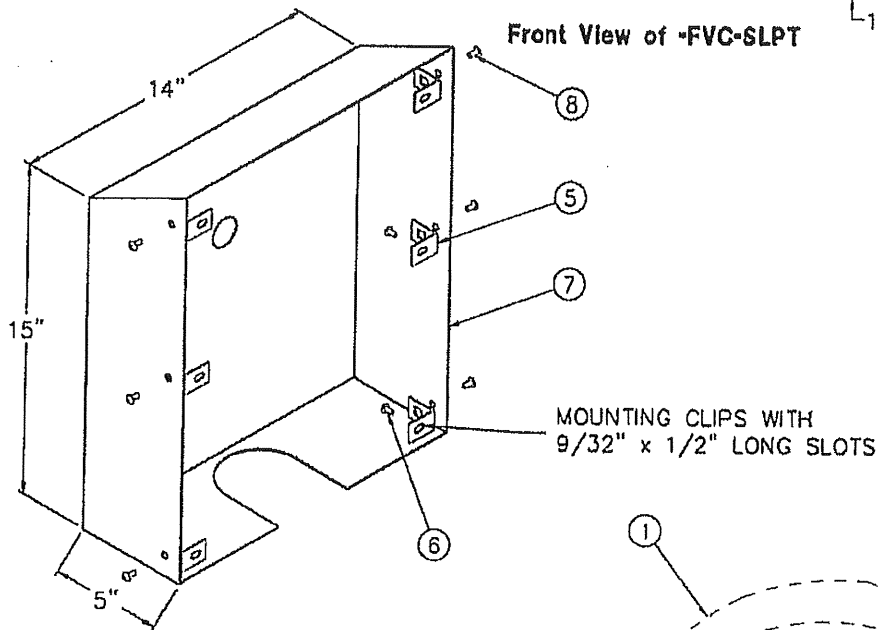
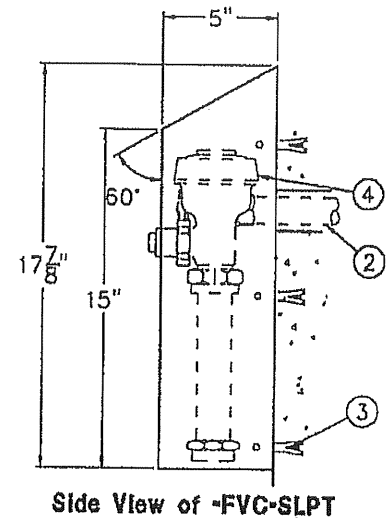
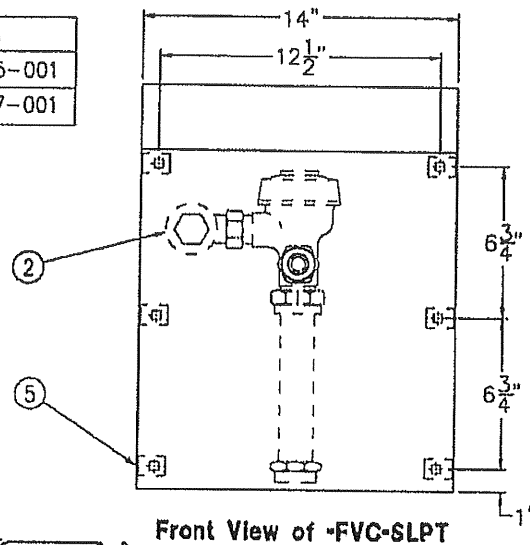
3. Hydraulic Flush Valve Pushbutton
 -LH Left Hand (right Hand Opposite)
4. Vandal Resistant Fasteners

Important: Installation instructions and current rough-in are furnished with each fixture. Do not rough in without certified dimensions. Dimensions are subject to manufacturer's tolerance of plus or minus 1/4" and change without notice. Acorn assumes no responsibility for use of void or superseded data. © Copyright 2007 Acorn Engineering Company

<p align="center">Selection Summary</p> <p>Model No. & Option _____</p> <p>Quantity _____</p>	<p align="center">Approved for Manufacturing</p> <p>Company _____ Title _____</p> <p>Signature _____ Date _____</p>
--	--



Reference Drawings	
Security Screws	9951-005-001
Tinnermon Nuts	9951-007-001



INSTALLATION INSTRUCTIONS

- A- MOUNT FIXTURE TO WALL (1).
- B- ROUGH-IN FOR FLUSH VALVE SUPPLY (2) REFER TO FIXTURE INSTALLATION INSTRUCTIONS.
- C- INSTALL WALL ANCHORS (BY OTHERS) (3).
- D- INSTALL FLUSH VALVE (4) TO FIXTURE (1).
- E- ATTACH MOUNTING CLIPS (5) TO WALL USING MOUNTING SCREWS (6) (BY OTHERS).
- F- ATTACH -FVC FLUSH VALVE COVER PLATE (7) TO MOUNTING CLIPS (5) USING #10-32 BUTTON HEAD SCREW (8) (PROVIDED).



ACORN ENGINEERING COMPANY
P.O. BOX 3527, Industry, CA 91744
15125 Praeger Ave. Industry, CA 91746
(026) 338-4561 FAX (020) 961-2200

TITLE

-FVC-SLPT FLUSH VALVE COVER WITH SLOPING TOP #2802

MANUFACTURE DATE

FEBRUARY 1976

TO PRESENT

DATE ISSUED

03/07/11

DATE REVISED

12/12/12

DRAWING NUMBER

9908-397-001

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 07 53 23 – EPDM Roofing

Corresponding to RFQ Item: 51

SECTION 07 53 23 - EPDM ROOFING

1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered EPDM membrane roofing system.
2. Vapor retarder.
3. Roof insulation.

B. Related Sections:

1. Division 06 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
3. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
4. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

1.2 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
- D. Minimum Quality Standard:
1. Provide roofing system that meets the requirements of:
 - a. FM Global Fire/Windstorm Classification Class 1A-90.
 - b. FM Global Hail-Resistance Rating SH.

1.4 PREINSTALLATION ROOFING CONFERENCE

A. Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
 1. For adhesives and sealants, including printed statement of VOC content.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
 1. Base flashings and membrane terminations.
 2. Tapered insulation, including slopes.
 3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- C. Samples for Verification: For the following products, in manufacturer's standard sizes:
 1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
 2. Roof insulation.
 3. Termination bars.
 4. Insulation fasteners: Each type, length, and finish.
 5. Cover board fasteners: Each type, length, and finish.
- D. Qualification Data: For qualified Installer.
- E. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.
 1. Submit evidence of complying with performance requirements.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

- G. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.
- H. Field quality-control reports.
- I. Maintenance Data: For membrane roofing system to include in maintenance manuals.
- J. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- C. Source Limitations: Obtain components including roof insulation and fasteners for membrane roofing system from same manufacturer as membrane roofing] or as approved by membrane roofing manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

- A. Project Warranty: Submit two (2) executed copies of standard 2-year Roofing Warranty on form included at the end of this Section, covering work of this section including roofing membrane, membrane flashing, roof insulation, and roofing accessories, signed and countersigned by Installer (Roofer) and Contractor. Provide both labor and material in the warranty. Warranty will begin at date of substantial completion.
- B. Manufacturer's Warranty: Submit executed copy of roofing manufacturer's state approved Unlimited Service Warranty agreement covering the provision of both labor and material and including flashing and installation endorsement, signed by an authorized representative of EPDM sheet roofing system manufacturer.

1. 20 year continuous guarantee.
2. The sample form of the guarantee shall be delivered to the Architect from the manufacturer processed through the Contractor.
- C. The roofing manufacturer's guarantee/warranty shall guarantee at the manufacturer's own cost and expense, to make or cause to be made such repairs to/replacement of, to correct any and all faulty installations or materials of the roofing system from the deck up, to keep the roofing system in a watertight condition throughout the guarantee period. The guarantee shall not be prorated. This guarantee shall provide all necessary labor and materials to keep the roofing system in a watertight condition throughout the 20-year guarantee period. The manufacturer's specific exclusion shall be itemized, reviewed, and approved by the Owner. The fully executed guarantee shall be delivered to the Architect prior to Final Acceptance of the Work.
- D. The definition of the roofing systems which are to be specified and guaranteed in the appropriate Section of the Specifications includes the materials and methods used from the deck up. Items typically excluded from the guarantee/warranty are the metal counterflashing, edging, caps and copings, vent covers (pre-manufactured), expansion joint covers and roof drain assemblies.

2. PRODUCTS

2.1 EPDM MEMBRANE ROOFING

- A. EPDM: ASTM D 4637, Type I, non-reinforced, uniform, flexible EPDM sheet.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products.
 - c. Versico Incorporated.
 2. Thickness: 60 mils, nominal.
 3. Exposed Face Color: Black.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

- A. Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesive: 80 g/L.
 - f. Single-Ply Roof Membrane Sealants: 450 g/L.

- g. Nonmembrane Roof Sealants: 300 g/L.
- h. Sealant Primers for Nonporous Substrates: 250 g/L.
- i. Sealant Primers for Porous Substrates: 775 g/L.
- j. Other Adhesives and Sealants: 250 g/L.
- B. Sheet Flashing: 60-mil-thick EPDM, partially cured or cured, according to application.
- C. Bonding Adhesive: Manufacturer's standard, water based.
- D. Seaming Material:
 - 1. Single-component, butyl splicing adhesive and splice cleaner
 - 2. Manufacturer's standard, synthetic-rubber polymer primer and 3-inch-wide minimum, butyl splice tape with release film.
- E. Lap Sealant: Manufacturer's standard, single-component sealant.
- F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- G. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.3 SUBSTRATE BOARD

- A. Substrate Board: One of the following:
 - 1. ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch thick.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) Georgia-Pacific Corporation; Dens Deck.
 - 2. Substrate Board: ASTM C 1278/C 1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate, 1/4 inch thick.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) USG Corporation; Securock.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.

2.4 VAPOR RETARDER

- A. Self-Adhering-Sheet Vapor Retarder: ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil- total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

2.5 ROOF INSULATION

- A. Preformed roof insulation boards manufactured or approved by EPDM membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.

~~B. Extruded Polystyrene Board Insulation: ASTM C 578, Type IV, 1.6 lb/cu. ft. minimum density, square edged.~~

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

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

- a. Atlas Roofing Corporation.
- b. Carlisle SynTec Incorporated.
- c. Firestone Building Products.
- d. GAF Materials Corporation.
- e. Insulfoam LLC; a Carlisle company.
- f. Johns Manville.
- g. Rmax, Inc.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

A. Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Cover Board: One of the following:

- 1. ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch thick.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) Georgia-Pacific Corporation; Dens Deck Prime.
- 2. Cover Board: ASTM C 1278/C 1278M, cellulosic-fiber reinforced, water-resistant gypsum substrate, 1/4 inch thick.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) USG Corporation; Securock.

2.7 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

3. EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

3.4 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 - 1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.

3.5 VAPOR RETARDER INSULATION

- A. Prime substrate board to receive vapor retarder.
- B. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches and 6 inches, respectively. Seal laps by rolling.

- C. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Where indicated or required, install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Install two layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.
 - 1. Set cover boards in a uniform coverage of full-spread adhesive, firmly pressing and maintaining in place.

3.7 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere membrane roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
- B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.
- E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeters.
- F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- G. Tape Seam Installation:
 - 1. Only taped seams are permitted. Do not use adhesive to make seams.

2. Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

H. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

- I. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.8 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- B. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 53 23

NOVEMBER 2012

REVISED ADDENDUM #4 – JANUARY 30, 2013

ROOFING WARRANTY

OWNER: _____

ADDRESS: _____

WHEREAS _____

Address _____

Telephone, _____

herein called the "Roofing Contractor", has performed roofing and flashing in accordance with the Contract Documents for Project No. _____, Part No. _____ (hereinafter called the "Work") under a Contract with the Owner.

Name of Project: _____

User Agency: _____

Location/Address: _____

Name and Type of Building: _____

Type(s) of Roof Deck(s): _____

Total Roof Area: _____ SF; Flashing, Edge: _____ LF; Base: _____ LF

Date of Acceptance: _____ Guarantee Period: 2 Years

Date of Expiration: _____

AND WHEREAS the Roofing Contractor has contracted to guarantee said work against water entry from faulty or defective materials and workmanship for the designated Guarantee period;

NOW THEREFORE the Roofing Contractor as the General Contractor guarantees, subject to the terms and conditions herein set forth, that during the Guarantee Period he will at his own cost and expense, make or cause to be made with approved procedures and materials such repairs to or replacements of said work resulting from water entry or faults or defects of said Work as are necessary to correct faulty and defective work and as are necessary to maintain said Work in watertight conditions and further to respond on or within two (2) working days upon written notification of leaks or defects by the Owner/User Agency.

NOVEMBER 2012

REVISED ADDENDUM #4 – JANUARY 30, 2013

This Guarantee is made subject to the following terms and conditions:

1. Specifically excluded from this guarantee are damages to the Work, other parts of the building and building contents caused by: A) lightning, windstorm (includes hurricanes and tornados), hailstorm, earthquakes and other unusual phenomena of the elements; B) fire; and C) structural failures causing excessive roof deck, edgings and related roof components movement. When the Work has been damaged by any of the foregoing causes, the Guarantee will be null and void until such damage has been repaired by the Roofing Contractor, and until the cost and expense thereof has been paid by the Owner or another responsible party so designated.
2. During the Guarantee Period, if the Owner/User Agency allows alteration of the Work by anyone other than a Contractor approved in writing by the Roofing Subcontractor, General Contractor, and Roofing Material Manufacturer prior to the work being performed, including cutting, patching and maintenance in connection with penetrations, attachment of other work, and positioning of anything on the roof, this Guarantee shall become null and void upon the date of said alterations. If the Owner/User Agency engages the Roofing Contractor to perform said alterations, the Guarantee shall not become null and void, unless the Roofing Contractor, prior to proceeding with said work, shall have notified the Owner/User Agency in writing, showing reasonable cause for claim that said alterations would likely damage or deteriorate the Work, thereby reasonably justifying a termination of this Guarantee.
3. The Owner/User Agency shall promptly notify the Roofing Contractor in writing of observed, known or suspected leaks, defects or deterioration and shall afford reasonable opportunity for the Roofing Contractor to inspect the Work, and to examine the evidence of such leaks, defects or deterioration.
4. This Guarantee is recognized to be the only guarantee of the General and Roofing Contractor on said work, and shall not operate to restrict or cut off the Owner from other remedies and recourses lawfully available to him in case of roofing failure. Specifically, this Guarantee shall not operate to relieve the Roofing Contractor of his responsibility for performance of the original work, regardless of whether the Contract was a Contract directly with the Owner or a Subcontract with the Owner's General Contractor.

IN WITNESS THEREOF, this instrument has been duly executed this _____
day of _____, 20____.

Roofing Contractor's Signature: _____

Typed Name: _____

Representing: _____

Telephone Number: _____

WITNESS _____

Telephone Number: _____

Witness: _____

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 32 92 00 Turf and Grasses

Corresponding to RFQ Item: 66

SECTION 32 92 00 TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Bid Scope Manual, and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- B. Section Includes:

1. Seeding.
2. ~~Sodding.~~
3. Lawn renovation.
4. Erosion-control material(s).

- C. Related Sections:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.

1.3 DEFINITIONS

- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- E. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.
- F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

- B. Product Data: For each type of product indicated.
- C. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each

species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod, identifying source, including name and telephone number of supplier.
- D. Qualification Data: For qualified landscape Installer.
- E. Product Certificates: For soil amendments and fertilizers, from manufacturer.
- F. Material Test Reports: For existing surface soil and imported topsoil.
- G. Planting Schedule: Indicating anticipated planting dates for each type of planting.
- H. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required initial maintenance periods.

1.5 QUALITY ASSURANCE

- B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.
 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
- C. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- D. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 1. Report suitability of topsoil for lawn growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

1.6 DELIVERY, STORAGE, AND HANDLING

- B. Seed: Deliver seed in original sealed, labeled, and undamaged containers.
- ~~C. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.~~

1.7 PROJECT CONDITIONS

- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.
1. Spring Planting: March - May.
 2. Fall Planting: September - November.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.8 MAINTENANCE SERVICE

- B. Initial Lawn Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
1. Seeded Lawns: 60 days from date of Substantial Completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.
 2. ~~Sodded Lawns: 30 days from date of Substantial Completion.~~

PART 2 - PRODUCTS

2.1 SEED

- B. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- C. Seed Species: State-certified seed of grass species, as follows:
- D. Seed Species, except baseball outfield: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
1. Full Sun: Bermudagrass (*Cynodon dactylon*).
 2. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
 3. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
 - b. 30 percent chewings red fescue (*Festuca rubra* variety).
 - c. 10 percent perennial ryegrass (*Lolium perenne*).
 - d. 10 percent redtop (*Agrostis alba*).

4. Shade: Proportioned by weight as follows:
 - a. 50 percent chewings red fescue (*Festuca rubra* variety).
 - b. 35 percent rough bluegrass (*Poa trivialis*).
 - c. 15 percent redtop (*Agrostis alba*).
- E. Seed Species, baseball outfield: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
 1. Outfield without irrigation system: Proportioned by weight as follows:
 - a. 85 percent fescue.
 - b. 10 percent rye.
 - c. 5 percent bluegrass.
 2. Outfield with irrigation system: Proportioned by weight as follows:
 - a. 70 percent bluegrass.
 - b. 30 percent rye.

~~2.2 TURFGRASS SOD~~

- ~~B. Turfgrass Sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with TPI's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.~~
- ~~C. Turfgrass Species, except baseball infield: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:~~
- ~~1. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.~~
 - ~~2. Sun and Partial Shade: Proportioned by weight as follows:~~
 - ~~a. 50 percent Kentucky bluegrass (*Poa pratensis*).~~
 - ~~b. 30 percent chewings red fescue (*Festuca rubra* variety).~~
 - ~~c. 10 percent perennial ryegrass (*Lolium perenne*).~~
 - ~~d. 10 percent redtop (*Agrostis alba*).~~
 - ~~3. Shade: Proportioned by weight as follows:~~
 - ~~a. 50 percent chewings red fescue (*Festuca rubra* variety).~~
 - ~~b. 35 percent rough bluegrass (*Poa trivialis*).~~
 - ~~c. 15 percent redtop (*Agrostis alba*).~~
- ~~D. Turfgrass Species, baseball infield: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:~~
- ~~1. 100 percent bluegrass with no netting.~~

2.3 TOPSOIL

- B. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones **1 inch (25 mm)** or larger in any dimension and other extraneous materials harmful to plant growth.
1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least **4 inches (100 mm)** deep; do not obtain from agricultural land, bogs or marshes.
 2. Topsoil Source: Import topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least **4 inches (100 mm)** deep; do not obtain from agricultural land, bogs or marshes.
 3. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Surface soil may be supplemented with imported or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least **4 inches (100 mm)** deep; do not obtain from agricultural land, bogs or marshes.

2.4 INORGANIC SOIL AMENDMENTS

- B. Lime: ASTM C 602, agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through **No. 8 (2.36-mm)** sieve and a minimum of 75 percent passing through **No. 60 (0.25-mm)** sieve.
 2. Class: O, with a minimum of 95 percent passing through **No. 8 (2.36-mm)** sieve and a minimum of 55 percent passing through **No. 60 (0.25-mm)** sieve.
 3. Provide lime in form of dolomitic limestone.
- C. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through **No. 6 (3.35-mm)** sieve and a maximum of 10 percent passing through **No. 40 (0.425-mm)** sieve.
- D. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- E. Aluminum Sulfate: Commercial grade, unadulterated.
- F. Perlite: Horticultural perlite, soil amendment grade.
- G. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

- H. Sand: Clean, washed, natural or manufactured, free of toxic materials.
- I. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- J. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.5 ORGANIC SOIL AMENDMENTS

- B. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch (19-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- D. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.
- E. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
 - 1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. (2.4 kg/cu. m) of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. (4 kg/cu. m) of loose sawdust or ground bark.
- F. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.6 PLANTING ACCESSORIES

- B. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

2.7 FERTILIZER

- B. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of [1] [4] percent nitrogen and [10] [20] percent phosphoric acid.
- C. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

- D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- E. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.8 MULCHES

- B. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- C. Peat Mulch: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- D. Peat Mulch: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.
- E. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: 50 to 60 percent of dry weight.
 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- F. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- G. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- H. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.9 EROSION-CONTROL MATERIALS

- B. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- C. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- D. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 4-inch (100 mm) nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Invisible Structures, Inc.; Slopetame 2.
 - b. Presto Products Company; Geoweb.
 - c. Tenax Corporation - USA; Tenweb.

2.10 PLANTING SOIL MIX

- B. Planting Soil Mix: Topsoil mixed with the following soil amendments and fertilizers in the following quantities:
 - 1. Ratio of Loose Compost to Topsoil by Volume: 1:3.
 - 2. Ratio of Loose Peat to Topsoil by Volume: 1:3.
 - 3. Weight of Lime per 1000 Sq. Ft. (92.9 Sq. m): 50 lbs.
 - 4. Volume of Sand Plus 10 Percent Diatomaceous Earth per 1000 Sq. Ft. (92.9 Sq. m) .
 - 5. Weight of Commercial Fertilizer per 1000 Sq. Ft. (92.9 Sq. m): 15 lbs.

PART 3 - EXECUTION

3.1 EXAMINATION

- B. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- B. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 2. Protect grade stakes set by others until directed to remove them.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN PREPARATION

- B. Limit lawn subgrade preparation to areas to be planted.
- C. Newly Graded Subgrades: Loosen subgrade to a minimum depth of **4 inches (100 mm)**. Remove stones larger than **1 inch (25 mm)** in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Apply superphosphate fertilizer directly to subgrade before loosening.
 2. Thoroughly blend planting soil mix off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 3. Spread planting soil mix to a depth of **4 inches (100 mm)** but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Spread approximately 1/2 the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top **2 inches (50 mm)** of subgrade. Spread remainder of planting soil mix.
 - b. Reduce elevation of planting soil to allow for soil thickness of sod.
- D. Unchanged Subgrades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 2. Loosen surface soil to a depth of at least [**6 inches (150 mm)**] [**8 inches (200 mm)**]. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top [**4 inches (100 mm)**] [**6 inches (150 mm)**] of soil. Till soil to a homogeneous mixture of fine texture.
 - a. Apply superphosphate fertilizer directly to surface soil before loosening.
 3. Remove stones larger than **1 inch (25 mm)** in any dimension and sticks, roots, trash, and other extraneous matter.
 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- E. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus **1/2 inch (13 mm)** of finish

elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

- F. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- G. Before planting, restore areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- B. Prepare area as specified in "Lawn Preparation" Article.
- C. For erosion-control mats, install planting mix in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- D. Fill cells of erosion-control mat with planting mix and compact before planting.
- E. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- F. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

- B. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- C. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft. (1.4 to 1.8 kg/92.9 sq. m).
- D. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.
- E. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.
- F. Protect seeded areas with erosion-control mats where shown, installed and anchored according to manufacturer's written instructions.
- G. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

- H. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch or peat mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a depth of ~~3/16 inch~~ (4.8 mm), and roll surface smooth.

3.6 SODDING

- ~~B. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.~~
- ~~C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.~~
 - ~~1. Lay sod across angle of slopes exceeding 1:3.~~
 - ~~2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.~~
- ~~D. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.~~

3.7 LAWN RENOVATION

- B. Renovate existing lawn.
- C. Renovate existing lawn damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish lawn where settlement or washouts occur or where minor regrading is required.
 - 2. Provide new topsoil as required.
- D. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury in soil.
- E. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.
- F. Mow, dethatch, core aerate, and rake existing lawn.
- G. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- H. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

- I. Till stripped, bare, and compacted areas thoroughly to a soil depth of **6 inches (150 mm)**.
- J. Apply soil amendments and initial fertilizers required for establishing new lawns and mix thoroughly into top **4 inches (100 mm)** of existing soil. Provide new planting soil to fill low spots and meet finish grades.
- K. Apply seed and protect with straw mulch as required for new lawns.
- L. Water newly planted areas and keep moist until new lawn is established.

3.8 LAWN MAINTENANCE

- B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn. Provide materials and installation the same as those used in the original installation.
 - 1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
- C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of **4 inches (100 mm)**.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water lawn with fine spray at a minimum rate of **1 inch (25 mm)** per week unless rainfall precipitation is adequate.
- D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - 1. Mow grass to a height of **2 to 3 inches (50 to 75 mm)**.
- E. Lawn Postfertilization: Apply fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that will provide actual nitrogen of at least **1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m)** to lawn area.

3.9 SATISFACTORY LAWNS

- B. Lawn installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any **10 sq. ft. (0.92 sq. m)** and bare spots not exceeding **5 by 5 inches (125 by 125 mm)**.

- 2. Satisfactory Sodded Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.
- C. Use specified materials to reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.10 CLEANUP AND PROTECTION

- B. Promptly remove soil and debris, created by lawn work, from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after lawn is established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 32 93 00 Plants

Corresponding to RFQ Item: 67

SECTION 32 93 00 PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Bid Scope Manual, and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- B. Section Includes:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Ground cover.
 - 4. Plants.
 - 5. Tree stabilization.
- C. Related Sections:
 - 1. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
 - 2. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
 - 3. Division 32 Section "Turf and Grasses" for lawn and meadow planting.

1.3 DEFINITIONS

- B. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- C. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
- D. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.
- E. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.
- F. Clump: Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.
- G. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining

a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.

- H. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.
- I. Finish Grade: Elevation of finished surface of planting soil.
- J. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- K. Multi-Stem: Where three or more main stems arise from the ground from a single root crown or at a point right above the root crown.
- L. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- M. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- N. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

- B. Product Data: For each type of product indicated.
- C. Qualification Data: For qualified landscape Installer.
- D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Material Test Reports: For existing surface soil and imported topsoil.
- F. Planting Schedule: Indicating anticipated planting dates for exterior plants.
- G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.

1.5 QUALITY ASSURANCE

- B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
- C. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- D. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 1. Report suitability of topsoil for plant growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
- E. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
 1. Selection of exterior plants purchased under allowances will be made by Architect, who will tag plants at their place of growth before they are prepared for transplanting.
- F. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above the ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.
- G. Observation: Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 1. Notify Architect of sources of planting materials seven (7) days in advance of delivery to site.
- H. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

- B. Deliver exterior plants freshly dug.
 1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- C. Do not prune trees and shrubs before delivery except as approved by Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery and handling.

- D. Handle planting stock by root ball.
- E. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 PROJECT CONDITIONS

- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. Spring Planting: March-May
 - 2. Fall Planting: September-Mid December
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed according to manufacturer's written instructions and warranty requirements.
- D. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns unless otherwise acceptable to Architect.
 - 1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

1.8 WARRANTY

- B. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty operation of tree stabilization.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Periods from Date of Substantial Completion:

- a. Trees and Shrubs: One year.
 - b. Ground Cover and Plants: One year.
3. Include the following remedial actions as a minimum:
 - a. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
 - b. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each exterior plant will be required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for replaced plant materials; warranty period equal to original warranty period.

1.9 MAINTENANCE SERVICE

- B. Initial Maintenance Service for Trees and Shrubs: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.
 1. Maintenance Period: 12 months from date of Substantial Completion.
- C. Initial Maintenance Service for Ground Cover and Plants: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.
 1. Maintenance Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- B. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- C. Provide trees and shrubs of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- D. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1.
- E. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name.

- F. Label at least one tree and one shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.
- G. If formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height and spread, and number label to assure symmetry in planting.

2.2 SHADE AND FLOWERING TREES

- B. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.
 - 1. Provide balled and burlapped trees.
 - 2. Branching Height: One-third to one-half of tree height.
- C. Small Upright Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
 - 1. Stem Form: As noted on the plant schedule.
 - 2. Provide balled and burlapped trees.
- D. Small Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
 - 1. Stem Form: As noted on the plant schedule.
 - 2. Provide balled and burlapped trees.

2.3 DECIDUOUS SHRUBS

- B. Form and Size: Shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
 - 1. Shrub sizes indicated are sizes after pruning.
 - 2. Provide balled and burlapped or container-grown shrubs.

2.4 CONIFEROUS EVERGREENS

- B. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.
- C. Form and Size: Specimen quality as described, symmetrically shaped coniferous evergreens.
 - 1. Shearing Designation: Semi-sheared or lightly sheared (LS).
 - 2. Provide balled and burlapped trees.

2.5 BROADLEAF EVERGREENS

- B. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.
- C. Form and Size: Specimen quality as described, symmetrically shaped broadleaf evergreens.
 - 1. Shearing Designation: Semi-sheared or lightly sheared (LS).
 - 2. Provide balled and burlapped or container-grown trees as noted on the plant schedule.

2.6 GROUND COVER PLANTS

- B. Ground Cover: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1 and the following requirements:

2.7 PLANTS

- B. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery[and that are in bud but not yet in bloom].
- C. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed, complying with requirements in ANSI Z60.1.
- D. Vines: Provide vines of species indicated complying with requirements in ANSI Z60.1 as follows:
 - 1. Two-year plants with heavy, well-branched tops, with not less than 3 runners 18 inches (450 mm) or more in length, and with a vigorous well-developed root system.
 - 2. Provide field-grown vines. Vines grown in pots or other containers of adequate size and acclimated to outside conditions will also be acceptable.

2.8 TOPSOIL

- B. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 2 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally

well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs or marshes.

2. Topsoil Source: Import topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs or marshes.
3. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Surface soil may be supplemented with imported or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs or marshes.

2.9 INORGANIC SOIL AMENDMENTS

- B. Lime: ASTM C 602, agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
 2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.
 3. Provide lime in form of dolomitic limestone.
- C. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.
- D. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- E. Aluminum Sulfate: Commercial grade, unadulterated.
- F. Perlite: Horticultural perlite, soil amendment grade.
- G. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.
- H. Sand: Clean, washed, natural or manufactured, free of toxic materials.
- I. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- J. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.10 ORGANIC SOIL AMENDMENTS

- B. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch (13-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- D. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.
- E. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
 - 1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. (2.4 kg/cu. m) of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. (4 kg/cu. m) of loose sawdust or ground bark.
- F. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.11 FERTILIZER

- B. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 10 percent phosphoric acid.
- C. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- D. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- E. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.12 MULCHES

- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.

2.13 TREE STABILIZATION MATERIALS

- B. Stakes and Guys:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
3. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch (2.7 mm) in diameter.
4. Hose Chafing Guards: Reinforced rubber or plastic hose at least 1/2 inch (13 mm) in diameter, black, cut to lengths required to protect tree trunks from damage.
5. Guy Cables: 5-strand, 3/16-inch- (4.8-mm-) diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches (75 mm) long, with two 3/8-inch (10-mm) galvanized eyebolts.
6. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

- C. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.

2.14 ~~METAL TRELLIS SYSTEM~~

- ~~B. Provide metal trellis system wall mounted to the building in 4 locations per the drawings. Trellis shall form a grid pattern for the purposes of supporting climbing vines as per the planting plans. Attach trellis system to the building per manufacturers' instructions, recommendations and specifications. Provide all necessary accessories including mounting clips, anchors, fasteners, edge trim, spacers and post caps. Refer to architectural drawings for lengths and Heights of the trellis~~

- ~~1. Basis of Design: 'Greenscreen' 1-800-450-3494.~~
 - ~~a. Trellis system to consist of rigid, three dimensional welded wire grid panels fabricated of 24 gauge galvanized steel wire. Wire shall be welded at each~~

~~intersection to form 2 x 2 inch face grid on the front and back panels. Metal components to be factory finished after fabrication.~~

~~b. Color to be Wrinkle Green.~~

~~2. Submittals:~~

~~a. Submit manufacturer's product data, standard details, and installation instructions.~~

~~b. Submit shop drawings showing sizes, critical dimensions and layout.~~

~~c. Submit color samples of product.~~

2.15 MISCELLANEOUS PRODUCTS

- B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- C. Trunk-Wrap Tape: Two layers of crinkled paper cemented together with bituminous material, 4-inch- (100-mm-) wide minimum, with stretch factor of 33 percent.

2.16 PLANTING SOIL MIX

- B. Planting Soil Mix: Mix topsoil with the following soil amendments[and fertilizers] in the following quantities:
 - 1. Ratio of Loose Compost to Topsoil by Volume: 1:3.
 - 2. Ratio of Loose Peat to Topsoil by Volume: 1:3.
 - 3. Ratio of Loose Wood Derivatives to Topsoil by Volume: 1:3.
 - 4. Weight of Lime per 1000 Sq. Ft. (92.9 Sq. m): 20 pounds.
 - 5. Volume of Sand Plus 10 Percent Zeolites per 1000 Sq. Ft. (92.9 Sq. m): 20 per cent by volume.
 - 6. Weight of Bonemeal per 1000 Sq. Ft. (92.9 Sq. m): 20 pounds.
 - 7. Weight of Superphosphate per 1000 Sq. Ft. (92.9 Sq. m): 5 pounds.
 - 8. Weight of Commercial Fertilizer per 1000 Sq. Ft. (92.9 Sq. m): 20 pounds.
- C. Planter Soil Mix: 1 part topsoil, 1 part coarse sand, 1 part peat, and 3 lb (1.36 kg) of dolomitic limestone per cubic yard (cubic meter) of mix.

PART 3 - EXECUTION

3.1 EXAMINATION

- B. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- B. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- D. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before planting. Make minor adjustments as required.
- E. Lay out exterior plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- F. Trunk Wrapping: Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling.
- G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING BED ESTABLISHMENT

- B. Loosen subgrade of planting beds to a minimum depth of 6 inches (150 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening.
 - 2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 - 3. Spread planting soil mix to a depth of 4 inches (100 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

- a. Spread approximately one-half the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil mix.
- C. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- D. Before planting, restore planting beds if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

- B. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.
 - 1. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.
 - 2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 - 3. If drain tile is shown or required under planted areas, excavate to top of porous backfill over tile.
- C. Subsoil removed from excavations may be used as backfill.
- D. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 - 1. Hardpan Layer: Drill 6-inch- (150-mm-) diameter holes, 24 inches (600 mm) apart, into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free-draining material.
- E. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- F. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE AND SHRUB PLANTING

- B. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.
- C. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball 1 inch (25 mm) above adjacent finish grades.
 - 1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled,

water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

- D. Set container-grown stock plumb and in center of pit or trench with top of root ball 1 inch (25 mm) above adjacent finish grades.
 - 1. Carefully remove root ball from container without damaging root ball or plant.
 - 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
- E. Organic Mulching: Apply 3-inch (75-mm) average thickness of organic mulch extending 12 inches (300 mm) beyond edge of planting pit or trench. Do not place mulch within 3 inches (75 mm) of trunks or stems.
- F. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling.
- G. Trunk Wrapping: Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling.

3.6 TREE AND SHRUB PRUNING

- B. Remove only dead, dying, or broken branches. Do not prune for shape.
- C. Prune, thin, and shape trees and shrubs as directed by Architect.
- D. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character.

3.7 TREE STABILIZATION

- B. Trunk Stabilization: Unless otherwise indicated, provide trunk stabilization as follows:
 - 1. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1830 mm) or one third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

2. Use 2 stakes for trees up to 12 feet (3.6 m) high and 2-1/2 inches (63 mm) or less in caliper; 3 stakes for trees less than 14 feet (4.2 m) high and up to 4 inches (100 mm) in caliper. Space stakes equally around trees.
 3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 4. Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- C. Guying and Staking: Guy and stake trees exceeding 14 feet (4.2 m) in height and more than 3 inches (75 mm) in caliper unless otherwise indicated. Securely attach no fewer than 3 guys to stakes 30 inches (760 mm) long, driven to grade.
1. For trees more than 6 inches (150 mm) in caliper, anchor guys to pressure-preservative-treated deadmen 8 inches (200 mm) in diameter and 48 inches (1200 mm) long buried at least 36 inches (900 mm) below grade. Provide turnbuckle for each guy wire and tighten securely.
 2. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 3. Support trees with strands of cable or multiple strands of tie wire encased in hose sections at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 4. Attach flags to each guy wire, 30 inches (760 mm) above finish grade.
 5. Paint turnbuckles with luminescent white paint.
- D. Root-Ball Stabilization: Unless otherwise indicated, provide at- or below-grade stabilization system to secure each new planting by the root ball.
1. Wood Hold-Down Method: Horizontal wood hold-down stake placed across top of root ball and screwed at each end to a vertical stake against side of root ball and driven into subsoil.
 - a. Provide stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation. Saw stakes off at horizontal stake.
 - b. Install screws through horizontal hold-down and penetrating at least 1 inch (25 mm) into stakes. Predrill holes if necessary to prevent splitting wood.
 - c. Install second set of stakes on other side of root trunk for larger trees as indicated.

3.8 GROUND COVER AND PLANT PLANTING

- B. Set out and space ground cover and plants as indicated.
- C. Dig holes large enough to allow spreading of roots and backfill with planting soil.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING BED MULCHING

- B. Mulch backfilled surfaces of planting beds and other areas indicated. Provide mulch ring around trees in lawn areas.
 - 1. Organic Mulch: Apply 2-inch (50-mm) average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.10 PLANT MAINTENANCE

- B. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, adjusting and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.
- C. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings.

3.11 CLEANUP AND PROTECTION

- B. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- C. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

3.12 DISPOSAL

- B. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

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Specification Section 09 65 19 Resilient Flooring and Base

Corresponding to RFQ Item: 72

REVISED ADDENDUM #4 – JANUARY 30, 2013

SECTION 09 65 19 - RESILIENT FLOORING AND BASE

1. GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Vinyl composition floor tile.
2. Rubber wall base.
3. Transition strips.

1.2 SUBMITTALS

- A. Product data for each type of product specified.
- B. Samples for verification purposes in form of full-size tiles, 6" lengths of base units and transition strips, and accessories, of each different color and pattern, showing full range of variations expected in these characteristics.
- C. Maintenance data for resilient tile, base, and accessories, to include in Operating and Maintenance Manual specified in Division 01.

1.3 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Provide resilient floor products with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Critical Radiant Flux: 0.45 watts per sq cm or more per ASTM E 648.
 2. Smoke Density: Less than 450 per ASTM E 662.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material and installation accessories to Project site in original manufacturer's unopened cartons and containers each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store materials in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F and 90 deg F.
- C. Store materials on flat surfaces. Move materials and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.

1.5 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 70 deg F in spaces to receive products for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55 deg F.
- B. Do not install flooring materials until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during product installation.

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1.6 COORDINATION

- A. Coordinate installation of transitions strips with with other types of flooring work specified elsewhere in the Project Manual:
 - 1. Carpet.
 - 2. Quarry Tile.
 - 3. Resinous Flooring.
 - 4. Safety Padding.

1.7 SEQUENCING AND SCHEDULING

- A. Install flooring materials and accessories after other finishing operations, including painting, have been completed.
- B. Do not install products over concrete slabs until the slabs have cured and are sufficiently dry to bond with adhesive as determined by manufacturer's recommended bond and moisture test.

1.8 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
 - 1. Furnish not less than 5 percent of each color and pattern of resilient floor tile installed.
 - 2. Furnish not less than 5 percent of each different type and color of resilient wall base installed.

2. PRODUCTS

2.1 RESILIENT TILE (VC)

- A. Specific manufacturer's resilient tile is indicated to establish the required color, style and standard of quality, and is not intended to preclude the use of other acceptable manufacturers.
- B. Basis of Design: Imperial Texture Standard Excelon; Armstrong World Industries.
 - 1. Subjection to compliance with requirements, equivalent products of the following manufacturers will be considered for approval:
 - a. Mannington.
 - b. Johnsonite.
- C. Provide tile complying with ASTM F 1066, Class 2 – through-pattern.
 - 1. Size: 12 in. Wide x 12 in. Length x 1/8 in. overall (nominal).
 - 2. Colors/patterns as indicated on Finish Schedule.
- D. Static Load Limit: 125 psi per ASTM F 970.

2.2 RUBBER WALL BASE (RB)

- A. Specific manufacturer's base are indicated to establish the required color, style and standard of quality, and are not intended to preclude the use of other acceptable manufacturers.

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B. Basis of Design: Johnsonite Rubber Wall Base.

1. Subject to compliance with requirements, equivalent products of the following manufacturers will be considered for approval:
 - a. Roppe
 - b. Flexco

C. Provide rubber wall base products, complying with ASTM F-1861, Type TP and the following:

1. Thickness: Minimum 1/8 inch.
2. Height: 4 inches, unless otherwise noted.
3. Style: Coved unless otherwise indicated.
4. Corners:
 - a. Interior: Field Formed.
 - b. Exterior: Premolded.
5. Colors: As indicated on Finish Schedule.

2.3 TRANSITION STRIPS

A. Provide transition strips for each condition indicated on drawings.

1. Transition strip of width and height required to protect exposed edge and in maximum available lengths to minimize running joints.

B. Resilient Transition Strips:

1. TR-2: Carpet to VCT
 - a. Johnsonite Item No. CTA-49-H, 1/4" to 1/8" material. No substitution.
2. TR-3: VCT to VCT
 - a. Johnsonite Item No. CTA-49-N, 1/8" to 1/8" Material. No substitution.

C. Metal Transition Strips:

1. TR-6: Safety Padding to VCT
2. Schluter Systems Reno-V-B, Item No. AEVB30. No substitution.
3. Finish: Satin Anodized Aluminum

2.4 INSTALLATION ACCESSORIES

A. Moisture Mitigation Coating (over concrete slab): Only an epoxy coating system is acceptable.

1. Manufacturers:
 - a. Ardex
 - b. Koester

B. Trowelable Underlayment and Patching Compound: Latex-modified, portland-cement-based formulation provided or approved by manufacturer for applications indicated.

1. Basis of Design: Ardex Feather Finish

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- C. Adhesives (Cements): Water-resistant type recommended by manufacturer to suit resilient floor tile, base and stair products and substrate conditions indicated.

3. EXECUTION

3.1 EXAMINATION

- A. Examine areas where installation will occur, with Installer present, to verify that substrates and conditions are satisfactory for installation and comply with manufacturer's requirements and those specified in this Section.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. ~~Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by manufacturer.~~
 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- ~~C. Do not proceed with installation until unsatisfactory conditions have been corrected.~~
- D. Where slab moisture content is unacceptably high, use moisture mitigation coating applied in accordance with manufacturer's printed instructions and other recommendations.

3.2 PREPARATION

- A. Comply with manufacturer's installation specifications to prepare substrates indicated to receive flooring.
- B. Use trowelable leveling and patching compounds per manufacturer's directions to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- D. Broom or vacuum clean substrates to be covered by products immediately before installation. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

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3.3 INSTALLATION

- A. Comply with manufacturer's installation directions and other requirements indicated that are applicable to each type of product installation included in Project.
- B. Floor Tiles Installation Method: Quarter Turn.
- C. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths at perimeter that equal less than one-half of a tile. Install tiles square with room axis, unless otherwise indicated.
 - 1. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
 - 2. Scribe, cut, and fit tiles to butt tightly to vertical surfaces, permanent fixtures, built-in furniture including cabinets, pipes, outlets, edgings, thresholds, etc.
 - 3. Extend tiles into toe spaces, door reveals, closets, and similar openings.
 - 4. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.
 - 5. Adhere tiles to flooring substrates without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed tile installation.
 - 6. Use full spread of adhesive applied to substrate in compliance with tile manufacturer's directions including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 7. Hand roll tiles where required by tile manufacturer.
- D. Apply resilient wall base to walls, columns, pilasters, casework, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 1. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 2. Install inside and exterior corners before installing straight pieces.
- E. Place metal transition strips so they are butted to adjacent materials of type indicated and bond to substrates as required. Install transition strips at edges of flooring that otherwise would be exposed, and as indicated on drawings.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing installation:
 - 1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Do not wash floor until after time period recommended by manufacturer.
 - 4. Damp-mop to remove black marks and soil.
- B. Protect flooring, base, and accessories against marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during

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remainder of construction period. Use protection methods indicated or recommended by manufacturer.

1. Apply protective floor polish to surfaces that are free from soil, visible adhesive, and surface blemishes.
 - a. Coordinate selection of floor polish with Owner's maintenance service.
2. Cover products with undyed, untreated building paper until inspection for Substantial Completion.
3. Do not move heavy and sharp objects directly over products. Place plywood or hardboard panels over products and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09 65 19

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Specification Section 09 67 23 Resinous Flooring

Corresponding to RFQ Item: 73

SECTION 09 67 23 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resinous flooring.
 - 2. Resinous wall surfacing.
 - 3. Metal transition strip.
 - 4. Metal top cap.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous system required, 6 inches square, applied to a rigid backing by Installer for this Project.
- C. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.
- D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- E. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
 - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
 - 2. Contractor shall have completed at least 10 projects of similar size and complexity.
- B. Source Limitations:
 - 1. Obtain primary resinous flooring materials, including primers, resins, water proofing membranes, hardening agents, grouting coats, broadcast aggregates and topcoats through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section.
 - 2. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

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- C. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.
 - 1. Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.
- D. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Apply full-thickness mockups on 48-inch- square floor area selected by Architect.
 - a. Include 48-inch length of integral cove base.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Pre-installation Conference:
 - 1. Conduct a meeting not less than thirty days prior to starting work.
 - 2. Attendance:
 - a. General Contractor
 - b. Architect
 - c. Owner's Representative.
 - d. Resinous Flooring Manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.
- C. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
 - 1. Maintain material and substrate temperature between 65 and 85 deg F during resinous flooring application and for not less than 24 hours after application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

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- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

1.6 WARRANTY

- A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full years from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation.
 - 1. A sample warranty letter must be included with bid package or bid may be disqualified.

PART 2 - PRODUCTS

2.1 RESINOUS FLOORING

- A. RESINOUS FLOORING SYSTEM (RF-1)
 - 1. Basis of Design: Stontec TRF as manufactured by Stonhard, Inc.
 - 2. Composition: Nominal 3/16"/5mm thick system comprised of a penetrating three-component urethane primer, a high performance, four-component mortar consisting of urethane resin, curing agent, selected, graded aggregates and inorganic pigments, two-component, epoxy undercoat, brightly colored flake broadcast and two coats of a high performance, two-component, clear urethane UV resistant, aliphatic polyaspartic urethane sealer.
 - 3. Subject to compliance with requirements, equivalent products of the following manufacturers will be considered for approval:
 - a. Dex-O-Tex
 - b. General Polymers
- B. System Characteristics:
 - 1. Color and Pattern: Select from manufactures standards
 - 2. Wearing Surface: Clear epoxy sealer.
 - 3. Integral Cove Base: 4" (inches).
 - 4. Overall System Thickness: Nominal 3/16" (inch).
- C. System Components: Manufacturer's standard components that are compatible with each other and as follows:
 - 1. Primer:
 - a. Two part epoxy primer, 4-6 mils thick
 - 2. Body Coat(s):
 - a. Resin: Three part Epoxy Mortar
 - b. Formulation Description: 100 percent solids.
 - c. Thickness of Coats: 3/16".
 - d. Number of Coats: One.

- e. Aggregates: Pigmented Blended aggregate.
- 3. Undercoat(s):
 - a. Resin: Epoxy.
 - b. Type: Pigmented
 - c. Formulation Description: 100% high solids.
- 4. Broadcast Aggregate:
 - a. Multi-color vinyl flakes broadcast.
 - b. Number of broadcasts: To refusal.
- 5. Topcoats: Stontec Sealers
 - a. Resin: Epoxy
 - b. Formulation Description: 100% high solids.
 - c. Type: Clear gloss
 - d. Number of Coats: Two.

2.2 RESINOUS WALL SYSTEM (RW-1)

- A. Basis-of-Design Product: StonGlaze VSF as manufactured by Stonhard.
 - 1. Subject to compliance with requirements, equivalent products of the following manufacturers will be considered for approval:
 - a. Dex-O-Tex
 - b. General Polymers
- B. Nominal 60 mil / 1.5 mm surfacing system with broadcast flakes and clear topcoat.

2.3 ACCESSORY MATERIALS

- A. Moisture Mitigation Coating (over concrete slab): Only an epoxy coating system is acceptable.
 - 1. Manufacturers:
 - a. Ardex
 - b. Koester
- B. Primer: Type recommended by manufacturer for substrate and body coats indicated. Formulation Description: Stonhard Standard Primer, 100% solids.
- C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated. Resinous based materials only. Cementitious or single component products not accepted.

2.4 TRANSITIONS AND CAPS

- A. Metal Transition Strip, resinous flooring to VCT.
 - 1. Product: Schluter Systems, Schiene, Item No. AE30. No substitution.

2. Tile Thickness: 1/8"
 3. Finish: Satin Anodized Aluminum
 4. Leg of transition strip to be installed under VCT tile. Do not install leg under RF, in case removal is needed in future.
- B. Metal Top Cap of resinous wall surfacing.
1. Product: Schluter Systems, Jolly, Item No. AEVB30. No substitution.
 2. Thickness of Resinous wall: 3/8"
 3. Finish: Satin Nickel Anodized Aluminum (AT)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Mechanically prepare substrates as required by flooring manufacturer.
 - a. Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent.
 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
 3. Verify that concrete substrates are dry.
 - a. Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 85 percent.
 - b. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.
 - c. ~~Perform additional moisture tests recommended by manufacturer.~~ Proceed with application only after substrates pass testing.
 4. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
 5. Where slab moisture content is unacceptably high, use moisture mitigation coating applied in accordance with manufacturer's printed instructions and other recommendations.

- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.2 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - 3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
 - a. Apply joint sealant to comply with manufacturer's written recommendations.
- B. Apply primer where required by resinous system, over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply metal trowel single mortar coat in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
- D. Apply base coats and topcoats in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may at any time and any numbers of times during resinous flooring application require material samples for testing for compliance with requirements.
 - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.4 CLEANING, PROTECTING, AND CURING

- A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.
- B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.
- C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer

END OF SECTION 09 67 23

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Sketch SKC-1

Corresponding to RFQ Item: 80

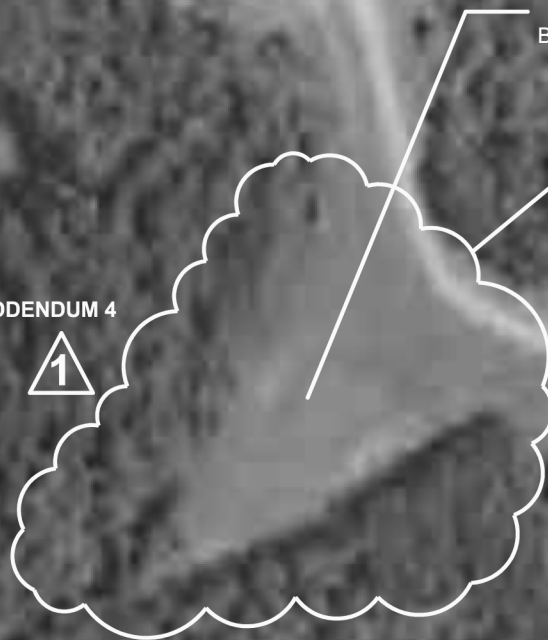
WILLIAM SHARPE
HOSPITAL


ADDITIONAL LAY DOWN AREA,
CONTRACTOR TO ADD GRAVEL
BASE AS NEEDED AT THE EXPENSE
OF THE CONTRACTOR

REMOVE GUARDRAIL AND
ALL APPURTENANCES AS
NEEDED FOR ACCESS TO
LAY DOWN AREA. STORE
PER OWNERS LOCATION.

1-30-2013 ADDENDUM 4

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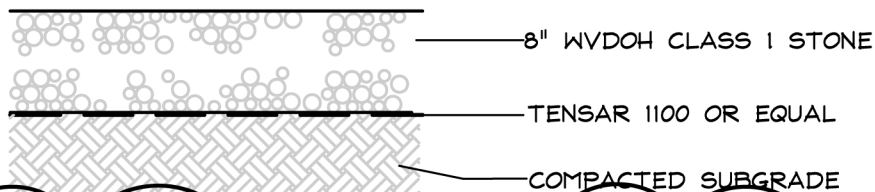
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Sketch SKC-2

Corresponding to RFQ Item: 81




9
C115

GRAVEL PARKING / CONSTRUCTION ROUTE

N.T.S.

1-30-2013 ADDENDUM 4
CHANGED NAME FROM

"TYPICAL GRAVEL FIRE ROAD-NOT USED" TO
"GRAVEL PARKING / CONSTRUCTION ROUTE "

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DATE:	SCALE:	2/7/2013	NTS	
JOB NO: 04-12-0237		SKC - 2		

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Specification Section 22 13 16 – Sanitary Waste and Vent Piping

Corresponding to RFQ Item: 82

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Division 20 – Mechanical, Electrical and Plumbing General Requirements applies to and forms a part of all specifications. Articles of this section shall govern unless superseded by specific stipulations of that Division of the Specifications.
- C. General notes on all drawings apply to and form a part of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.
 - 3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Architect and Owner no fewer than five days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Architect's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Caulking Materials: ASTM B 29, hemp fiber.

2.3 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Copper Pressure Fittings:
 - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- ~~B. Cellular Core PVC Pipe: ASTM F 891, Schedule 40.~~

- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
 - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Solvent Cement: ASTM D 2564.
 - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Fernco Inc.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - 3) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
 - 4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.

- b. Standard: ASTM C 1460.
- c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in other Sections of specifications.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install all piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.

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- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Install steel piping according to applicable plumbing code.
- O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- P. Install aboveground PVC piping according to ASTM D 2665.
- Q. Install underground PVC piping according to ASTM D 2321.
- R. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
 - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 20 Section "Sleeves and Sleeve Seals for MEP/FP Piping, Raceways and Cabling."

- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 20 Section "Sleeves and Sleeve Seals for MEP/FP Piping, Raceways and Cabling."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 20 Section "Escutcheons for Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Unshielded, nonpressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for restraint devices specified in Division 20 Section "Vibration Controls for MEP/FP Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Division 20 Section "Hangers and Supports for HVAC and Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.

- 4. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
- G. Install supports for vertical copper tubing every 10 feet.
- H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 - 2. NPS 3: 48 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
- I. Install supports for vertical PVC piping every 48 inches.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Comply with requirements for cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
 6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Identification for HVAC and Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

- A. Aboveground, soil and waste piping NPS 4 shall be the following:
 1. Copper DWV tube, copper drainage fittings, and soldered joints.
 2. Solid-wall or ~~Cellular-core~~ PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- B. Aboveground, vent piping NPS 4 shall be any of the following:
 1. Solid-wall or ~~Cellular-core~~ PVC pipe, PVC socket fittings, and solvent-cemented joints.
 2. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- C. Underground, soil, waste, and vent piping NPS 4 shall be the following:
 1. Service class, cast-iron soil piping; gaskets; and gasketed caulking materials; and caulked joints. **All underground grease lines from floor drain to inlet of grease interceptor shall be cast-iron piping.**

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2. Solid wall ~~or Cellular-core~~ PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.

END OF SECTION 22 13 16

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 23 31 13 – Metal Ducts

Corresponding to RFQ Item: 83

SECTION 23 31 13 – METAL DUCTS

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.
- B. Division 20 – Mechanical, Electrical and Plumbing General Requirements applies to and forms a part of all specifications. Articles of this section shall govern unless superseded by specific stipulations of that Division of the Specifications.
- C. General notes on all drawings apply to and form a part of the Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Double-wall rectangular ducts and fittings.
 - 3. Single-wall round ducts and fittings.
 - 4. Double-wall round ducts and fittings.
 - 5. Sheet metal materials.
 - 6. Sealants and gaskets.
 - 7. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

- D. Mechanical Contractor shall coordinate with TAB Contractor for duct leakage testing requirements.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Sealants and gaskets.
- B. Shop Drawings:
 - 1. Penetrations through fire-rated and other partitions.
 - 2. Equipment installation based on equipment being used on Project.
 - 3. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- D. Welding certificates.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

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- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. McGill AirFlow LLC.
 - 2. Sheet Metal Connectors, Inc.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular

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Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F (24 deg C) mean temperature.
- G. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.
- H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved,

duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Lindab Inc.
 2. McGill AirFlow LLC.
 3. SEMCO Incorporated.
 4. Sheet Metal Connectors, Inc.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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- a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch- (2.4-mm-) diameter perforations, with overall open area of 23 percent.
- D. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F (24 deg C) mean temperature.

2.5 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G90 (Z275).
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Factory- or Shop-Applied Antimicrobial Coating:
1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 5. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.6 SEALANT

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature, but includes tapes and combinations of open-weave fabric strips and mastics.
 1. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
 2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, use O.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

- C. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- D. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

- A. All ducts shall be galvanized steel.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round: 6.
 - 2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 6.
 - c. SMACNA Leakage Class for Round: 3.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 16.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg (250 Pa).
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 6.
2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 3.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

~~F. Double Wall Duct Interstitial Insulation:~~

- ~~1. Supply Air Ducts: 1 inch thick.~~

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

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- a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

H. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
- 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

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50 Bed Addition

Specification Section 23 25 00 – HVAC Water Treatment

Corresponding to RFQ Item: 84

SECTION 23 25 00 – HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 20 – Mechanical, Electrical and Plumbing General Requirements applies to and forms a part of all specifications. Articles of this section shall govern unless superseded by specific stipulations of that Division of the Specifications.
- C. General notes on all drawings apply to and form a part of the Specifications.

1.2 SUMMARY

- A. This Section includes water-treatment systems for the extension of the existing chilled- and hot-heating water systems:
 - 1. Mechanical Contractor shall be responsible for furnishing and installing one of the following inhibited 30% propylene glycol and deionized water. The glycol solution shall provide freeze protection to 9°F above zero for entire system. Mechanical Contractor shall chemically clean and flush new piping. Mechanical contractor shall furnish temporary circulator and temporary power for cleaning process and circulation of glycol mixture during filling.
- B. Equipment shall have a minimum 2 year parts and labor warranty.
- C. Approved Glycol Products and Manufacturers:
 - 1. DOWFROST® HD – Dow Chemical Company Midland, MI
 - 2. PROTOCOL® NT – Glycol Technologies, Warrendale, PA.

1.3 SYSTEM DESCRIPTION

- A. Closed System: Maintain system essentially free of scale, corrosion, and fouling to sustain the following water characteristics:
 - 1. < 50 ppm as Sulfate, < 50 ppm as Chloride, < 60 ppm total hardness
 - 2. <5 ppm as Copper, < 5 ppm as Iron

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

- B. Product data for each type of product specified. Include manufacturer's technical product data, furnished specialties, accessories, and installation and startup instructions.
- C. Field test reports indicating and interpreting test results relative to compliance with specified requirements.
- D. Maintenance data to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions.

1.5 QUALITY ASSURANCE

- A. Supplier Qualifications: A recognized glycol manufacturer and chemical water treatment supplier with warehousing facilities in the Project's vicinity and that is or employs an experienced consultant, available at reasonable times during the course of the Work to consult with Contractor, Engineer, and Owner about water treatment.
- B. Chemical Standards: Meet state and local pollution-control regulations.
- C. Comply with NFPA 70 for components and installation.
- D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- E. Manufacturer of the DOWFROST® HD or PROTOCOL® NT product shall make available inhibitor additive packages to ensure a minimum ortho-phosphate concentration of 2,000 mg/l as PO₄ is achieved in the resulting 30 vol. % solution of glycol and deionized water solution.
- F. The system shall have an 8 inch by 10 inch metal system nameplate and shall contain the following information:
 - 1. Date of original glycol charge.
 - 2. Description of the heat transfer fluid.
 - 3. Manufacturer's names, address, and telephone number.
 - 4. Percentage of propylene glycol.
 - 5. Freeze point and burst point chart.
 - 6. Total system gallons.
 - 7. Reference to Material Safety Data Sheets.
 - 8. Instructions for sampling of the fluid.
 - 9. Month of annual sampling and analytical testing.
 - 10. Mailing instructions.

1.6 MAINTENANCE

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- A. Glycol supplier is required to perform a complete and comprehensive glycol analysis of the glycol water solution on an annual basis without charge to the system owner for the lifetime of the fluid.
- B. Manufacturer of the DOWFROST® HD or PROTOCOL® NT product shall make available inhibitor additive packages to ensure a minimum ortho-phosphate concentration of 2,000 mg/l as PO₄ is achieved in the resulting 30 vol. % solution of glycol and deionized water.

1.7 SERVICE PERIOD

- A. Provide chemicals and service program for period of two years from Substantial Completion date, including the following:
 - 1. Initial baseline glycol solution analysis report.
 - 2. Startup assistance.
 - 3. Training of operating personnel.
 - 4. Periodic field service and consultation.
 - 5. Laboratory technical assistance.

1.8 EXTRA MATERIALS

- A. Glycol: Furnish one 55-gallon drum of DOWFROST® HD or PROTOCOL® NT, 30% solution premixed with deionized water. This premixed version will be used for system make up and is to be added to the glycol feed system as required after the initial startup.

PART 2 - PRODUCTS

2.1 CHEMICAL TREATMENT, TESTS AND TEST EQUIPMENT

- A. Glycol supplier is to provide an initial glycol solution baseline report 2 to 4 weeks after the piping systems are placed into service and to provide an annual analysis report each year afterwards for the life of the fluid.
- B. System Cleaner: Liquid Cleaner with emulsifying agents and detergents to remove grease and petroleum products.
 - 1. MD-710 as manufactured by M & P Technologies.
 - 2. SC-101 as manufactured by Glycol Technologies.
- C. Closed System (Water) Chemicals: Only those products that comply with Setion 1.3; subsection A.2.
- D. Heat transfer fluid for the closed loop system shall be a 30% by volume solution of DOWFROST HD or PROTOCOL NT.

- E. Glycol supplier shall provide the Owner with a refractometer and training for its proper use in sampling and testing the glycol concentration.

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping adjacent to equipment to allow servicing and maintenance.
 - 2. Water Piping: Conform to applicable requirements of Division 23 Section "Hydronic Piping."

3.2 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris; repair damaged finishes, including chips, scratches, and abrasions.
- B. When initially filling the systems for cleaning, the water used for filling shall be metered. Ensure that system is operational, filled, started, and vented prior to cleaning. Place terminal control valves in OPEN position during cleaning. When draining the system after cleaning and flushing, the amount of water removed shall be metered and compared to the initial metered fill volume to determine how much trapped water still remains in the systems.
- C. Perform the following procedure for cleaning, flushing and filling the piping systems:
 - 1. Fill the piping system with fresh water with all air bleeds in the open position to remove all air from the system and circulate for 30 minutes. Drain the entire system as quickly as possible through the low point drains to remove as much loose residue and debris as possible. Contractor shall meter the water volume during the fill and drain process to determine how much trapped water still remains in the systems.
 - 2. Refill the piping system with fresh water with all air bleeds in the open position to remove all air from the system. Add cleaner to the piping system as recommended by the manufacturer to achieve the recommended concentration.
 - 3. Heat the cleaning solution to the temperature recommended by the manufacturer. If this temperature is not practical, heat the water to the highest possible temperature.
 - 4. Circulate the cleaning solution for 60 minutes then test the pH. Continue circulating and testing the pH of the cleaning solution until the pH reaches 8.0 indicating the cleaning solution is spent. If the fluid cannot be heated to the manufacturers recommended temperature, the cleaning solution shall be circulated for a minimum of 24 hours, regardless of the pH readings.

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5. Discontinue the circulation and drain the system as quickly as possible through the low point drains and flush the system a minimum of three (3) times until no foaming is evident and the water runs clear.
 6. Once the system is cleaned and flushed, the Contractor shall inform the Engineer by means of a written letter. The letter shall state that the systems have been cleaned to the satisfaction of these specifications and of the glycol manufacturers requirements.
- D. After the cleaning and flushing of piping systems is complete, completely fill piping systems with 30% solution of inhibited DOWFROST HD or PROTOCOL NT propylene glycol and deionized water in accordance with this specification.

3.3 COMMISSIONING

- A. Startup Services: Provide the services of a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.
- B. Startup Procedures: During system startup and tie into to existing piping systems, operate existing glycol feed system to maintain proper fill of the systems and glycol concentration.

3.4 DEMONSTRATION

- A. Provide services of supplier's technical representative for one hour to instruct Owner's personnel in operation, maintenance, and testing procedures of glycol solution.
- B. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- C. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance."

END OF SECTION 23 25 00

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50 Bed Addition

Specification Section 23 74 10 – Custom Outdoor Air-Handling Units

Corresponding to RFQ Item: 85

SECTION 23 74 10 – CUSTOM OUTDOOR AIR-HANDLING UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Division 20 – Mechanical, Electrical and Plumbing General Requirements applies to and forms a part of all specifications. Articles of this section shall govern unless superseded by specific stipulations of that Division of the Specifications.
- C. General notes on all drawings apply to and form a part of the Specifications.

1.2 SUMMARY

- A. This Section includes custom outdoor air handling heating and cooling units.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections. ***If Custom Outdoor Air Handler Submittals are rejected more than once then the Submitting Contractor's application for payment shall be reduced by \$3,500 to pay the Engineer for his service before the re-submittal is reviewed. No time extension will be granted for project completion resulting from the submittals being rejected. In addition for each re-submittal thereafter the Submitting Contractor's application for payment shall be reduced by amounts stipulated above.***
- B. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail the mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Wiring diagrams shall be both point to point and ladder diagrams. Wiring shall be color coded and marked with three digit identification on each end. Diagrams shall also be laminated in plastic and permanently fixed to the control compartment door. Installation and maintenance manuals shall be supplied with each unit, located in a metal pocket in the control access compartment. AHU's equipment shall be single point electrical connection. Unit manufacturer shall provide disconnects, variable frequency drives, and other electrical components factory installed and wired.

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2. **Outdoor Units shall be painted with a color selected by the Architect from manufacturer's standard color selections.** Unit manufacturer shall submit color chart for Architect to select or match color selected by Architect to match other elements of the project at no additional cost.

NOTE: Equipment other than referred standard shall be fully coordinated among trades due to differences in characteristics such as dimension or weight. All costs associated with such changes shall be borne by the Contractor solely including additional engineering fees.

- D. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.
- E. Maintenance Data: For equipment to include in the maintenance manuals specified in Division 20 Section "General Mechanical and Electrical Requirements."
- F. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE/REFERENCES

- A. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- B. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- D. Comply with NFPA 70 and NFPA 101.
- E. Unit shall be ETL Listed as a complete assembly.
- F. AMCA Standard 99: Standards Handbook
- G. AMCA /ANSI Standard 204: Balance Quality and Vibration Levels for Fans
- H. AMCA Standard 210: Laboratory Methods of Testing Fans for Ratings
- I. AMCA Standard 300: Reverberant Room Method for Sound Testing of Fans
- J. AMCA Standard 500: Test Methods for Louvers, Dampers and Shutters
- K. ARI Standard 410: Forced-Circulation Air-Cooling and Air-Heating Coil
- L. ASHRAE Standard 52.2: Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter
- M. ASHRAE/ANSI Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems

- N. UL Standard for Heating and Cooling Equipment
- O. ASTM A-525: Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver air handling units broken down as required for shipping and contractor assembly. Unit sections and connection shall be provided with protective crating and covering.
- B. Coordinate delivery of units in sufficient time to allow for installation.
- C. Handle air handling units to comply with manufacturers written rigging and installation instructions for unloading and moving to final location.

1.6 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed. Warranty period shall be:
 - 1. Manufacturer shall warrant all equipment provided by Manufacturer that it will be free of defects in workmanship and material for **twenty-four (24) months** from the date of Substantial Completion. NOTE: Warranty does not start from the date of shipment or installation.
 - 2. Mechanical Contractor: **24 months** from date of Substantial Completion - labor only.

1.7 Cabinet Sound Testing

- A. The equipment manufacturer shall furnish calculations showing the estimated sound power levels at the supply connection, return connection, and unit casing radiation for each air conditioning unit. Calculations shall be based on fan sound power levels that were determined in accordance with AMCA Standard 300. Sound power levels shall be determined for each octave band and shall not exceed the following:

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OCTAVE BAND SOUND POWER LEVEL, db Re: 10-12 WATTS

AHU Center Band Freq.	63	125	250	500	1000	2000	4000	8000
Supply Fan Outlet Casing Radiated at 3 ft.	82	83	90	77	77	76	73	67
Supply Fan Inlet Casing Radiated at 3 ft.	86	88	87	90	87	86	84	80
Return Fan Outlet Casing Radiated at 3 ft.	73	78	82	66	67	64	59	42
Return Fan Inlet Casing Radiated at 3 ft.	85	82	79	76	73	73	65	62

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
1. Filters: One set of filters for each unit plus one spare set to be turned over to the Owner.
 2. UV Lights: One set of bulbs for each unit a plus one spare set to be turned over to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Custom Packaged Air Handling Units – See section 1.3, A.
 - a. Governair Corp. (basis of design)
 - b. Buffalo Air
 - c. Huntair
 - d. Flanders
 - e. Webco
 2. If an alternate Custom Packaged Air Handling Unit manufacturer other than the Basis of Design is used by the Contractor, the Contractor accepts responsibility for **ALL** field coordination with other trades on site, engineering time to review submittals and structural steel shop drawing revisions and revisions necessary to ensure proper installation. The engineering time can be 8% of the equipment costs including taxes and markups that the contractor must pay the engineer(s) prior to review of the alternate Custom Outdoor Air Handling Unit submittals.

2.2 CUSTOM UNITS

- A. Description: Industrial quality equipment shall be furnished and installed. Units shall be completely factory assembled and tested. The equipment's cooling, heating, ventilating, exhausting capacity and performance shall meet or exceed that shown on the schedule. Tags and decals to aid in service or indicate caution areas shall be

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provided. Electrical wiring diagrams shall be attached to the control panel access doors. Operation and Maintenance Manuals shall be furnished with each unit. Units shall provide proper discharge air openings per the plans.

- B. Unit Manufacturer shall verify design conditions and match supply and return air openings on drawings. Unit Manufacturer shall coordinate each duct connection with installing contractor. Supply and return air openings shall match that as shown on the plans.
- C. Casing: Cabinets shall be constructed in a watertight and airtight manner and tested to 10" static pressure. The manufacturer's standard cabinet construction shall result in an ASHRAE/ANSI Standard 111-88 Leakage Class of less than nine (9) as measured in accordance with AMCA Standard 210-85. Unit serial numbers shall be permanently welded into the base frame.
 - 1. The unit shall be constructed on a welded tubular steel frame. The tubing shall be cold formed carbon steel electric resistant welded square and rectangular type complying with ASTM A-500 Grade B. Minimum yield strength shall be 46,000 psi. The unit's upper structural tubing frame shall form an integral structure when assembled with the wall panels thus greatly increasing the rigidity of the unit. Floors and walls shall be designed to deflect no more than 1/240 of span at unit operating pressures. The base frame shall have integral lifting lugs. The lifting lugs shall be fabricated from structural steel with an appropriate rigging hole. The lifting lug shall be fixed bolt down and removable to meet the specific site requirements. Lifting lugs shall be located and sized to allow rigging and handling of the unit. Steel internal base frame cross-members shall be internally recessed so the perimeter base can overhang the roof curb in a self-flashing manner.
 - 2. Units shipped in multiple sections shall be engineered for field assembly. Demount sealing gasket (gasketing required between each section) shall be required and provided. Contractor shall apply caulking furnished by unit manufacturer between sections as recommended by unit manufacturer and required for a tight seal. Internal lifting eyes shall be provided so that mating sections can be set together in their proper location by the crane without dragging or pushing them together. The mating upper frame of each section shall also be fabricated with a flanged perimeter. The flanged perimeter shall be drilled with assembly clearance holes and be continuously gasketed. Demount gasket supplied with the unit shall be a high quality weather resistant closed cell type. Assembly lugs, fabricated from structural steel with appropriate assembly clearance holes, shall be electrically welded to the base frame. All gasket and necessary assembly hardware shall ship loose with unit. Junction boxes with a factory supplied numbered terminal strip shall be supplied at each shipping split for reconnection of control wiring.
- D. AHU floors shall be screwed down and shall be fabricated of 16 gauge minimum G-90 galvanized sheet steel. All floors shall be turned-up 2" around the perimeter. All joints shall be sealed with an industrial gasket for water and air tightness. All floors shall be double-wall, 4" minimum ~~and insulated with minimum 3-lb density acoustical insulation,~~ foam insulated with minimum R-value of 27. Return air and supply air openings shall have grating covering the openings as required for servicing the fans. Grating shall be sized as required to minimize the static pressure losses. All panels shall be of thermal break construction. All air tunnel panels shall be 3" double wall and fabricated of 16 gauge galvanized sheet steel outer shell with a 20 gauge solid (22 gauge perforated in Fan Section) galvanized sheet steel inner liner. The steel shall conform to ASTM A-527 for lock-former quality. Outer shell shall have a 5-step baked-on corrosion

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protection system applied. (See section on Corrosion Protection Systems for coating specification.) All panel corners will be internally caulked with sealant. Panels shall be sealed to the structural frame with an industrial gasket to form a water and airtight seal with the panel. Fasteners used to attach the panel will pass through into one side of the tube but not penetrate into the air tunnel. Panels shall not exceed 24" without a structural steel support member in at least one axis. All unprotected metals and welds shall be factory coated.

~~1. All exterior panels, roof and floor shall be insulated with 2" 3 lb density fiberglass insulation (minimum R=8) fill between the shell and liner for AHU's. AHU's shall be acoustically treated with "Soundcoat" to reduce sound transmission from the entire AHU housing. Insulation shall be Mylar faced behind perforated liners (supply and return fan sections). Floors shall be insulated with a minimum of 4" of fiberglass insulation with a minimum R-value of 11. Insulation shall not exceed 25 flame spread, 50 fuel contribution, or 50 smoke generation when tested under ASTM E-84 and UL 723.~~

1. All exterior panels for the roof and wall shall be insulated with 3" - 3 lb density fiberglass insulation (minimum R-value of 12) fill between the shell and liner for AHU's. AHU's shall be acoustically treated with "Soundcoat" to reduce sound transmission from the entire AHU housing. Insulation shall be Mylar faced behind perforated liners (supply and return fan sections). Floors shall be insulated with a minimum of 4" foam insulation with a minimum R-value of 27. Insulation shall not exceed 25 flame spread, 50 fuel contribution, or 50 smoke generation when tested under ASTM E-84 and UL 723.

E. Durable access doors shall be provided for easy access to components and have zero air leakage at 10.0" w.g. static pressure. Access doors shall be double wall and completely insulated between the interior and exterior sheet metal of the door and attached to a 2" thick steel or aluminum tube frame that has an integral thermal break. Hinges shall be heavy duty stainless steel butt-type. High compression latches, operable from both sides of the door, shall be used. All access doors shall be gasketed around the complete perimeter. The exterior doors of all air handlers shall have door tie backs and keyed lockable door hardware to prevent unauthorized access. Door viewing windows shall be double-paned wire reinforced type. Size shall be 6"x6" minimum. All windows shall be fabricated with ~~an integral desiccant between the~~ hermetically sealed panes (Filter and Fan sections).

F. Curbs: curbs shall be constructed of minimum 14 gauge galvanized sheet steel with 1" of armaflex insulation on the inside of the full perimeter of the curb. All thickness shall conform to ASTM A-527 for lock-former quality. Zinc coating weight shall be G-90 as per ASTM A-525. Finish shall be bright spangle. Roof curbs shall be sloped as required to ensure AHU's sit plumb and level. The outside air intakes for AHU's shall be a minimum height of 36 inches above the finished roof level and shall be coordinated with drawings.

G. Painting: Coating adhesion shall comply with ASTM D-3359-B with no lifting of 1/8" squares of coating between scribe lines in cross hatch adhesion testing applied after a 2 x gauge reverse impact. No significant undercutting shall be exhibited on steel panels in a scribed condition after 1,000 hours in 5% salt spray testing at 95 °F and 95% relative humidity as per ASTM B-117. Gloss shall be 20-30% at 60 degrees. Film pencil hardness shall be in the F-H range. Film solvent resistance shall withstand 100 double rubs with MEK. **Color shall be selected by Architect.**

1. The base frame and upper structural frame shall be completely coated with 1.5

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mils of corrosion resistant phenolic or enamel primer after fabrication and welding. This coating shall exhibit a pencil hardness of B.

Exterior coated sheet metal shall be coated with a 5-step baked on coating system: Galvanized zinc coating of G60 weight shall be applied as per ASTM A-525. After galvanizing, the material shall be cleaned and immediately pretreated on both sides with Bonderite 1421 or approved equal.

The material shall then be immediately primed on with Morton 20Y128 epoxy primer or alkyl enameled red oxide applied at 0.15 to 0.26 mils on each side. The primary finish coat shall be a baked on enamel or polyester coating equal to Morton Polyceram 3200 applied at minimum of 0.8 mils on the exterior exposed side and 0.3 mils on the reverse. The entire system shall be baked on for 25 seconds in a 650 °F oven. The peak metal temperature shall reach no less than 450 °F. The final coat will be an air-dried acrylic modified alkyd coating.

- H. Fans: Shall be in a FANWALL configuration. Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run.
1. Fans shall be plenum type configuration direct drive type. Fan wheels shall be of the non-overloading centrifugal backward incline type, constructed of aluminum and containing matching inlet venturi for optimum unit performance. FANWALL shall have thrust restraint isolators that shall be provided for each fan block to minimize movement of the assembly(s). Each fan housing shall be square in shape and readily attachable in column sections as required. Provide fan housing 2" acoustical insulated fan housing for fan housings, 22 ga perforated liner for each fan housing.
 2. Units shall be supplied with variable frequency drives (VFD's). Each fan cube shall be wired to an individual VFD as specified elsewhere for each fan motor. VFD's shall be mounted in a NEMA 1 enclosure and shall be labeled by an approved testing agency such as UL. VFD's shall include sine wave carrier input, PWM output. IGBT transistors. Adjustable acceleration and deceleration timing. Keypad to be removable, with alphanumeric display able to provide output status monitoring, output frequency, output voltage, output RPM, and output current. Include fault log display with capacity for the recent 30 faults with a time stamp. Diagnostic display menus to include reference speed command, heat sink temp, bus voltage, active I/O command status, time from power up, and current setting. Line and load reactors required for all 480 volt applications. VFD shall be factory supplied, installed, and wired. Final connections shall be by the electrical contractor.
 3. BAS tie-in: Units shall be provided with two independent fan controllers one for the supply fans and one for the return fans. Building controls contractor shall provide on/off call and a speed control signal (0-10VDC) to the unit's FANWALL control panels one for supply fans and one for return fans. FANWALL optimization controls shall automatically bring online the required number of fan cells at the optimal speed to meet the controls contractors speed control. FANWALL control system shall provide a 0-10VDC to field BAS for actual airflow in CFM, a Fan status signal and a failure alarm signal from both the return and exhaust fan controls. FANWALL control system shall have terminal block for field safety circuit terminations.

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4. Controls interface: Controls contractor shall indicate to equipment supplier the preferred controls protocol. Controls protocol options include BACNET IP, BACNET MSTP, LONworks, or MODBUS.
 5. Each fan/motor cube shall be provided with a built-in coplanar silencer to attenuate sound produced by the fan during operation. The coplanar silencer shall consist of an acoustic dampening material protected and held in place by a perforated liner.
 6. Each fan/motor cube shall be provided with an individual back-draft damper engineered to produce little to no static pressure loss at the designed operating conditions. Seals shall be solid rubber. Bearings shall be rubber shielded radial ball bearings, permanently lubricated. The vertical blades of the damper open as airflow commences and close when the fan is idle. This is accomplished without the use of mechanical means or weights.
 7. Shaft grounding: As required by system design, when using variable frequency drives provide an AEGIS SGR shaft grounding system for each AC motor to prevent electrical discharge to motor bearings and to extend motor life by safely channeling harmful shaft currents to ground. The AEGIS system is frictionless, has no wear and requires no maintenance or additional service during the life of the motor.
 8. Fan motors shall be TEFC or TEAO motors selected at the specified operating voltage, RPM, and efficiency as specified or as scheduled elsewhere.
- I. Coils: All coils shall meet or exceed all capacities specified on the mechanical schedule for the project. All water coil performances shall be certified by the manufacturer in compliance with ARI Standard 410. Cooling coils shall be mounted in the unit for horizontal airflow. Coil air face velocities shall not exceed the specified velocities of the mechanical schedule. All coils shall be mounted on steel glide channels and fastened to the air seal wall. Coils shall be mounted to air seal wall structure with high strength 0.25" bolts, lock washers and nuts. Air seal joints shall be completely caulked with a silicone adhesive sealant.
- J. Chilled and Hot Water Coils: All hydronic coils shall be tested to 350 psig compressed air under clear water. Coils shall be designed to operate at 250 psig internal pressure and up to 300°F. Internal tubes shall be round seamless wall copper tubes minimum 0.020" tube thickness that have been deoxidized by the addition of phosphorous. Coil casings shall be constructed of a minimum of 16 gauge continuous galvanized steel. Coil casing reinforcements shall be required for fin lengths over 42". Coil fins shall be plate type, die-formed ripple edge corrugated aluminum with guide channels to create turbulent wiping behind the tubes with collars drawn and belled. Internal copper tubes shall be staggered in direction of airflow. The copper circuiting tubes shall be mechanically expanded to the aluminum fins. The fin spacing shall be a maximum of 12 fins per inch. All hydronic coils shall be drainable with 0.25" F.P.T. plugged drain or vent tap on the supply and return headers. Seamless copper tubes shall be brazed to the copper supply and return headers.
- K. Cooling coil sections shall have a pitched, in two directions, drain pan constructed from 16 gauge type 304 stainless steel. All corners shall be welded watertight. Drain pan is to be a minimum of 2" deep with a minimum pitch of 1" from high point to the drain outlet connection. Coil condensate drain pan shall be completely insulated. If coils are stacked, a sloped, stainless steel intermediate drain pan with recessed drain connection is required. This intermediate pan shall drain to the bottom main pan. Intermediate drain tubes shall be copper. Plastic drain pans and plastic lines shall not be acceptable. The coil main pan shall have a 1-1/4" M.P.T. drain extended to the exterior of the air handler.

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- L. Chilled and Hot Water Coils shall be pre-piped and tested at the factory. Controls contractor shall furnish control valves and unit manufacturer shall install. Piping assembly shall be removed in a single piece as required for shipping and reassembled in the field. Refer to details on drawings for piping requirements.
- M. Electric Devices: General. ATC Contractor is responsible for temperature controls. All required controllers, sensors to be furnished and field installed by ATC Contractor. The manufacturer shall provide all safety and operating controls required to meet the equipment's ETL or UL listing and the requirements of UL. Controls shall include branch and sub-circuit fusing, contactors, relays and pressure controls. Panel to be constructed to NEMA 3R requirements and will have hinged access panels.
 - 1. Vapor Proof Service Lights: Each section shall be equipped with a vapor proof 23 watt compact fluorescent service light. All lights (except UV lights), switches and outlets shall be factory wired to a single point in the control panel for field supplied 120V power to be connected. UV lights shall be factory wired through a step down transformer from 480V to 120V fed from the 480V single point connection. 480V power will be field installed to the single point connection by the EC.
 - 2. Provide unit mounted phase and brownout protection. This protection shall be equal to Linebacker EAC-8002 phase protector.
 - 3. Provide copper wires, bus bars, and fittings throughout. Identify power supply terminals with permanent markers. The maximum temperature of terminals shall not exceed 167°F (75°C) when the equipment is tested in accordance with its rating.
 - 4. Mount a permanent nameplate on the unit to display the manufacturer, serial number, model number, date of manufacture, and current and voltage readings and ETL and UL Listing.
 - 5. Electric/Electronic Actuators: The actuators for modulating service are direct-coupled electronic type. The actuators for the outside air and exhaust air are spring return type. The input signal shall be 0-10 VDC and power requirements are 24 VAC. Actuators shall be **Belimo** and furnished and factory installed by AHU Manufacturer. Dampers shall be furnished and installed by AHU unit Manufacturer.
- N. Filters: Filter holding frames shall be of heavy-duty construction designed for industrial applications. Holding frames applied in low efficiency filter applications shall be either upstream or downstream accessible. Holding frames shall be constructed from no less than 18 gauge-galvanized steel. They shall be equipped with foam gaskets and fasteners. Filter fasteners shall be capable of being installed without the requirement of tools, nuts or bolts. The holding frame shall be designed to accommodate standard size filters with the application of the appropriate type fastener.
 - 1. Flat filter racks shall be completely factory assembled and designed for industrial applications. Filter racks shall be fabricated from no less than 16 gauge galvanized steel. Filter racks shall have one central access cover per row of filters centered in the unit for easy access. Filter racks over 72" in length shall require an angle center reinforcement support. Filter racks shall be designed for a maximum of 500 fpm, or meet or exceed the area specified in the mechanical schedule.
 - 2. Pleated filters: Shall be 2" thick, pleated MERV 8 face loaded i Filter media shall be 100% synthetic or cotton/polyblend. The filter shall have an average efficiency

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of 30-35% and an average arrestance of 90-92%. The filters shall be listed as Class II under UL Standard 900. Filters shall be tested per latest ASHRAE Standard 52. The effective media shall not be less than 4.6 square feet of media per 1.0 square foot of filter face area, and shall contain not less than 15 pleats per linear foot. Initial resistance at 500 fpm approach shall not exceed 0.28" w.g.

- O. UV-Germicidal Lamps: UV-C emitters and fixtures shall be designed for use inside an HVAC system. Individual lamp output shall be measured in an ASME nozzled test apparatus using a 45°F air stream moving at not less than 400 fpm. Lamp output of 253.7nm shall not be less than 10 microwatts / cm² per inch of arc length measured at a distance of one meter.
1. UV-C power supplies shall be a high efficiency electronic type, which are matched to the emitters and are capable of producing the specified output intensity with an input power of no more than 80 watts.
 2. UV-C fixtures shall be factory installed and wired to a SPDT disconnect switch and door interlock switch. UV-C lamps shall ship separately for field installation to minimize the chance for bulb damage. Emitters to be powered by unit manufacturer.
 3. Emitters and fixtures shall be installed in sufficient quantity and arranged so as to provide an equal distribution of UV-C energy on the coil and drain pan.
 4. The minimum UV-C energy striking the leading edge of the coil pan shall not be less than 820 microwatts / cm² at the closest point and through placement, not less than 60% of that value at the farthest point. Equal amounts are to strike the drain pan, either directly or indirectly through reflection.
 5. Emitters and fixtures shall be installed such that UV-C energy strikes all surfaces of the coil, drain pan, and the available line of sight air stream.
 6. The UV system shall minimize the opportunity for mold and/or bacteria to survive on the coil and related surfaces.
 7. The UV emitters shall be factory installed, and placed as to directly irradiate the leaving air side of the coil and its drain pan. The area containing the UV emitters shall be assembled as to not allow UV rays to be seen from outside of the unit.
 8. All door and related assemblies shall have a protective interlock switch(es) should its opening have access to illuminated UV emitters.
 9. The UV emitters shall be easily accessible through an access door for lamp replacement.
 10. The UV emitters shall be arranged in a fashion so no part of the coil surface sees less than 300mw/cm² and for a maximum biological surface kill. All non metallic surfaces (wiring, filter frames, PVC pipe) exposed to UV light shall be UV resistant material or shall be properly shielded.
 11. Provide an hour meter on all emitters so they may be changed at proper intervals. The hour meter will be energized whenever the ballast is energized.
- P. Service Corridor: Units shall include a service corridor as indicated on the drawings. The corridor shall be manufactured from the same materials and construction as the unit construction, except floor shall be fabricated of 10 gauge tread plate of welded and water tight construction, and shall be field attached to the main unit. Floor shall be sloped to the exterior wall in the shortest distance and install weep holes through the exterior wall at the floor. Unit shall be manufactured to maintain a weather-tight construction after field assembly is completed. Service corridors shall be sized by the manufacturer to accommodate all piping, controls, VFD's, power, etc. necessary for a complete and operational system and maintaining all required service clearances.
- Q. Air Handling Unit manufacturer shall coordinate sectionalizing AHU as required for

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mechanical contractor to disassemble and reassemble air handlers as required to install on site.

- R. Dampers (equal to Ruskin CD50): Aluminum airfoil low-leakage dampers shall be heavy duty construction for industrial application. Blades shall be parallel blade type, in either horizontal or vertical arrangement as required when blending two adjacent damper air streams. All other dampers shall be opposed blade type. The frame shall be fabricated from 16 gauge galvanized steel formed "C" channel. Side framing shall have extruded bearing holes that decrease wear and allow smooth rotation of the blade shaft bearing. Vertical damper blades shall be suspended so that the weight of the blade rides on the top bearing. Blades must be suspended so that blades are centered and bottom edge blade seals are not unduly compressed. Blade end seals shall be spring type tempered stainless steel. Damper linkage shall be concealed in the frame, out of the air stream, for reduced air turbulence. Low operating torque linkage rides on self-lubricated delrin type bearings contained within the quadrant clamp. Rigid, low maintenance blades shall be fabricated from 6063-T6 heavy gauge extruded aluminum. Blades shall be airfoil in shape for smooth air passage. Extruded Santoprene low-leak blade edge blade seals shall be installed on each blade. Vinyl or PVC type extruded seals are unacceptable. Blade seals shall be locked in extruded blade slots without the use of cement. Drive shafts shall be square to ensure proper alignment and positive locking connection between the blade, axle and linkage. Round drive shafts are unacceptable. Dampers shall be tested by an independent AMCA approved laboratory for leakage and air pressure drop in accordance with AMCA Standard 500. Leakage shall not exceed 4.2 CFM per square foot at 4" w.g. Pressure drop shall not exceed 15" w.g at 1000 feet per minute. Damper shall be rated for a maximum velocity of 4000 fpm without generating objectionable noise.
- S. Louvers: Outside air louvers and relief louvers shall be stationary drainable blade type entirely contained within a 7" minimum frame. Leading edge of the damper blade shall be rounded to smooth air flow and minimize pressure drop. Framing shall be no less than 16 gauge galvanized steel channel with box flanges. Louver blades shall be fabricated from 16 gauge galvanized steel. A 1/2" mesh bird-screen shall be provided on all louvers. A standard 48"x48" louver shall have a minimum free area of 50%. Drain pans shall be installed below each louver to carry away any condensation that forms internally on the louver frame. Louvers shall be tested by an independent AMCA approved laboratory for water carry-over and air pressure drop in accordance with AMCA Standard 500. Testing reports shall be supplied with the submittal data. Water carry-over shall not exceed 0.01 ounces of water per 15 minute period at 580 fpm gross area velocity. Pressure drop at the same airflow including the 1/2" wire mesh bird-screen shall not exceed 0.12" w.g.
1. Exhaust (Relief) Air Louvers: Louvers shall be stationary blade type entirely contained within a 6" frame. Framing shall be no less than 16 gauge galvanized steel channel with box flanges. Louver blades shall be fabricated from 16 gauge galvanized steel. A 1/2" mesh bird-screen shall be provided on all louvers.
 2. All louvers and hoods shall be made of the same material as the unit casing.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate capacity according to ARI 360, "Commercial and Industrial Unitary Air-Conditioning Equipment."

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1. Sound Power Level Ratings: Comply with ARI 270, "Standard for Sound Rating of Outdoor Unitary Equipment."
- B. Fan Vibration Testing: Fan wheel and shaft assemblies shall be dynamically analyzed ~~after the fan, motor and drive assemblies have been installed in the unit.~~ The fan shall be analyzed with an electronic balance analyzer with a tunable filter. Vibration measurements shall be taken on each bearing housing in the horizontal, vertical, and axial positions with the filter tuned to the fan RPM. The vibration shall be less than 0.157 in/sec velocity for a centrifugal fan. The testing shall be performed at the factory. A detailed report, including all data and test methods, shall be presented to the OWNER or his representative prior to equipment shipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roof for compliance with requirements for conditions affecting installation and performance of Air Handling units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units according to manufacturer's written instructions.
- B. Install units level and plumb, maintaining manufacturer's recommended clearances.
- C. Curb Support: Install curb on roof as required to support units and set level and plumb.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 1. Install piping to allow service and maintenance. Piping shall be factory installed with all valving and controls, removed for shipping and field installed by the mechanical contractor.
- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 1. Provide supply and return air duct connections to connect to manufacturers supply and return air plenum at base of unit.
- C. Electrical: Conform to applicable requirements in Division 23 Sections.
- D. Ground equipment.
 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 COMMISSIONING

- A. Verify that installation is as indicated and specified.
- B. Complete manufacturer's installation and startup checks and perform the following:
 - 1. Level unit.
 - 2. Inspect for visible damage to unit casing.
 - 3. Inspect for visible damage to fans.
 - 4. Verify that clearances have been provided for servicing.
 - 5. Check that labels are clearly visible.
 - 6. Verify that controls are connected and operable.
 - 7. Remove shipping bolts, blocks, and tie-down straps.
 - 8. Verify that filters are installed.
 - 9. Adjust vibration isolators.
 - 10. Check acoustic insulation.
 - 11. Check operation of dampers.
- D. Check fan-wheel rotation for correct direction without vibration and binding.
- E. Adjust fan to proper alignment.
- F. Start unit according to manufacturers written instructions.
 - 1. Complete startup sheets and attach copy with Contractor's startup report.
- G. Check and record performance of interlocks and protection devices; verify sequences.
- H. Operate unit for an initial period as recommended or required by manufacturer.
- I. Calibrate room thermistors.
- J. Adjust and check high-temperature limits.
- K. Check internal isolators.
- L. Check outside-air damper for proper stroke and interlock with return-air dampers.
- M. Check controls for correct sequencing of heating, mixing dampers, and normal and emergency shutdown.
- N. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - 1. Supply-air volume.
 - 2. Return-air volume.
 - 3. Relief-air volume.
 - 4. Outside-air intake volume.
- O. Verify operation of remote controller and failure modes. Check the following:
 - 1. Warm-up for morning cycle.
 - 2. Freezestats operation.
 - 3. Free-cooling mode, outside-air changeover.

4. Alarms.
5. Smoke shut down for AHU's.

- P. After starting and performance testing, change filters, vacuum cooling and heating coils, lubricate bearings and adjust belt tension.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance. Refer to Division 20, 200000A paragraph "Instruction to Owner's Employees" and Division 01 Section "Demonstration and Training" for further requirements.
 2. Schedule training with Owner, through Engineer, with at least 7 days notice.
 3. Review data in the maintenance manuals. Refer to Division 20 Section 200000A paragraphs on Operation and Maintenance Data and Division 01.

END OF SECTION 23 74 10

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 26 13 00 – Medium Voltage Switchgear

Corresponding to RFQ Item: 86

SECTION 26 13 00 - MEDIUM-VOLTAGE SWITCHGEAR

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.
- B. Division 20 – Mechanical, Electrical and Plumbing General Requirements applies to and forms a part of all specifications. Articles of this section shall govern unless superseded by specific stipulations of that Division of the Specifications.
- C. Drawings and General Notes apply to and form a part of the Specifications.

1.2 SUMMARY

- A. This Section includes outdoor pad-mounted deadfront switchgear.

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. GFCI: Ground-Fault Circuit Interrupter.

1.4 SUBMITTALS

- A. Product Data: For each type of switchgear and related equipment, include the following:
 - 1. Rated capacities, operating characteristics, furnished specialties, and accessories for individual interrupter switches.
 - 2. Time-current characteristic curves for overcurrent protective devices, including fusible devices.
- B. Shop Drawings: For each type of switchgear and related equipment, include the following:
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:
 - a. Tabulation of installed devices with features and ratings.
 - b. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
 - c. Drawing of cable termination compartments showing preferred locations for conduits and indicating space available for cable terminations.

- d. Floor plan drawing showing locations for anchor bolts and leveling channels.
 - e. Current ratings of buses.
 - f. Short-time and short-circuit ratings of switchgear assembly.
 - g. Nameplate legends.
- 2. Wiring Diagrams: For each type of switchgear and related equipment, include the following:
 - a. Power, signal, and control wiring.
 - b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
 - c. Schematic control diagrams.
 - d. Diagrams showing connections of component devices and equipment.
 - e. Schematic diagrams showing connections to remote devices.
- C. Source quality-control test reports.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For switchgear and switchgear components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- B. Source Limitations: Obtain each type of switchgear and associated components through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in sections of lengths that can be moved past obstructions in delivery path as indicated.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect and Owner no fewer than three days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of switchgear and components with other construction. Maintain required clearances for workspace and equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Six of each type and rating used. Include spares for future transformers, control power circuits, and fusible devices.
 - 2. Fuse Refills: One set of three fuse refills for each rating.
 - 3. Touchup Paint: Three containers of paint matching enclosure finish, each 0.5 pint.
- B. Maintenance Tools: Furnish tools and miscellaneous items required for interrupter switchgear test, inspection, maintenance, and operation. Include the following:
 - 1. Fuse-handling tool.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to:

- a. Eaton Corp; Cutler Hammer
- b. S&C Electric
- c. Siemens

2.2 MANUFACTURED UNITS

- A. Description: Factory assembled and tested, and complying with IEEE C37.20.1.
- B. Ratings: Suitable for application in 3-phase, 60-Hz, solidly grounded-neutral system.

2.3 METAL-ENCLOSED INTERRUPTER SWITCHGEAR

A. GENERAL

1. Assembly: The outdoor padmounted gear shall consist of a single self-supporting enclosure, containing three-phase gang-operated interrupter switches and three-phase sets of single-pole fuses with the necessary accessory components, all completely factory assembled and operationally checked.
2. Coordination: To ensure a completely coordinated design, the padmounted gear shall be integrally designed and produced by the manufacturer of the basic switching equipment.
3. Certification of Ratings: The manufacturer shall be completely and solely responsible for the performance of the basic switch and fuse components as well as the complete integrated padmounted gear assembly as rated. The manufacturer shall furnish, upon request, certification of ratings of the basic switch and fuse components and/or the integrated padmounted gear assembly consisting of the switch and fuse components in combination with the enclosure. This certification of the integrated unit shall include testing the padmounted gear to the fault close requirements of the specification to assure the bus support system and components are adequate.
4. Submittals: When requested, the manufacturer shall furnish the following drawings and reports:
 - a. Layout showing dimensions, arrangements, electrical ratings, components and weights.
 - b. Certified test reports of similar manufactured units showing fault closing capability and load interrupting capability of switches and complete padmounted gear assembly based on maximum design voltage.
5. Compliance with Standards and Codes: The padmounted gear shall conform to or exceed the applicable requirements of the following standards and codes:
 - a. Applicable safety and health standards promulgated pursuant to Federal Occupational Safety and Health Act of 1970.
 - b. Article 710-21 (e) in the National Electrical Code, which specifies that the interrupter switches in combination with power fuses shall safely withstand

- the effect of closing, carrying, and interrupting all possible currents up to the assigned maximum short-circuit rating.
- c. All portions of ANSI, IEEE, and NEMA standards applicable to the basic switch and fuse components including, but not limited to, IEEE C37.20.3 and C37.20.7.
6. Enclosure Design: To ensure a completely coordinated design, the padmounted gear shall be constructed in accordance with the minimum construction specifications of the fuse and/or switch manufacturer to provide adequate electrical clearances and adequate space for fuse handling. In establishing the requirements for the enclosure design, consideration shall be given to all relevant factors such as controlled access and tamper resistance.
 7. Ratings: Ratings for the integrated padmounted assembly shall be as designated below:

System Voltage Class	
	15KV
KV, Nominal	12.47
KV, Maximum Design	17
KV, BIL	95
Main Bus Cont, Amps	600
Load Inter. Amps	600
Short-Circuit Ratings*	
Amps, RMS Symmetrical	25,000
MVA, 3-Phase Sym. at rated Nominal Voltage	620
Fault Closing Amps, RMS, Asym., 3-Time Duty Cycle**	40,000

*These are nominal switch ratings. Integrated padmounted unit may be limited by the fuse, bushing wells, bushing inserts, elbow and cable ratings used with these units.

Fuse Ratings				
14.4 KV Nominal				
Fuse Manufacturer	Fuse Type	3-Phase MVA SYM.	Amps RMS ASYM	Cont. Amps
S & C	SM-4	310	20,000	200
S & C	SMU-20	350	22,400	200
Cutler-Hammer	DBU	350	22,400	200

8. Insulators: The interrupter switch and fuse mounting insulators shall have the following material characteristics and restrictions:
 - a. Operating experience of at least 15 years under similar conditions.
 - b. Ablative action to ensure non-tracking properties.
 - c. Adequate leakage distance established by test per IEC Publication 507, First Edition, 1975.
 - d. Adequate strength for short-circuit stress established by test.
 - e. Conformance with applicable ANSI standards.

- f. Homogeneity of the cycloaliphatic epoxy resin throughout each insulator to provide maximum resistance to power arcs. Ablation due to high temperature from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation. Furthermore, any surface damage to insulators during installation or maintenance of the padmounted gear shall expose material of the same composition and properties so that insulators with minor surface damage need not be replaced.
 - g. Each insulator shall be x-rayed to assure it is essentially void free. An alternate testing method may be used only by approval of the engineer.
- 9. High Voltage Bus:
 - a. Bus and interconnections shall consist of bare aluminum bar of 56% IACS conductivity with an oxide-inhibiting agent at all bus joints.
 - b. Bus and interconnections shall withstand the stresses associated with short circuits up through the maximum rating of the padmounted gear, including proper allowance for transient conditions.
 - c. Bolted aluminum-to-aluminum connections shall be made with a suitable number of non-corrosive bolts and with two Belleville spring washers per bolt, one under the bolt head and one under the nut. Bolts shall be tightened to an appropriate torque to assure good electrical connection.
- 10. Ground Connection Pads:
 - a. A ground connection pad shall be provided in each termination compartment of the padmounted gear.
 - b. The ground connection pad shall be constructed of 1/4" thick, galvanized or stainless steel and have a NEMA 2-hole pattern for ground connections. The pad shall be welded to the enclosure and shall have a short-circuit rating equal to that of the integrated assembly.
 - c. A full width copper grounding rod shall be provided in each cable terminating compartment.

B. CONSTRUCTION

- 1. Enclosure:
 - a. The padmounted enclosure shall be of unitized construction (not structural frame and bolted sheet) to maximize strength, minimize weight, and inhibit internal corrosion.
 - b. The basic materials shall be 11 gauge hot rolled, pickled and oiled steel sheet. All structural joints and butt joints shall be welded, and the external seams shall be ground flush and smooth. A welding process shall be employed that eliminates alkaline residues and minimizes distortion and spatter.
 - c. To guard against unauthorized or inadvertent entry, enclosure construction shall not utilize any externally accessible hardware.
 - d. The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.

- e. The door openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between doors and door openings to guard against water entry.
 - f. In consideration of tamper resistance, the enclosure shall conform to or exceed the requirements of ANSI C57.12.28.
 - g. A heavy coat of insulating "no-drip" compound shall be applied to the inside surface of the roof to reduce condensation of moisture thereon.
 - h. Lifting tabs shall be removable. Sockets for the lifting tab bolts shall be blind-tapped. A protective material shall be placed between the lifting tabs and the enclosure to prevent the tabs from scratching the enclosure finish. This material shall be non-hygroscopic to prevent moisture from being absorbed.
2. Barrier Assembly: Insulating interphase and end barriers shall be provided in each switch and fuse compartment. This barrier system shall be constructed of fiberglass reinforced polyester (NEMA rated GPO-3).
3. Doors:
- a. Doors shall be constructed of 11 gauge hot rolled, pickled and oiled steel sheet.
 - b. Door edge flanges shall overlap with door opening flanges and shall be formed to create a mechanical maze that shall guard against water entry or discourage tampering or insertion of foreign objects.
 - c. Doors shall have a minimum of three stainless steel hinges and hinge pins. The hinge pins shall be secured in place to guard against tampering.
 - d. One active and one passive door shall be provided and in consideration of controlled access and tamper resistance, each active door shall be equipped with a positive-action three-point auto-latch mechanism and padlock hasp.
 - e. Each active door shall be provided with a stainless steel door handle. The door handles shall be padlockable and shall incorporate a hood to protect the padlock shackle from tampering and access to the operating bolt. Each handle shall be provided with a recessed penta (hex optional) head bolt for additional security.
 - f. Each passive door shall be provided with a penta (hex optional) head bolt for additional security. The active and passive door shall require the same tool to open.
 - g. Doors providing access to fuses shall have provisions to store spare expulsion type fuse units or refills.
 - h. Each door shall be provided with a zinc plated, galvanized or stainless steel door holder located above the door opening. These holders shall be hidden from view when the door is closed, and it shall not be possible for the holders to swing inside the enclosure.
4. Finish:
- a. Full coverage at joints and blind areas shall be achieved by processing enclosures independently of components such as doors and roofs before assembly into the unitized structures.
 - b. All exterior seams shall be sanded or ground smooth for neat appearances.
 - c. To remove oils and dirt, and to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard

underfilm propagation of corrosion, all surfaces shall undergo a chemical cleaning and phosphatizing process before any protective coatings are applied.

- d. The finishing system shall be applied without sags or runs for a pleasing appearance.
- e. After the enclosure is completely assembled and the components (switches, bus, etc.) are assembled and the components (switches, bus, etc.) are installed, the finish shall be inspected for scuffs and scratches.
- f. Blemishes shall be carefully touched up by hand to restore the protective integrity of the finish.
- g. Unless otherwise specified, the color shall be Munsell No. 7GY3.29/1.5, dark green.
- h. To assure that the finishing system is capable of resisting corrosion, the manufacturer shall provide on request, certification that representative test panels, protected by the manufacturer's finish system, have passed the following tests:

- 1) Salt spray. Scribe to bare metal and test for 2000 hours in a 5% salt spray per ASTM B-117. Loss of adhesion from bare metal should not extend more than 1/8" from the scribe. Underfilm corrosion should not extend more than 1/16" from the scribe.
- 2) Crosshatch adhesion. Scribe to bare metal a cross hatch pattern of 100 1/16" wide squares. Apply Scotch 710 tape and rapidly remove. There should be 100% adhesion to the bare metal and between layers.
- 3) Humidity. Test of 1000 hours subject to 100% humidity at 45-50 degrees C per ASTM D-2247. There should be no blisters.
- 4) Impact. Impact the test panel with a 160 in-lb. falling dart per ASTM D-2794. There should be no cracking or chipping of the paint on the impact side of the test panels.
- 5) Oil resistance. Immerse two test panels in mineral oil for 3 days, one at room temperature and one at 100 degrees C (212 degrees F). There should be no apparent changes, such as color shifts, blisters, loss of hardness or streaking.
- 6) Ultraviolet Accelerated Weathering Test. Continuous exposure to ultraviolet light for 500 hours per ASTM G-53 with a cycle of 4 hours ultraviolet followed by 4 hours of condensation. Loss of gloss shall not exceed 50% of original per ASTM D523.
- 7) Water Resistance. Immerse a test panel in distilled water for 3 days at room temperature. There should be no apparent changes, such as blistering, color shift, loss of hardness or streaking.
- 8) Adhesion Fed. Spec 141A, Method 6301.1 Immerse test panel in distilled water for 24 hours. Make two parallel scratches 1" apart. Apply Scotch 710 tape and rapidly remove. There should be 100% adhesion to the bare metal and between layers.
- 9) Abrasion Test - Taber Abrader. Prepare a panel coated with the component of the finish intended to provide abrasion resistance. Test using a CS-10 wheel, 1000 gram weight, 3000 cycles, per Fed. Spec. 141, Method 6192. This provides a comparative test between samples. To guard against corrosion, all hardware (including door fittings, fasteners, etc.), all operating-mechanism parts, and other parts subject to abrasive action from mechanical motion shall be of either nonferrous materials, or galvanized or zinc chromate plated ferrous materials. Cadmium-plated ferrous parts shall not be used.

5. Interrupter Switches:

- a. Interrupter switches shall have a three-time duty-cycle fault-closing rating equal to or exceeding the short circuit rating of the integrated padmounted gear assembly. These ratings define the ability to close the interrupter switch either alone (unfused) or in combination with the appropriate power fuses three times against a three-phase fault with asymmetrical current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Tests substantiating these ratings shall be performed at maximum design voltage with current applied for at least 10 cycles. Certified test abstracts establishing such ratings shall be furnished upon request.
- b. Interrupter switches shall utilize a quick-make, quick-break mechanism installed by the switch manufacturer. The quick-make, quick-break mechanism shall be integrally mounted on the switch frame, and shall swiftly and positively open and close the interrupter switch independent of the speed of the switch operating handle.
- c. Interrupter switches shall be operated by means of an externally accessible switch-operating hub. The switch-operating hub shall be located within a recessed stainless steel pocket mounted on the side of the padmounted enclosure. The switch-operating hub pocket shall include a padlockable stainless steel access cover that shall incorporate a hood to protect the padlock shackle from tampering. Labels or targets to indicate switch positions shall be provided in the switch operating hub pocket.
- d. Each interrupter switch shall be completely assembled and adjusted by the switch manufacturer on a rigid mounting frame. The frame shall be of heavy gauge steel construction.
- e. Interrupter switch shall be provided with contact blades and interrupters for circuit closing, including fault closing, continuous current carrying, and circuit interrupting. Spring loaded auxiliary blades shall not be permitted.
- f. Circuit interruption shall be accomplished by use of an interrupter which is positively and inherently sequenced with the blade position. It shall not be possible for the blade and interrupter to get out of sequence.
- g. Interrupter switches shall have a readily visible open gap when in the open position to allow positive verification of correct switch position.
- h. Each interrupter switch shall be provided with a switch operating handle. The switch-operating handle shall be secured to the inside of the switch operating hub pocket and shall be stored behind the switch operating hub access door.
- i. Key interlocks shall be provided to guard against opening fuse compartment door(s) unless all switches (series tap switch only, where furnished) are locked open.
- j. Provision to padlock switch operating hub in open or closed position shall be provided.
- k. Cable guides shall be provided to help orient cables at switch and bus compartment terminals.
- l. Mounting provisions shall be provided to accommodate one three-phase fault indicator with three single-phase sensors in each switch compartment (except series tap switch, where furnished).

6. Switch Compartments:

- a. Switch terminals shall be equipped with 600 ampere rated bushings that include removable threaded studs to accommodate a choice of termination

systems. Fuse terminals are equipped with 200 ampere rated bushing wells designed to accept 200 ampere bushing inserts. Bushings and bushing wells have interfaces in accordance with ANSI/IEEE Standard 386 (ANSI Standard C119.2) to accept all standard separable insulated connectors and inserts. Parking stands are provided adjacent to each bushing and bushing well to accommodate feed-throughs and standoff insulators.

- b. All medium-voltage switch and fuse components are completely encased in an inner grounded steel compartment. The component compartment floor shall be of 18-gauge galvanized steel sheet to exclude foliage and animals.
- c. Viewing windows are provided within the termination compartments to allow visual verification of switch position and inspection of blown-fuse indicators on power fuses.

7. Fuse Compartment:

- a. Fuse access panels have a mechanical interlock that guards against gaining access to the fuse before opening the loadbreak separable insulated connector at the fuse terminal.
- b. The fuse shall be accessible only when de-energized and isolated — for full-view non-loadbreak disconnection and removal with a shotgun stick. This mounting features positive latching in both the energized and de-energized positions. When latched in the open position, the de-energized fuse is electrically isolated and readily accessible to operating personnel for removal.
- c. Access to the compartment containing energized switches or fuses shall be blocked by a latched GPO-3 panel.
- d. Individual ground rings are provided for each fuse mounting to allow convenient grounding of cable concentric neutrals and elbow accessories. These ground rings are also equipped with cable guides to assist in cable training and to prevent cables from interfering with movement of the fuse-access panel.
- e. To provide maximum service life and to prevent corrosion of moving parts, all latches and pivots in the fuse-handling mechanism are either painted steel, stainless steel, or zinc-plated.
- f. Fuse storage hooks shall be provided on switch-termination compartment access door(s). Each set of hooks shall allow the storing of three spare fuseholder or fuse units with end fittings for power fuses. Storage hooks shall be for two holders when current limiting fuses are used.

C. LABELING

- 1. Warning Signs: All external doors shall be provided with NEMA approved "WARNING — HIGH VOLTAGE — KEEP OUT" signs.
- 2. Rating Nameplates and Connection Diagrams:
 - a. The outside of both the front and back shall be provided with nameplates indicating the manufacturer's name, catalog number, model number, and date of manufacture.
 - b. The inside of each door shall be provided with a ratings label indicating the following: voltage ratings; main bus continuous rating; short-circuit ratings (amperes, RMS symmetrical and MVA three-phase symmetrical at rated nominal voltage); the type of fuse and its ratings including duty-cycle fault-

- c. closing capability; and interrupter switch ratings, including duty-cycle fault closing capability and amperes, short-time, RMS (momentary asymmetrical and one-second symmetrical).
- c. A three-line connection diagram showing interrupter switches, fuses and bus along with the manufacturer's model number shall be provided on the inside of both the front and rear doors, and on the inside of each switch operating hub access cover.
- D. Auxiliaries: End fittings or holders, and fuse units or refill units for original installation, as well as spare fuse unit or refill unit for each fuse mounting, shall be furnished in accordance with the client's requirements when specified.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive switchgear for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Anchor switchgear assembly to 4-inch, channel-iron sill embedded in concrete base and attach by bolting.
 - 1. Sills: Select to suit switchgear; level and grout flush into concrete base.
 - 2. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no less than 3 inches in all directions beyond the maximum dimensions of switchgear, unless otherwise indicated or unless required for seismic anchor support.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchgear units and components.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
- B. Diagram and Instructions:
 - 1. Frame under clear acrylic plastic on front of switchgear.
 - a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.

- b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.
- 2. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

3.4 CONNECTIONS

- A. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" and Section "Medium-Voltage Cables."

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1. Inspect switchgear, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
 - 2. Assist in field testing of equipment including pretesting and adjusting of automatic power factor correction units.
 - 3. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:
 - a. Switchgear.
 - b. Protective relays.
 - c. Instrument transformers.
 - d. Metering and instrumentation.
 - e. Ground-fault systems.
 - f. Battery systems.
 - g. Surge arresters.
 - h. Capacitors.
- D. Remove and replace malfunctioning units and retest as specified above.

- E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes infrared-scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Set field-adjustable, protective-relay trip characteristics according to results in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of switchgear. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.

3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 26 13 00

WSH13095

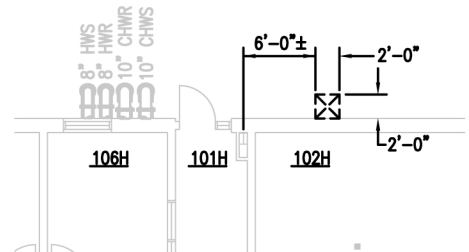
William Sharpe Hospital
50 Bed Addition

Sketch SKE-1

Corresponding to RFQ Item: 97

PLAN NOTES

- ① CONTRACTOR SHALL FURNISH AND INSTALL UNDERGROUND SCHEDULE 80 PVC CONDUITS WITH PULL WIRE FOR FUTURE USE AS FOLLOWS: (2)-4", (2)-2" AND (4)-1". MINIMUM BURIAL DEPTH TO TOP OF CONDUITS = 2'-6". CONDUITS SHALL BE ENCASED IN CONCRETE WITH RED DYE ADDED TO MIXTURE. REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION.
- ② FURNISH AND INSTALL 2'-0" x 2'-0" x 1'-6" DEEP "QUAZITE" PG STYLE OPEN BOTTOM STACKABLE ENCLOSURE AS MANUFACTURED BY HUBBELL POWER SYSTEMS (OR EQUAL AS APPROVED BY ENGINEER). PROVIDE COVER FLUSH WITH FINISHED GRADE AND STAMPED "ELECTRICAL". ALL HARDWARE, FASTENERS, ETC. SHALL BE STAINLESS STEEL.
- ③ ALL CONDUITS SHALL TURN UP INTO BOTTOM OF "QUAZITE" BOX.
- ④ CONTRACTOR SHALL FIELD VERIFY ROUTING OF CONDUITS TO AVOID CONFLICT WITH OTHER UTILITIES AND TO INSTALL PER APPLICABLE CODES. PULL BOXES SHALL BE PROVIDED AS NECESSARY/REQUIRED AND ALL COSTS SHALL BE INCLUDED IN BASE BID.



PARTIAL FLOOR PLAN-BLDG "H"

SCALE: 1/16" = 1'-0"

PARTIAL SITE PLAN

SCALE: 1/16" = 1'-0"

ZDS

DESIGN/CONSULTING
SERVICES

91 SMILEY DRIVE
ST. ALBANS, WV 25177
PHONE: (304) 755-0075
FAX: (304) 755-0076

WILLIAM R. SHARPE
HOSPITAL
50 Bed Addition
ADDENDUM #4
RFQ RESPONSE 97
REFERENCE DRAWING ES101
REVISION #1

PROJECT #
WSH13095

ISSUE DATE:
11-14-12

REVISION DATE:
1-30-13

DRAWING #

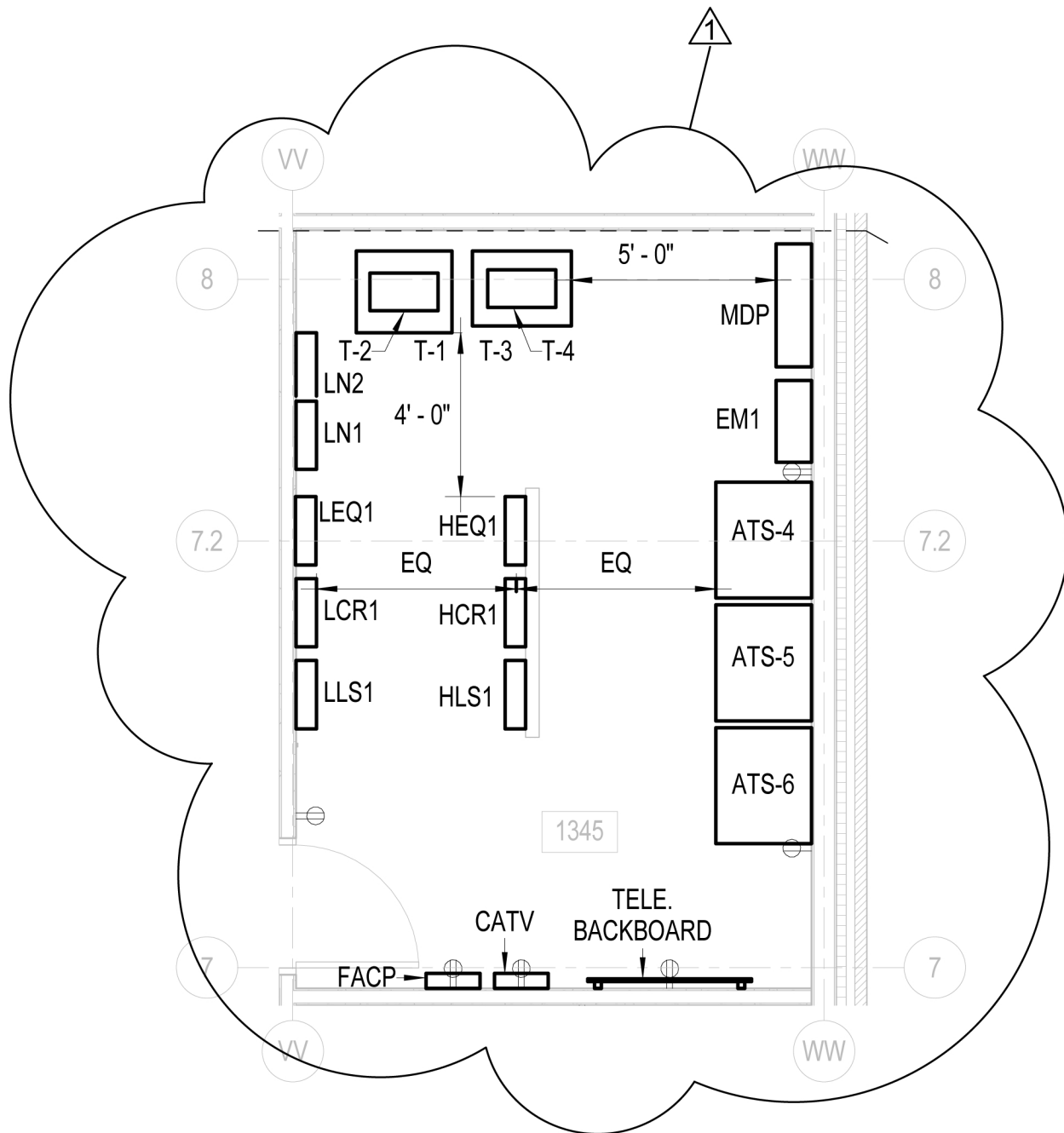
SKE-1

WSH13095

William Sharpe Hospital
50 Bed Addition

Sketch SKE-2

Corresponding to RFQ Item: 98



REVISED ELECTRICAL ROOM

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

ZDS

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RFQ RESPONSE 98
REFERENCE DRAWING E203
REVISION # 1

PROJECT #
WSH13095

ISSUE DATE:
11/14/2012

REVISION DATE:
1-30-2013

DRAWING #

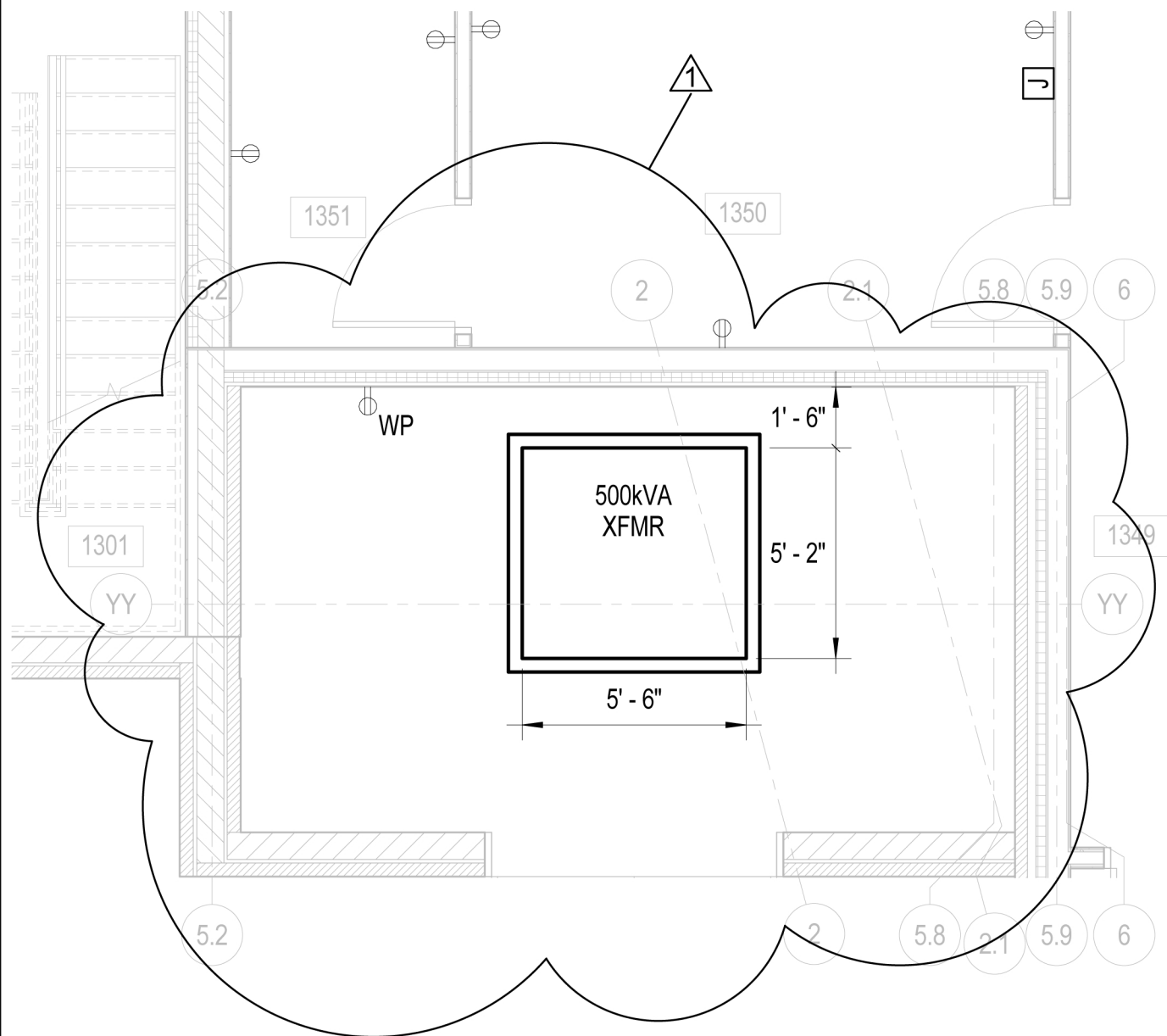
SKE-2

WSH13095

William Sharpe Hospital
50 Bed Addition

Sketch SKE-3

Corresponding to RFQ Item: 98



TRANSFORMER ENCLOSURE

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

ZDS

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RFQ RESPONSE 98
REFERENCE DRAWING E203
REVISION # 1

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1-30-2013

DRAWING #

SKE-3

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 01 91 13 – General Commissioning Requirements

Corresponding to RFQ Item: 100

SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Division 20 – Mechanical, Electrical and Plumbing General Requirements applies to and forms a part of all specifications. Articles of this section shall govern unless superseded by specific stipulations of that Division of the Specifications.
- C. General notes on all drawings apply to and form a part of the Specifications.

1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is ideally achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment start-up, control system calibration, testing and balancing, performance testing and training.
- C. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - 2. Verify and document proper performance of equipment and systems.
 - 3. Verify that O&M documentation is complete and delivered to the Owner.
 - 4. Verify that the Owner's operating personnel are adequately trained.
- D. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product. The Commissioning Agent is hired directly by the Owner not the Contractor. All contractor responsibilities related to the commissioning process shall be included in the Contractor's base bid.
- E. Related Sections:
 - 1. Division 01 Section "Submittal Procedures" for additional detail in submittals required for commissioning.

2. Division 01 Section "Closeout Procedures" which defines substantial completion and functional completion, relative to commissioning.
3. Division 01 Section "Operation and Maintenance Data" defines commissioning documentation requirements.
4. Division 22 Section "Commissioning of Plumbing" for commissioning process activities for plumbing systems, assemblies, equipment, and components.
5. Division 23 Section "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.
6. Division 26 Section "Commissioning of Electrical Systems" for commissioning process activities for electrical systems, assemblies, equipment, and components.

1.3 DEFINITIONS

- A. Acceptance Phase: This is the phase of the project when the facility and its systems and equipment are inspected, tested, verified, and documented; and when most of the Functional Performance Testing, O&M documentation review and formal training occurs. This will generally occur after the Construction Phase is complete (start-up and checks have been accomplished). The Acceptance Phase typically begins with Substantial Completion and ends with Functional Completion.
- B. Action Item (AI): Any issue that requires a response, completion, corrective or additional work, or any other action. Examples include a Request for Information (RFI), a work directive, a clarification request, a to-do item, an identified deficiency, or any other like item. Action Items must be categorized as appropriate.
- C. Approval/Acceptance: Acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.
- D. Architect/Engineer (A/E): The prime consultant (architect) and sub-consultants who comprise the design team, generally the HVAC mechanical designer/engineer and the electrical designer/engineer.
- E. ASHRAE: American Society of Heating, Refrigerating, and Air Conditioning Engineers.
- F. Basis of Design (BoD) Document: The Basis of Design document shall respond to, and be consistent with, the performance criteria specified in the Design Intent Document. The BoD illustrates the means by which DID criteria are to be achieved, documenting the assumptions and parameters used in the design, and documenting the primary thought processes or decisions made that resulted in the selected alternatives. At the end of the project, the final BoD may be incorporated into the Facility Manual if desired in part or in its entirety.
- G. Building Automation System (BAS): The computer-based control or automation system. May also be referred to as the FMS.
- H. Commissioning (Cx): The process of ensuring that all building systems perform interactively according to the design intent, the systems are efficient and cost effective and meet the Owner's operational needs.

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- I. Commissioning Authority/Agent (CA or CxA): hired by the Owner not associated with the Contractor. The CxA directs and coordinates the day-to-day commissioning activities. The CxA does not take an oversight role.
- J. Commissioning Issues Log: A log created and updated by the CxA to track and maintain the updates of issues found during the Commissioning Process.
- K. Commissioning Plan (Cx Plan): A document developed by the CxA that outlines the organization, schedule, allocation of resources, documentation requirements, etc. of the commissioning process.
- L. Commissioning Specifications ('Commissioning Specs'): Includes separate Commissioning specification sections and Commissioning-related subsections of other specifications. All Contractor requirements relating to Commissioning should be conveyed within the Commissioning Specs.
- M. Contractor: As used herein, 'Contractor' is a general reference to the installing Party and can therefore refer to the General Contractor (GC), subcontractors (Controls Contractor or Temperature Controls Contractor (CC or TCC); Electrical Contractor (EC); Mechanical Contractor (MC); Plumbing Contractor (PC); Fire Protection Contractor (FP); Fire Alarm Contractor (FA)), or vendors as inferred by its usage.
- N. Construction Phase: Phase of the project during which the facility is constructed and/or systems and equipment are installed and started. Contractor and subcontractors complete the installation, complete start-up documentation, submit O&M information, establish trends, and perform any other applicable requirements to get systems started. Contractor and Vendors may also conduct equipment specific training. The Construction Phase will generally end upon completed start-up and TAB of systems and equipment.
- O. Contract Documents: The documents governing the responsibilities and relationships between Parties involved in the design and construction of this project including (but not necessarily limited to):
 - 1. Agreements/Contracts.
 - 2. Construction Plans and Drawings.
 - 3. Specifications.
 - 4. Addenda.
 - 5. Change Orders.
- P. Deferred Functional Tests : FTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.
- Q. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).
- R. Endurance Period: The period for critical facilities during which the systems are operated by operators and occupant representatives in accordance with the design intent to validate that it is performing properly and is maintainable. The period starts at the end of Functional Completion (completion of successful Functional Performance Testing). Substantial Completion will typically start concurrently with the Endurance Period.

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- S. Facility Management System (FMS): Alternate reference to the computer based control or automation system. May also be referred to as automatic temperature control (ATC) system, direct digital control (DDC) system, building automation system (BAS), building management system (BMS), building management and control system (BMCS), digital control system (DCS), Energy Management System (EMS), Energy Management and Control System (EMCS) or System Control And Data Acquisition (SCADA) System.
- T. Factory Authorized Representative: An individual fully trained on the equipment and certified by the manufacturer to perform the respective task.
- U. Factory Testing: Testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.
- V. Functional Completion: A milestone that marks the completion of the Acceptance Phase and successful completion of the FTs by the CxA.
- W. Functional Performance Test (FT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FT's are performed after pre-functional checklists and start-up are completed.
- X. IAQ: Indoor Air Quality.
- Y. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- Z. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
- AA. Non-Compliance: See Deficiency.
- BB. Non-Conformance: See Deficiency.
- CC. Operation and Maintenance (O&M) Documentation: When a full Facility Manual is not specified, this refers to Contractor- developed documentation designed to address the needs of facilities personnel and customized for the context of the specific facility and installation. The foundation of O&M Documentation is manufacturer's literature (including 'O&M Manuals', parts lists, troubleshooting guides, etc.) as well as Contractor-developed instructions for start-up and shut-down, sequences, and other

installation-specific information. O&M Documentation content is a subset of the Facility Manual, so it is common for only one or the other to be specified.

- DD. O&M Manuals: This term shall be reserved for referencing manufacturer-published O&M documents, which generally has no information specific to the specific facility. Specifications should strive for this information to be submitted in electronic form whenever possible.
- EE. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50°F to 75°F to verify economizer operation). See also “Simulated Signal.”
- FF. Owner/Owner Representative (OR): Responsible individual representing the Owner in the overall construction project through whom all decisions and direction are made.
- GG. Party: Individual, company or entity.
- HH. Pre-functional Checklist (PC): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment. Forms will be prepared and provided by the CxA to the Contractor, the Contractor is responsible for performing all inspections, tests, checks and completing the forms. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word pre-functional refers to before functional performance testing. Pre-functional checklists augment and are combined with the manufacturer’s start-up checklist. Even without a commissioning process, contractors typically perform some, if not many, of the pre-functional checklist items a commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The commissioning authority only requires that the procedures be documented in writing, and does not witness much of the pre-functional check listing, except for larger or more critical pieces of equipment as selected by the CxA.
- II. Project Phases: Phases of the project include the Design, Construction Phase, Acceptance Phase, Warranty Phase, and Occupancy.
- JJ. RFI: Request for Information.
- KK. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.
- LL. Seasonal Performance Tests: FT that are deferred until the system(s) will experience conditions closer to their design conditions.
- MM. Simulated Condition: Condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).

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- NN. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.
- OO. Start-up: Refers to the process whereby the Contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the Start-Up Checklist, energizes the device, verifies that it is in proper working order and ready for dynamic testing, and completes the Start-Up Tests.
- PP. Start-up Documentation: The record of the start-up activity. These are typically forms produced by the manufacturer or the Commissioning team to document the key start up related parameters and to solicit, from the start up technician, confirmations of successful completion of required activities. The start-up technician completes the start-up documentation and signs off on it for confirmation.
- QQ. Start-up Procedures: Refers to the tasks and processes indicated by the Start-Up Checklists and Start-Up Tests. Start-up Procedures are typically performed by the Contractor with or without a formal Commissioning process. The Contractor documents the start-up process by completing and submitting the Start-up Procedures.
- RR. Systems Matrix: A matrix that lists systems and equipment as individual rows (generally using the spec as a guide) and columns that indicate different tasks, documentation, and work elements. The content of the cells of the matrix summarizes the requirement for system as it relates to that column. It provides an effective summary of requirements that is approved by the Owner and operator representatives during design phase.
- SS. TAB: Can refer to the test, adjust, and balance process or the Testing, Adjusting, and Balancing Contractor.
- TT. Temporary Conditioning Plan: A plan that summarizes the logistics, procedures and protocols for taking permanent equipment and using it to maintain conditions throughout construction. The Temporary Conditioning Plan must be approved by all members of the Commissioning Team prior to placing equipment into temporary service.
- UU. Test: A task, procedure or measurement that confirms capacity, functionality, accuracy, etc. Tests have a status of Pass, Fail, Couldn't or Didn't.
- VV. Test Procedures: The step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA.
- WW. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents
- XX. Trending: Monitoring using the building control system.
- YY. Vendor: Supplier of equipment.
- ZZ. Warranty Period: Warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

- AAA. Witnessed Start Up: A period at the end of equipment or systems start up during which a quality control checklist items are completed to ensure the start-up was done to a high standard of care. Contractor provides notification of the activity and operators and CxT members are invited to witness. Contractor does not have to schedule around other parties' availability.

1.4 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1-2007 - Guideline for Commissioning HVAC Systems
- B. ASHRAE Guideline 4 - Preparation of operating and Maintenance Documentation for Building Systems
- C. NEBB - Procedural Standards for Building Systems Commissioning
- D. AABC Commissioning Group (ACG) – Commissioning Guideline

1.5 COORDINATION

- A. Commissioning Team: The members of the commissioning team consist of the Commissioning authority (CxA or CA), the Owner's Representative (OR), the General Contractor (GC or Contractor), the architect and design engineers (particularly the mechanical and electrical engineers), the HVAC Contractor (HC), the Plumbing Contractor (PC), the Electrical Contractor (EC), the TAB representative, the Direct Digital Controls Contractor (DDC), any other installing subcontractors or suppliers of equipment. The Owner's building or plant operator/engineer is also a member of the commissioning team.
- B. Scheduling: The CxA will work with the GC according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.
- C. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The Commissioning Plan—Construction Phase provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxA to be incorporated into the Contractor's construction schedule.

1.6 SYSTEMS TO BE COMMISSIONED

- A. Commissioning of equipment or systems specified for this project is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's Operation and Maintenance personnel, is required in cooperation with the Owner and the Commissioning Authority.
- B. The Contractor is responsible for providing full commissioning of 100% of the systems and equipment included below as part of the construction phase of this project

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regardless of the sampling rate of the CxA. The CxA will prepare a final list of all systems and equipment to be commissioned involving the CxA and will identify the sampling quantity of each system or equipment to be field verified by the CxA as part of the final Cx Plan.

- C. Systems to be commissioned as part of this project include, but are not limited to the list below. Quantities shown in parenthesis indicate an approximate sampling amount of each system/equipment type for which the Contractor is to include commissioning time in their bid to allow for the verification of functional performance testing results as directed by the CxA. The CxA shall refine this list and the sampling quantity in the final Cx Plan. If during verifications, it is determined that significant deficiencies in functional performance exist even after the contractor has indicated that systems meet the performance requirements, the CxA may expand the sampling quantity to a greater amount to verify the deficiencies of each piece of equipment. In the event this becomes necessary, the Contractor will be charged and will pay for the additional costs incurred by the CxA, A/E, and Owner to perform additional verification/witnessing.

1. Plumbing (Division 22)

- a. Hot water circulating pumps and controls. (100%)
- b. Thermostatic mixing valves. (100%)
- c. Point of use temperatures. (10% - 20% of showers and lavatories)

2. HVAC (Division 23)

a. Air Handling Units (100%):

1. Supply and Return fans, motors, and Variable Speed Drives. Fanwall system control and sequencing.
2. Cooling coils and control valves.
3. Heating coils and control valves.
4. Filters.
5. Dampers.
6. Ultra-violet lights.
7. Safeties such as smoke detectors or freeze-stats and damper end switches.
8. Controls, complete sequence of operation testing, including smoke management operation.
9. Meters, gages, and vibration isolation.

b. Exhaust Fans: Fan, motor, controls and safeties. (10% or minimum of 2)

c. Direct Digital Control System (100%):

1. Operator Work Station hardware and software.
2. Building controller hardware and software.
3. Terminal unit controller hardware and software.
4. Web-based interface operation and access control.
5. All sequences of operation, including smoke management and exterior lighting control.
6. Power monitoring.
7. System and device accuracy and response time.

d. Smoke Zone Pressurization Control (100%):

1. Pressure sensors.
2. Terminal units/dampers.

3. Controls and alarms.
 - e. Terminal Units (100% serving patient rooms, 20% or minimum of 2 of remainder):
 1. Variable Air Volume (VAV) boxes and re-heat coils and controls.
 - f. Unit Heaters. (10% or minimum of 2).
 - g. Radiant Ceiling panels and controls. (10% or minimum of 2).
 - h. Air Curtains. (100%)
 - i. Split Systems: Fan and controls (10% or minimum of 1).
 - j. Testing, Adjusting, and Balancing (TAB): Verification of reported final balancing values for randomly selected systems/devices. (100% associated with patient areas, 10% of remainder)
 3. Electrical (Division 26)
 - a. Emergency Power Distribution Systems (100%):
 1. Automatic transfer switches and operation on loss of normal power.
 2. Interface with the emergency generator systems.
 - b. Lighting Controls (20%):
 1. Control system hardware and software and light zoning.
 2. Occupancy sensor operation.
 4. Electronic Safety and Security (Division 28)
 - a. Fire Detection and Alarm: Mechanical systems interface for smoke management operation, verification of system testing performed and passed in the presence of the authority having jurisdiction. (100%)
- D. In addition to other commissioning related tasks, including meetings, the Contractor shall allow for the following anticipated participation and durations for functional performance test verification and closeout by the CxA for each piece of equipment or system identified. The duration periods will be refined by the CxA in the Cx Plan as reviewed with the Contractor. The Contractor is to include time in their bid price using the following as a guide, but will be expected to perform the requirements of the functional performance verification at no additional charge to the Owner, regardless of the actual durations.
1. Plumbing
 - a. Hot water circulating pumps and controls: CxA, PC, TAB – 1/2 hour/pump.
 - b. Thermostatic mixing valves: CxA, PC, TAB – 1 hour/device.
 - c. Point of use temperatures: CxA, PC – 1 hour total.
 2. HVAC
 - a. Air Handling Units: CxA, MC, TAB, CC, EC – 4 hours/unit.
 - b. Exhaust Fans: CxA, MC, CC, TAB, EC – 1/2 hour/unit.
 - c. Direct Digital Control System: CxA; TAB, MC, EC – 4 hours; CC – 12 hours and as required for all other system verifications described herein.
 - d. Space Pressurization Equipment: CxA, TAB, CC, FA – 4 hours total.

- e. Terminal Units – VAV boxes: CxA, MC, TAB, CC – 1 hour/unit.
- f. Unit Heaters: CxA, TAB, CC – 1/2 hour/unit.
- g. Radiant Ceiling Panels: CxA, TAB, CC – 1/2 hour/unit.
- h. Air Curtains: CxA, TAB, CC – 1/2 hour /unit.
- i. Split Systems: CxA, MC, CC – 1/2 hour /unit.
- j. Testing, Adjusting, and Balancing (TAB): CxA, TAB – 4 hours and as required for all other system verifications described above.

3. Electrical

- a. Emergency Power Distribution Systems: CxA, EC – 8 hours total.
- b. Lighting Controls: CxA, EC – 4 hours total.

4. Electronic Safety and Security

- a. Fire Detection and Alarm – Smoke Management Operation Interface: CxA, FA – up to 4 hours total.

1.7 COMMISSIONING PROCESS

- A. Commissioning Plan: The Commissioning Plan, which will be fully developed by the CxA shall be binding on the Contractor. The commissioning plan provides guidance in the execution of the commissioning process. The CxA shall develop a preliminary Cx Plan and submit it to the GC and the Owner for review. After the initial commissioning scoping meeting the CxA will update the plan which is then considered the “final” plan, though it will continue to evolve and expand as the project progresses. In the event of a conflict, The Specifications will take precedence over the Commissioning Plan. The Commissioning Plan shall include, but is not limited, to the following:

- 1. Plan for delivery and review of submittals, O&M manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.
- 2. Description of the organization, layout, and content of commissioning documentation and a detailed description of documents to be provided along with identification of responsible parties.
- 3. Identification of systems and equipment to be commissioned and verified/witnessed.
- 4. Identification of items that must be completed before the next operation can proceed.
- 5. Description of responsibilities of commissioning team members.
- 6. Description of observations to be made.
- 7. Description of requirements for operation and maintenance training.
- 8. Schedule for commissioning activities with dates coordinated with overall construction schedule.
- 9. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
- 10. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
- 11. Preliminary Systems Functional Performance Test procedures.

- B. The Commissioning will be categorized into Phases as indicated below. Note that per schedule, different systems and/or areas may be in different phases of construction at any given time given that the Commissioning and testing process will be integrated into the construction process:
1. Construction Phase: This is the period of time where the systems are installed, much of the commissioning documentation is developed, the systems are started, prefunctional checklists are completed, and the majority of the contractor required training is performed. On any given system or area, the Construction Phase, as it relates to commissioning, will end when the CxA recommends proceeding with the Functional Performance testing.
 2. Acceptance Phase: This is the period of time where the systems will be functionally tested and the systems will operate through an endurance period. Refer to item "Endurance Period" below.
 3. Warranty Phase: This is the period of time that coincides with the start and end of the contractor's base warranty.
- C. Commissioning Process: The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
 2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
 3. Equipment documentation is submitted to the CxA during normal submittals, including detailed start-up procedures, spare parts lists, and preventive maintenance schedules.
 4. The CxA works with the Contractors in developing start-up plans and start-up documentation formats, including providing the Contractors with pre-functional checklists to be completed by the Contractor, during the start-up process.
 5. In general, the checkout and performance verification procedures range from simple to complex; from component level to equipment to systems and intersystem levels with pre-functional checklists being completed before functional performance testing.
 6. The Contractors, under their own direction, execute and document the pre-functional checklists and perform start-up and initial checkout. The CxA documents that the checklists and start-up were completed according to the approved plans. This may include the CxA witnessing start-up of selected equipment.
 7. The CxA develops specific equipment and system functional performance test procedures. The Contractors review the procedures.
 8. The procedures are executed by the Contractors, under the direction of and witnessing by the CxA, and documented by the CxA.
 9. Items of non-compliance in material, installation or setup are corrected at the Contractor's expense and the system retested.
 10. The CxA reviews the O&M and Preventive Maintenance Schedules documentation for completeness.
 11. Commissioning is completed before Substantial Completion is issued.
 12. The CxA reviews, makes comments, attends, and evaluates the training provided by the Contractors and verifies that it was completed.
 13. Deferred testing is conducted, as specified or required.

1.8 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, the General Contractor (GC) and representatives of the Contractor, including Project superintendent and sub-contractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 - 1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
 - 2. Representatives of the facility user and operation and maintenance personnel.
 - 3. The Owners Representative.
 - 4. Architect and engineering design professionals.

1.9 RESPONSIBILITIES

- A. Owner's Responsibilities
 - 1. Engage the services of an individual, company or firm to act as the Commissioning Authority (CxA).
 - 2. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:
 - a. Coordination meetings.
 - b. Training in operation and maintenance of systems, subsystems, and equipment.
 - c. Testing meetings.
 - d. Witness and assist in Systems Functional Performance Testing.
 - 3. Provide the Construction Documents, prepared by the Architect/Engineer and approved by the Owner, to the Commissioning Authority for use in managing the commissioning process, developing the commissioning plan, and reviewing the operation and maintenance manuals and training plan.
- B. Commissioning Authority's Responsibilities
 - 1. Organize and lead the commissioning team.
 - 2. Prepare the preliminary and finalized commissioning plan, and continually update as necessary throughout the construction progress.
 - 3. Review and comment on selected submittals from the Contractor for general conformance with the Construction Documents and commissioning process. Review and comment on the ability to test and operate the system and/or equipment, including providing gages, controls and other components required to operate, maintain, and test the system. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the Construction Documents and commissioning process.
 - 4. At the beginning of the construction phase, conduct an initial construction phase coordination/scoping meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance

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- submittals; operation and maintenance training sessions; TAB Work; Pre-Functional Checklists, Systems Functional Performance Testing; and project completion.
5. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss status of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The Commissioning Authority shall prepare and distribute minutes to commissioning team members and attendees.
 6. Observe construction and report progress, observations and issues. Observe systems and equipment installation for adequate accessibility for maintenance and component replacement or repair, and for general conformance with the Construction Documents and to facilitate the commissioning process.
 7. Prepare Project specific Pre-Functional Checklists and Systems Functional Performance Test procedures.
 8. Coordinate Systems Functional Performance Testing schedule with the Contractor.
 9. Witness selected systems startups.
 10. Verify selected Pre-Functional Checklists completed and submitted by the Contractor.
 11. Witness and document Systems Functional Performance Testing.
 12. Compile test data, observation reports, and certificates and include them in the commissioning report.
 13. Review and comment on operation and maintenance (O&M) documentation and preventive maintenance schedule manual for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Division 01 and Division 20 Sections.
 14. Review operation and maintenance training program developed by the Contractor. Verify training plans provide qualified instructors to conduct operation and maintenance training.
 15. Prepare commissioning Field Observation Reports.
 16. Prepare the Final Commissioning Report.
 17. Assemble the final commissioning documentation, including the Final Commissioning Report and Addendum to the Final Commissioning Report.

C. Contractor Responsibilities

1. Construction Phase: The following delineates the commissioning-related responsibilities of the Contractor (and their subcontractors) during the Construction Phase.
 - a. Include Commissioning requirements as indicated in this and all related commissioning specifications in the bid price and plan for all associated work. The Contractor shall include time to provide full commissioning on 100% of the systems and equipment identified in Section 1.6 above, as well as indicated sampling quantities for verification of performance testing.
 - b. Designate a Commissioning Coordinator (CxC) from the GC and each major subcontractor with activities related to commissioning. These Commissioning Coordinators are to be the primary contacts for Commissioning activities.
 - c. Attend Construction Phase Commissioning Kick Off/Scoping Meeting. The Commissioning Coordinator and Project Manager from each major subcontractor shall attend at a minimum.

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- d. The Commissioning Coordinator shall attend all Commissioning progress meetings unless otherwise agreed to by the CxA.
- e. Address any deficiencies identified throughout construction.
- f. Prepare and submit required draft Start-Up Procedures and submit along with the manufacturer's application, installation and start-up information.
- g. TAB shall submit sample balancing forms for review and comment prior to starting work.
- h. Schedule and coordinate Commissioning efforts into the construction schedule. Incorporate the tasks and anticipated commissioning durations as indicated in the specifications and the Cx Plan, provided by the CxA, into the construction schedule. Indicate at a minimum all tasks indicated in the Cx Plan for equipment and systems.
- i. Coordinate the work of subcontractors, vendors, manufacturers, and Testing Agencies provided with the bid, and ensure that they are informed of and are adhering to the requirements of the Commissioning process specified throughout the contract documents. Particular reference is made to providing the required O&M Documentation; to submittal of training materials and documentation of that training; to collaboration with the overall start-up and testing process; to developing comprehensive integrated procedures for scheduling and task notification and documenting them in a common format; and to electronic delivery requirements as applicable.
- j. Develop and submit Temporary Conditioning Plan as necessary.
- k. Provide assistance to the CxA in preparation of the specific Functional Performance Test (FT) procedures. Contractors, subcontractors and vendors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests. Damage caused to equipment performed in accordance with the approved procedures will be the responsibility of the Contractor.
- l. Thoroughly complete and inspect installation of systems and equipment as detailed throughout Contract Documents, as required by reference or industry standards, and as specifically indicated elsewhere this section.
- m. Start-up, test, adjust, and balance systems and equipment prior to verification and performance testing by the Commissioning Authority. Start-up procedures shall be in accordance with Contract Documents, reference or industry standards, and specifically individual Commissioning specifications. Provide skilled technicians qualified to do the work required. Provide factory trained/authorized technicians where required by the contract documents and stated in the applicable technical sections. Generally start up and testing shall proceed from device checkout, to component checkout, to system checkout, to inter-system checkout.
- n. Prepare spaces with adequate security for on-site contractors to store equipment. The various subcontractors and the CxA will need space to conduct business and store equipment and files.
- o. Schedule for representative space mock ups as early as possible to facilitate determining standards for close out.

- p. Record start-up and testing procedures on start-up forms or checklists and certify that the systems and equipment have been started and or tested in accordance with the requirements specified above. Each task or item shall be indicated with the party actually performing the task or procedure.
 - q. Provide skilled technicians qualified to perform the work required.
 - r. Provide factory-trained and authorized technicians where required by the Contract Documents.
 - s. Record Start-up Procedures on start-up procedure forms and certify that the systems and equipment have been started and or tested in accordance with the requirements specified above. Each task or item shall be indicated with the Party actually performing the task or procedure.
 - t. Tag equipment that is started with the responsible individual's name and date.
 - u. Demonstrate the operation of all systems as specified.
 - v. Certify that systems have been installed and are operating per Contract Documents prior to functional performance testing.
 - w. Maintain an updated set of Record Documentation as required by the Contract Documents.
 - x. Copy the CxA on indicated documentation.
 - y. Conduct and document Equipment and Systems Training events as required by this Section and by applicable sections of the Specifications pertaining to each piece of equipment or system.
2. Acceptance Phase: The following delineates the commissioning-related responsibilities of the Contractor (and their subcontractors) during the Acceptance Phase.
- a. Assist CxA in functional performance testing. Assistance will generally include the following:
 - 1. Manipulate systems and equipment to facilitate testing as indicated in the functional performance testing forms and specification sections.
 - 2. Provide any specialized instrumentation necessary for functional performance testing.
 - 3. Manipulate BAS and other control systems to facilitate functional performance testing.
 - b. Correct any work not in accordance with Contract Documents.
 - c. Participate in Training Events relative to use of O&M information and the Preventive Maintenance program.
 - d. Maintain record documentation, and update and resubmit it after Functional Completion.
 - e. Monitor systems, equipment and areas throughout the Endurance Period. Log and diagnose all alarms during this period. Maintain trends and logs of all critical parameters. Forward the logs and trends on a weekly basis throughout all Endurance Periods.

3. Warranty Phase: The following delineates the commissioning-related responsibilities of the Contractor (and their subcontractors) during the Warranty Phase.
 - a. Provide warranty service.
 - b. Provide warranty maintenance as specified.
 - c. Conduct BAS sequence training.
 - d. Respond to and document warranty issues.
 - e. Participate as required in the opposite season testing.
 - f. Correct any deficiencies identified throughout the warranty phase.
 - g. Update record documentation to reflect any changes made throughout the warranty phase and resubmit final Record Drawings at the close of the warranty period.

D. Equipment Supplier/Vendor Responsibilities

1. Construction Phase: The following delineates the commissioning-related responsibilities of the Equipment Supplier during the Construction Phase.
 - a. Provide shop drawings and product data in hard copy and electronic format.
 - b. Provide manufacturer's application, installation and start-up instructions within 30 days of shop drawing/product data approval.
 - c. Where factory-authorized start-up is specified, coordinate and participate in the specified commissioning process and document start-up on the appropriate forms.
 - d. Review and approve Functional Test Procedures affecting supplied equipment.
 - e. Where training is to be provided by factory-authorized personnel, provide required Training Plan information including course content for approval by A/E and review and comment by CxA prior to conducting the training.
 - f. Conduct and document Equipment and Systems Training events as required by this Section and by applicable sections of the Specifications pertaining to each piece of equipment or system.
 - g. Provide spare parts and materials as required by Specifications.
 - h. Provide special tools as required by the Specifications.
 - i. Provide content as required and develop project-specific O&M content as required by the Commissioning requirements.
 - j. Provide all specified warranties.
2. Acceptance Phase: The following delineates the commissioning-related responsibilities of the Equipment Supplier during the Acceptance Phase.
 - a. Participate in any Functional Performance Testing and Demonstrations required.
 - b. Consult on issues identified relative to the supplied equipment.
3. Warranty Phase: The following delineates the commissioning-related responsibilities of the Equipment Supplier during the Warranty Phase.

- a. Provide any warranty service required to the supplied equipment as applicable with the agreement with the Contractor.
- b. Provide technical support to the Owner's facilities personnel.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform start-up and initial prefunctional checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. All testing equipment used in the commissioning process shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC system and controls system in Division 23, except for equipment specific to and used by the TAB in their commissioning responsibilities. Two-way radios shall be provided by the Division Contractor.
- B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone data logging equipment that may be used by the CxA.
- C. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 MEETINGS (Contractors shall include time in their base bid for CxA meetings)

- A. Scoping Meeting: Within 120 days of commencement of construction, the CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise their preliminary Commissioning Plan to its "final" version, which will also be distributed to all parties. The following will be discussed at this meeting:
 - 1. The Commissioning Documents.

2. Requirements of Commissioning.
3. Responsibilities of the construction parties.
4. Management protocols.
5. Required submittals.
6. Schedule.

- B. Miscellaneous Meetings: Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with the General Contractor and affected subcontractors. The CxA will plan these meetings and will minimize unnecessary time being spent by Subcontractors. These meetings may be held monthly, until the final 3 months of construction when they may be held as frequently as one per week.

3.2 REPORTING

- A. The CxA will provide regular reports to the A/E, GC and Owner with increasing frequency as construction and commissioning progresses.
- B. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.
- C. Testing or review comments and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

3.3 SUBMITTALS AND DOCUMENTATION

- A. Contractor shall provide to the Commissioning Authority the following per the procedures specified herein and in other Sections of the specification:
 1. Shop Drawings and Data: One hard copy of Shop Drawings and product data related to systems or equipment to be commissioned. Commissioning Authority shall review and incorporate comments via the Design Engineer. Documentation shall include spare parts lists.
 2. Draft Start-Up Procedures: Contractor shall develop Start-up Procedures for all applicable equipment and systems along with the manufacturer's application, installation and start-up procedures. CxA may initially provide to the Contractor generic Start-up Checklists, the content of which must be reviewed by the Contractor and supplemented with manufacturer- specific requirements and the Contractor's own internal quality assurance procedures and checks. CxA will review drafts and provide comments.
 3. Draft Preventive Maintenance Schedules: Contractor shall provide manufacturer suggested preventive maintenance schedules for each piece of equipment and sample preventive maintenance tracking/verification forms for review and comment prior to the Acceptance Phase. The Preventive Maintenance Schedules shall be collected by the GC from all subcontractors and bound in a tabbed three ring binder(s) with Table of Contents.

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4. Factory Test Reports: Contractor shall provide any factory testing documentation or certified test reports required by the specifications. These shall be provided prior to Acceptance Phase.
 5. Schedule Updates: Issue periodic updates to the construction schedule. Provide to the CA at least once per month before building is closed in and every two weeks. Contractor shall use schedule to notify Commissioning team of scheduled start-up and training activities.
 6. Action Item/Commissioning Issue Response: Responses to Action Items/Issues Log Items to which Commissioning team members assign the Contractor responsibility.
 7. Field Testing Agency Reports. Provide all documentation of work of independent testing agencies required by the specification. These shall be provided prior to Acceptance Phase.
 8. Completed Start-Up Procedures: Completed Start-Up Procedure documentation for all applicable equipment and systems. CA will review prior to functional performance testing.
 9. Nameplate Data Documentation: Provide prior to the start of the Acceptance Phase.
 10. Equipment Warrantees: Provide prior to the start of the Acceptance Phase.
 11. Training Plan: Provide prior to the start of the Acceptance Phase.
 12. Record Training Documentation: Provide at least 7 days prior to the start of the applicable training.
 13. Provide O&M Documentation content per the requirements of this section, and Division 1 requirements. Submit at least one month prior to the beginning of the Acceptance Phase.
- B. The CxA will provide appropriate contractors with a specific request for additional submittal documentation the CxA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. The request will include, at a minimum, the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings, spare parts lists, preventive maintenance schedules and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning authority. All documentation requested by the CxA will be included by the sub-contractors in their O&M manual documentation.
- C. The Commissioning authority will review and provide comment on submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance

with equipment specifications. The Commissioning authority will notify the GC, OR or A/E as requested, of items missing or areas that are not in conformance with Contract Documents and which require resolution.

- D. The CxA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.
- E. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CxA will review and approve them.
- F. Record Drawings: Contractor shall maintain at the site an updated set of record documents reflecting actual installed conditions and all approved changes and modifications to the contract documents. Contractor shall provide access to the CxA to review the Record Drawings. Provide Record Drawings in accordance with Division 01.

3.4 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned, according to Part 1.6 - "Systems to be Commissioned" from above, and any additional systems or equipment identified by the CxA. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical systems, may have very simplified PCs and start-up.
- B. General: Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan: The CxA shall assist the commissioning team members responsible for start-up of any equipment in developing detailed start-up plans for all equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed.
- D. Instrumentation
 - 1. General: All testing equipment used in the commissioning process shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. All equipment shall be calibrated according to the manufacturer's recommended intervals. Calibration tags shall be affixed or certificates readily available.
 - 2. Standard Testing Instrumentation: Standard mechanical and electrical testing instrumentation normally used for performance assessment and diagnosis will be provided by the Contractor, including the MC, EC, TAB and BAS subcontractors for their use in assisting the CxA during the commissioning process.
 - 3. Special Tools: Special equipment, tools and instruments (only available from a vendor, and specific to a piece of equipment) that are required for testing

equipment in accordance with these Contract Documents shall be included in the base bid price to the Contractor and left on site for the Owner.

E. Execution of Prefunctional Checklists and Start-up

1. A minimum of four weeks prior to equipment start-up, the Contractors and vendors shall coordinate and schedule start-up and checkout dates with the GC and CxA. The performance of the prefunctional checklists, start-up and checkout are directed and executed by the Subcontractor or vendor. When completing prefunctional checklists, signatures may be required of other Subcontractors for verification of completion of their work.
2. The CxA may witness, at a minimum, the procedures for each piece of primary equipment, unless there are multiple units, in which case a sampling strategy may be used as determined by the CxA. The quantity of each piece of equipment to be witnessed shall be determined by the CxA and included in the final Cx Plan.
3. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CxA shall observe a sampling of the prefunctional and start-up procedures. The sampling quantities shall be identified in the final Cx Plan.
4. The Subcontractors and vendors shall execute start-up for ALL pieces of equipment and provide the CxA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.
5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

- F. Sample Prefunctional Checklists (PC) for plumbing, mechanical and electrical systems can be found in Appendix A of this Section. These are samples only to provide the contractor with an idea of the level of detail required to complete the forms as part of the commissioning process. The CxA will develop final PC forms for all systems and equipment in their standard format and distribute to the Contractors for their use.

3.5 DEFICIENCIES, NON-CONFORMANCE AND ACCEPTANCE IN CHECKLISTS AND START-UP

1. The Subcontractors shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are to be provided to the CxA within two days of test completion.
2. The CxA reviews the report and provides either a non-compliance report or a recommendation of acceptance to the Owner. The CxA shall work with the Subcontractors and vendors to address and retest deficiencies or uncompleted items. The installing Subcontractors or vendors shall address all areas that are deficient or incomplete in the checklists and test in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and completed prefunctional checklist and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA will review and recommend acceptance of the execution of the checklists and start-up of each system to the Owner.

3. Items left incomplete, which later cause deficiencies or delays during functional testing will result in back charges to the responsible party. Refer to Part 3.8 herein for details.

3.6 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to all commissioning functional testing for all divisions.
- B. Objectives and Scope: The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.
 1. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load, etc.) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, no flow, equipment failure, etc. shall also be tested.
- C. Development of Test Procedures: Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, control sequences and parameters. Using the testing parameters and requirements in Divisions 01, 22, 23, and 26 the CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each subcontractor or vendor responsible to execute a test, shall provide limited assistance to the CxA in developing the procedures and review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the Subcontractors who shall review the tests for feasibility, safety, equipment and warranty protection. The CxA will submit the tests to the A/E for review.
 1. The CxA shall review owner-contracted, factory testing or required owner acceptance tests which the CxA is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the Specifications. Redundancy of testing shall be minimized.
 2. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.
 3. Representative test formats and examples (not designed for this facility) are found in Divisions 22, 23 and 26. The test procedure forms developed by the CxA shall include (but not be limited to) the following information:
 - a. System and equipment or component name(s).
 - b. Equipment location and ID number.
 - c. Unique test ID number, and reference to unique prefunctional checklist and start-up documentation ID numbers for the piece of equipment.
 - d. Date.
 - e. Project name.
 - f. Participating parties.

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- g. A copy of the specific sequence of operations or other specified parameters being verified, if applicable.
- h. Formulas used in any calculations.
- i. Required pre-test field measurements.
- j. Instructions for setting up and performing the test.
- k. Special cautions, alarm limits, etc.
- l. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format.
- m. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
- n. A section for comments
- o. Signatures and date block for the CxA, participating contractors, OR and A/E.

D. Test Methods.

- 1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers.
- 2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
- 3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair dryer rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
- 4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
- 5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the A/C compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
- 6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
- 7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Subcontractor executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test,

the Subcontractor shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

- E. Coordination and Scheduling. The Contractors shall provide sufficient notice to the CxA regarding their completion schedule for the prefunctional checklists and start-up of all equipment and systems. The Contractors shall be responsible for performing full functional testing on 100% of the systems and equipment identified in the specifications and by the CxA, and notify the CxA when the functional performance testing is complete. The CxA will schedule verification of functional tests with the GC and affected Subcontractors. The CxA shall direct, witness and document verifications of the functional testing of all selected equipment and systems. The Subcontractors shall execute the tests as directed by the CxA.
 - 1. In general, functional testing is conducted after prefunctional testing and start-up has been satisfactorily completed. The control system is sufficiently tested and approved by the CxA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
- F. Test Equipment. Refer to Part 2 and Article 3.4 for test equipment requirements.
- G. Problem Solving. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractors and A/E.
- H. Sample Functional Performance Test forms (FT) for plumbing, mechanical and electrical systems can be found in Article 3.17 of this Section. These are samples only to provide the contractor with an idea of the level of detail required to complete the testing and forms as part of the commissioning process. The CxA will develop final FT forms for all systems and equipment in their standard format and distribute to the Contractors for their use.

3.7 DOCUMENTATION, NON-CONFORMANCE AND ACCEPTANCE OF TESTS

- A. Documentation: The CxA shall witness and document the results of selected quantities of functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the GC and the subcontractors for their review and use. The CxA will include the filled out forms in the final commissioning report and in the O&M manuals.
- B. Non-Conformance
 - 1. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the GC, Owner, and A/E by either a standard non-compliance form, through the commissioning issues log, or through commissioning observation reports.
 - 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.

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3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owner.
 4. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
 - a. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it:
 1. The CxA documents the deficiency and the Contractor's response and intentions and they go on to another test or sequence. After the day's work, the CxA submits the non-compliance reports to the Contractor for signature, if required. A copy is provided to the Contractor, CxA, Owner and A/E. The Contractor corrects the deficiency as directed by the Owner or A/E, provides a report of corrective action taken certifying that the equipment is ready to be retested and sends it back to the CxA.
 2. The CxA reschedules the test and the test is repeated.
 - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 1. The deficiency shall be documented with the Contractor's response and a copy given to the Owner, A/E, GC and the Subcontractor representative assumed to be responsible.
 2. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E and/or Owner. Final acceptance authority is with the Owner and A/E.
 3. The CxA documents the resolution process.
 4. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, provides a report of corrective action taken certifying that the equipment is ready to be retested and sends it back to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
 5. Cost of Retesting: Refer to Article 3.8 for details regarding costs/penalties for retesting.
 6. The Contractor shall respond in writing to the CxA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 7. The CxA retains the original non-conformance report/form until the end of the project.
 8. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.
- C. Failure Due to Manufacturer Defect. If 10%, or a minimum of three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all

identical units may be considered unacceptable by the CxA, A/E or OR. In such case, the Contractor shall provide the Owner with the following:

1. Within one week of notification from the CxA, A/E or OR, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the GC, A/E, CxA and OR within two weeks of the original notice.
 2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
 3. The A/E or OR will determine whether a replacement of all identical units or a repair is acceptable.
 4. Two examples of the proposed solution will be installed by the Contractor and the GC and subcontractors will be allowed to test the installations for up to one week, upon which the A/E and/or OR will decide whether to accept the solution.
 5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.
- D. Acceptance: The CxA notes each satisfactorily demonstrated function on the test form. Formal acceptance of the functional test is made later after review by the CxA, A/E and Owner. The CxA recommends acceptance of each test to the Owner by submitting the completed functional performance test forms and report. The OR gives final acceptance on each test using the same form, providing a signed copy to the CxA and the Contractor.

3.8 PENALTIES FOR RETESTING SYSTEMS OR EQUIPMENT

- A. The cost for the Contractor to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated between the Owner, CxA and GC/subcontractor.
- B. For a deficiency identified, not related to any prefunctional checklist or start-up fault, the following shall apply: The CxA will advise the Owner or A/E of the issue, who will then review and direct the GC and their subcontractors as to corrective action to take and to retest the equipment. The cost to perform the retest of the equipment shall be negotiated between the Owner and GC. However, the CxA's time for a second and any successive retest/verification will be charged to and paid by the Contractor.
- C. The time for the CxA and Owner to direct any retesting required because a specific prefunctional checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, shall be charged to and paid by the Contractor.

3.9 ENDURANCE PERIOD

- A. General: As a part of the Commissioning Process, the building shall operate throughout a 30 day period, starting with the successful completion of functional performance testing and ending when the respective facility/area has successfully operated for 30 days as defined below. This period is referred to as the Endurance Period. The Endurance period will apply by areas of the building if the occupancy of the areas is phased. The period then applies to all systems and utilities supporting that area. As such, since Endurance Periods may be sequenced/staggered somewhat, central system's Endurance Periods will exceed the 30 day length to encompass the periods for all areas in which they serve.
- B. Sequence: The sequence of the testing and Endurance Periods for each of the areas will be defined in the construction schedule and coordinated with the CxA.
- C. Prerequisites: Before commencing the Endurance Period, the following shall apply:
 - 1. Functional Tests of supporting systems and the zones in the areas shall have been successfully passed with no outstanding issues. CxA may exempt incidental items that will not affect operation, cause service interruption to resolve, and/or not require contactor work in the space. This means that prior to the start of the Endurance Period:
 - a. All documentation shall have been submitted and approved and applicable functional tests relating to that system or equipment are "passed".
 - b. All normal steady state functional operation tests are passed and documented in all achievable operational modes.
 - c. All capacity related functional tests are passed and documented.
 - d. All safety devices related and "crash" testing aspects of the functional tests are passed and documented. This involves component and system failures.
 - e. All Fireman's override mode aspects of functional testing have been passed and documented.
 - f. All but the BAS building specific sequence training shall have been completed, documented, and have resulted in positive evaluations. The BAS building specific sequence training may generally be conducted during this period.
 - 2. Environmental Monitoring and trend archiving shall be set up and operational. The BAS shall be "live" on the facility system.
 - 3. For these critical areas, the punch list must be fully developed prior to commencing the Endurance Period; however, contractor shall have access to the spaces during this period to complete minor items (at the discretion of the Owner) that will not impact facility operation and performance. Given that Owner will have access to the spaces; contractor shall not be responsible for damage caused by Owner representatives providing it can be demonstrated that the damage was caused by them. Generally acceptable "punch out" work will be finish related and not require work on systems that requires isolation or service interruption. However, incomplete punch list items will extend the period until they are completed and signed off. The intent for the Endurance Period is that occupancy will begin at the conclusion of the Endurance Period and there will not be an opportunity for the contractor to fix any outstanding issues within the space. Therefore if deficiencies are identified that are the responsibility of the Contractor that require their access to the space, the Endurance Period will not be considered complete.

4. Contractor certifies that the work is complete and in accordance with the contract documents.
 5. All temporary protection devices are removed such as construction filters and strainers. Note that final permanent filters will not be provided until the end of the Endurance Period.
 6. Fire Alarm System shall be made "live" on the campus system.
- D. Access: During the Endurance Period, Owner shall have full access to the space. They may simulate conditions, use, load, maintain, isolate, etc. the space and its supporting systems within the design intent. Examples of area/system use that may occur during the Endurance Period include but are not limited to:
1. Varying temperature and humidity setpoints within the design intent.
 2. Operating the facility/equipment through typical daily cycles.
 3. Providing a load within the design intent.
 4. Operating installed equipment per the proper procedure stipulated by the manufacturer.
 5. Performing routine maintenance procedures to ensure attic stock is applicable to the installed systems and to ensure that system conditions and services remain within tolerance per the design intent.
 6. Decontaminating the area.
 7. Simulating failures of supporting systems and equipment: Contractor shall approve methods by which these are simulated.
 8. Initiating alarms and emergency modes to check enunciation and recovery/operation.
 9. Generating reports from BAS and Environmental Monitoring systems.
 10. Attempting security breach.
 11. Mock fire enunciations.
 12. Changing schedules for lighting and occupancy.
 13. Starting and running the generator.
 14. Creating power outages including going through the normal generator load test that is done annually.
 15. Move in and connect equipment to test services and utilities.
- E. Trending: BAS contractor shall trend all pertinent parameters of the spaces as required by the Commissioning process during operational tests and functional testing as determined by the CxA, and all environmental monitoring systems shall be functional. Each week throughout the process, BAS contractor shall submit contiguous data in an acceptable electronic format as required by the CxA.
- F. Monitoring: During the Endurance Test, the contractor shall maintain a hard copy log of all alarms generated by the BAS. For each alarm received, contractor shall diagnose the cause of the alarm, and shall list on the log for each alarm, the diagnosed cause of the alarm, and the corrective action taken. If in the contractor's opinion, the cause of the alarm is not the responsibility of the contractor, contractor shall immediately notify the Owner.
- G. Ownership: Contractor is responsible for the integrity, operation, and maintenance of the systems throughout this period. Contractor shall be held accountable for any property damage or personal injury that occurs during this period, provided it was not caused by improper use of the area/systems by Owner.

H. Acceptance Criteria: Endurance Period will end after 30 days of continuous operation in which:

1. The systems operated and performed per the contract documents.
2. All alarms were a direct result of a corresponding test by Owner or an event not caused by a system malfunction or misuse.
3. Any component failures are shown to be statistically within published mean time between failure occurrences. Contractor seeking to invoke this clause shall provide the documentation.
4. Contractor shall not be responsible for Endurance Period extensions due to design issues. As such, if a condition is observed which is outside the design intent; however, the contractor can demonstrate that the systems performed per the contract documents, the period will not be restarted at the expense of the contractor.

3.10 DEFICIENCIES IDENTIFIED DURING ENDURANCE PERIOD

A. Non-Conformance: Deficiencies due to non-conformance identified during Endurance Period shall be resolved as follows:

1. The Contractor, CxA, or Owner will issue an Action Item (tracked in the Commissioning Issues Log) and distribute it to the GC, A/E and Owner as well as the apparent responsible parties. Owner or A/E shall direct the GC or subcontractor as to the corrective action to be taken. GC or subcontractor shall acknowledge responsibility via a response to the Action Item.
2. Owner shall issue a work directive, in conformance with the General Conditions and Division 01, to the GC or responsible party for the corrective actions.
3. Responsible contractor shall notify the GC when the deficiency is corrected and GC shall notify the Owner, A/E and CxA the date at which the correction was completed which is coincident with the restart of the Endurance Period.
4. Corrections of minor deficiencies identified may be made immediately upon identification at the discretion of the responsible party. Responsible party shall notify GC of the date the deficiency was corrected. GC shall notify Owner, A/E and CxA that the Endurance Period is restarted.
5. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - a. The deficiency shall be documented as an Action Item with the GC and contractor's response and Owner and A/E will be notified. At the direction of the Owner, the GC will track this issue both in the Action List (for information only) and under the construction contract dispute resolution provisions set forth in the General Conditions and Division 01.
 - b. Final interpretive authority is with the A/E and/or Owner. Final acceptance authority is with the Owner.
 - c. The CxA documents the resolution to the Action Item.
 - d. As applicable, the Owner issues a work directive for the corrective action. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, responds to the Action Item indicating completion. The GC notifies the Owner, A/E and CxA that Endurance Period is restarted. CxA then closes the Action Item.

3.11 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals.

1. The specific content and format requirements for the standard O&M manuals are detailed in Division 01 and other individual Sections throughout the specifications.
2. CxA Review and Comment. Prior to substantial completion, the CxA shall review the O&M manuals, documentation and redline as-builds for systems that were commissioned to verify compliance with the Specifications. The CxA will communicate deficiencies in the manuals to the Owner and A/E, as required. The Owner or A/E shall direct the GC or subcontractor to correct the deficiency as necessary and resubmit. Upon a successful review of the corrections, the CxA recommends acceptance of these sections of the O&M manuals to the Owner and A/E. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

3.12 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.
- B. The CxA shall be responsible for overseeing and commenting on the content and adequacy of the training of Owner personnel for commissioned equipment.

1. The CxA shall interview the facility/maintenance manager to determine the special needs and areas where training will be most valuable. The Owner and A/E, with the advice of the CxA, shall decide how rigorous the training should be for each piece of commissioned equipment. The Owner shall communicate the requirements to the GC, subcontractors, and vendors who have training responsibilities. In addition to these general requirements, the specific training requirements of Owner personnel by Contractors and vendors is specified in Division 20, 21 , 22, 23, 26, 27 and 28.
2. Each Contractor and vendor responsible for training will submit a written training plan to the CxA for review and comment prior to training. The plan will cover the following elements:

Equipment (included in training)

- a. Intended audience.
- b. Location of training, and training Objectives.
- c. Subjects covered (description, duration of discussion, special methods, etc).
- d. Duration of training on each subject.
- e. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.).
- f. Instructor qualifications.
- g. For the primary HVAC equipment, the Controls Contractor shall provide a discussion of the control of the equipment during the mechanical or electrical training conducted by others.

3. The CxA shall review and provide comments regarding the contractors overall training plan. The GC shall coordinate and schedule the training for the commissioned systems with the Owner and CxA. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, providing surveys to maintenance staff, etc. The CxA recommends acceptance of the training to the Owner if they feel the training meets the contract document requirements.
4. Video recording of the training sessions shall be in accordance with the contract documents, and shall be provided by the Trade Contractor, with training session properly cataloged and burned to DVD's or approved electronic transfer media. Provide high quality color DVD on standard size DVD disks or approved electronic transfer media. Training videos shall be added to the O&M manuals submitted to the Owner.

3.13 DEFERRED TESTING

- A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the Owner. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.
- B. Seasonal Testing: During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) specified in Division 23 shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subcontractors, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builds due to the testing will be made.

3.14 TEMPORARY CONDITIONING

- A. Contractor shall only use building permanent equipment to provide temporary conditioning on the approval of the A/E and Owner. Approval for such will only be given upon acceptance of a detailed plan provided by the individually involved subcontractors and compiled by the GC, presented to the Owner, A/E and CxA for review and comment. The temporary conditioning plan shall consider/address the following at a minimum.
- B. Indicate that the full start up protocol as required by the specification for final acceptance will be performed for the temporary start up. Temporary conditioning plan shall include the start-up forms to be used which will be the same as those that will be used for final start up.
- C. Contractor shall address how equipment will be maintained in good, clean condition. Specifically address:
 1. Temporary filtering of air: Air Filters used for construction shall be at least that specified for final use. Contractor shall remove construction filters and replace with new filters at substantial completion. Filters shall be maintained and replaced at the specified final pressure drop. Contractor shall install a filter

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- pressure gauge for visual indication of pressure drop as well as set up the loaded filter DP switch for monitoring on the BAS.
2. Temporary Filtering of Water: Construction strainers shall be used while circulating fluid during construction. Strainer shall be finer than specified for final strainers.
 3. Sealing/Filtering of Open Ducts: Address that all open ducts shall be either sealed or protected with filter media. Operation of return or exhaust systems shall be avoided where possible by using a non-ducted relief of ventilation supply, or temporary mechanical exhaust. Use of permanent return and exhaust systems shall require specific approval for use during construction.
 4. Lubrication and Maintenance: Contractor shall maintain the systems and equipment in accordance with the manufacturer's instructions. Contractor shall coordinate lubricants used with Owner's operators. Frequency of lubrication and inspection shall be as recommended by manufacturers' literature. Applicable maintenance lubrication schedules shall be included in the plan. Draft maintenance logs shall be submitted with plan and completed as maintenance is performed.
 5. Operation outside of Normal ranges: Systems and equipment shall not be operated outside the range of specified conditions. Plan shall address how the contractor will ensure that operation will not harm the equipment.
 6. Emergency Condition Identification and Response protocols: Plan shall address protocols for responding to equipment malfunctions and or harmful operation. Automatic safeties and remote enunciation shall be in place to protect people and property. Temporary operation shall not be allowed until there is an automatic communication/enunciation medium such as a phone connection or an internet connection. At a minimum, an alarm on the equipment used for temporary service shall be automatically sent to the contractor's 24 hour monitoring service and to the Owner's systems control. The contractor shall respond to and be responsible for securing conditions within the building. Owner shall assess the situation and as necessary secure utilities feeding the building from isolation points outside of the building.
- D. Facility Utility Impact: The plan shall address the expected impact on the campus utilities involved in the temporary conditioning equipment. Specifically address:
1. How the systems will be controlled to both ensure they are operating in range, and to avoid energy waste or inefficient conditions.
 2. Project the range of loads and flows to be imposed on the facility systems.
 3. For facility chilled water and heating hot water connections, the connection and automatic control and related sequences shall be installed, functional and tested.
- E. Building Protection: Address how the system will be controlled to avoid humidity conditions that will either promote mold growth or cause corrosion.
- F. Equipment Reconditioning: Address with specific means and methods how the equipment used for temporary conditioning will be re-conditioned to new condition. Belts, seals, bearings, couplings, or other parts that wear more than 3 percent of their expected life shall be replaced.
- G. Cleaning: Address how ducts, pipes, coils, converters, air handling equipment, terminal units, etc. shall be cleaned at final turn over.

- H. Operations Log: Contractor responsible for operating the equipment shall maintain a log of all activities associated with operating and maintaining equipment. Log shall be submitted to Owner monthly upon request.
- I. Any material, device, component, equipment, etc. that is assessed as damaged or as having a substantially shortened life as a result of temporary conditioning operation shall be replaced by the contractor at no cost to the Owner.
- J. Segregation: Where only portions of a system are to be used, contractor shall specifically indicate how the used portion will be isolated from the unused portion. Plan shall address how to ensure that the reduced operation condition will be maintained within acceptable ranges, and/or how capacity will be throttled to keep all operating parameters in recommended ranges.

3.15 PHASING PLAN

- A. If contractor intends to start, run, or occupy portions of systems in phases, contractor shall submit a plan for phasing in areas/portions of systems that will be connected subsequent to the initial portions. Specifically address:
 - 1. Pipe and Duct Cleaning: indicate the configurations and protocols for isolating subsequent regions and then protecting the preceding regions when the subsequent region is cleaned/flushed and connected.
 - 2. Pipe disinfection: Indicate the plan for disinfecting each region of potable water pipe that requires disinfection. Indicate how the preceding regions of the system will be protected when connecting subsequent regions.
 - 3. System Modifications: Indicate the protocols for making subsequent changes to the systems of pipe and duct when the systems have already been cleaned, flushed, pressure tested, disinfected, certified, etc.

3.16 SAMPLE PREFUNCTIONAL CHECKLISTS

- A. See Appendix A

3.17 SAMPLE FUNCTIONAL PERFORMANCE TESTS

- A. See Appendix B

END OF SECTION 01 91 13

APPENDIX

A

SAMPLE PREFUNCTIONAL CHECKLISTS

Domestic Hot Water Heater Prefunctional Checklist

Building Name _____

PC-_____ Domestic Hot Water Heater #'s _____

Associated checklists: _____

1. Submittal / Approvals

Submittal: The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. ____ List attached.

_____ Mechanical Contractor	_____ Date	_____ Controls Contractor	_____ Date
_____ Electrical Contractor	_____ Date	_____ Sheet Metal Contractor	_____ Date
_____ TAB Contractor	_____ Date	_____ General Contractor	_____ Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CxA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, PC = plumbing contractor, TAB = test and balance contractor, ____ = ____.

Approvals: This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ Commissioning Agent	_____ Date	_____ Owner's Representative	_____ Date
------------------------------	---------------	---------------------------------	---------------

Notes:

2. Requested documentation submitted (This section to be completed by CxA)

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
Manufacturer's cut sheets							
Performance data (fan curves, coil data, etc.)							
Installation and startup manual and plan							
Sequences and control strategies							
O&M manuals							

- **Documentation complete as per contract documents**..... **YES** **NO**

3. Model verification

[Contr = _____]

1 = as specified, 2 = as submitted, 3 = as installed. Check if Okay. Enter note number if deficient.

Equip Tag-->					
1					
Manuf. 2					
3					
1					
Model 2					
3					
Serial # 3					
1					
Capacity 2					
3					
1					
Volts/Ph/A 2					
3					

- **The equipment installed matches the specifications for given trade**..... **YES** **NO**

4. Physical Installation Checks

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
General Installation							
General appearance good, no apparent damage							
Site sufficiently clean for testing							
Equipment labels affixed							
Required seismic restraints in place							
Flue completely installed and sloped properly							
Combustion air supply complete							
System filled							
Pressure gages installed							
Thermometers installed							
Piping							
Gas piping installed and tested (supply is at proper pressure)							
Piping complete, safety reliefs							
Isolation valves and balancing valves installed							
Pipe fittings and accessories complete							

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
Piping type and flow direction labeled on piping							
Expansion tanks verified to not be air bound and system completely full of water							
Electrical and Controls							
Power to unit and disconnect installed							
All electrical components grounded							

- *The checklist items of Part 4 are all successfully completed for given trade.* ___ YES ___ NO

NOTES:

-- END OF CHECKLIST --

Air Handling Unit Prefunctional Checklist

Building Name _____

PC-____ AIR HANDLING UNIT, AHU #'s _____

Components included: ____ supply fans, ____ return and exhaust fans, ____ coils, ____ valves, ____ VFD, ____ dampers

Associated Checklists: _____

1. Submittal / Approvals

Submittal: The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. ____ List attached.

_____ Mechanical Contractor	_____ Date	_____ Controls Contractor	_____ Date
_____ Electrical Contractor	_____ Date	_____ Sheet Metal Contractor	_____ Date
_____ TAB Contractor	_____ Date	_____ General Contractor	_____ Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractor's assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CxA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor, ____ = _____.

Approvals: This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ Commissioning Agent	_____ Date	_____ Owner's Representative	_____ Date
------------------------------	---------------	---------------------------------	---------------

Notes:

2. Requested documentation submitted (This section to be completed by CxA)

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
Manufacturer's cut sheets							
Performance data (fan curves, coil data, etc.)							
Installation and startup manual and plan							
Sequences and control strategies							
O&M manuals							

- **Documentation complete as per contract documents for given trade** **YES** **NO**

3. Model verification

[Contr = _____]

1 = as specified, 2 = as submitted, 3 = as installed. Check if Okay. Enter note number if deficient.

Equip Tag-->						
1						
Manuf. 2						
3						
1						
Model 2						
3						
Serial # 3						
1						
Capacity 2						
3						
1						
Volts/phase 2						
3						

- **The equipment installed matches the specifications for given trade** **YES** **NO**

4. Installation Checks

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
Cabinet and General Installation							
Permanent labels affixed, including for fans							
Casing condition good: no dents, leaks, door gaskets installed							
Access doors close tightly - no leaks							
Boot between duct and unit tight and in good condition							
Vibration isolation equipment installed & released from shipping locks							
Maintenance access acceptable for unit and components							
Thermal insulation properly installed and according to specification							
Instrumentation installed according to specification (thermometers, pressure gages, flow meters, etc.)							
Clean up of equipment completed per contract documents							
Filters installed and replacement type and efficiency permanently affixed to housing--construction filters removed							
Valves, Piping and Coils							
Pipe fittings complete and pipes properly supported							
Pipes properly labeled							
Pipes properly insulated							

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
Strainers in place and clean							
Piping system properly flushed							
No leaking apparent around fittings							
All coils are clean and fins are in good condition							
All condensate drain pans clean and slope to drain, per spec							
Valves properly labeled							
Valves installed in proper direction							
OSAT, MAT, SAT, RAT, chilled water supply sensors properly located and secure (related OSAT sensor shielded)							
Sensors calibrated (See calibration section below)							
Motors: Premium efficiency verified, if specified?							
P/T plugs and isolation valves installed per drawings							
Fans and Dampers							
Supply fan and motor alignment correct							
Supply fan belt tension & condition good							
Supply fan protective shrouds for belts in place and secure							
Supply fan area clean							
Supply fan and motor properly lubricated							
Supply fan: Adequate access for service							
Supply fan: Variable sheaves adjusted and locked							
Supply fan: After 24 hours of operation, rechecked belt tension and alignment							
Return/exhaust fan and motor aligned							
Return/exhaust fan belt tension & condition good							
Return/exhaust fan protective shrouds for belts in place and secure							
Return/exhaust fan area clean							
Return/exhaust fan and motor lube lines installed and lubed							
Return/exhaust fan: Adequate access for service							
Return/exhaust fan: Variable sheaves adjusted and locked							
Return/exhaust fan: After 24 hours of operation, rechecked belt tension and alignment							
Filters clean and tight fitting							
Filter pressure differential measuring device installed and functional (magnahelic, inclined manometer, etc.)							
Smoke and fire dampers installed properly per contract docs (proper location, access doors, appropriate ratings verified)							
All dampers close tightly							
All damper linkages have minimum play							
Low limit freeze stat sensor located to deal with stratification & bypass							
Ducts							
Sound attenuators installed							
Duct joint sealant properly installed							
No apparent severe duct restrictions							
Turning vanes in square elbows as per drawings							

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
OSA intakes located away from pollutant sources & exhaust outlets							
Pressure leakage tests completed							
Branch duct control dampers operable							
Ducts cleaned as per specifications							
Balancing dampers installed as per drawings and TAB's site visit							
Electrical and Controls							
Pilot lights are functioning							
Power disconnects in place and labeled							
All electric connections tight							
Proper grounding installed for components and unit							
Safeties in place and operable							
Starter overload breakers installed and correct size							
Sensors calibrated (see below)							
Control system interlocks hooked up and functional							
Smoke detectors in place							
All control devices, programming and wiring complete							
Control Panel Wiring neat and orderly, Wiring diagram mounted and readable							
Control Panel labeling is affixed and clear							
Control Panel termination tight and labeled							
Control Panel: clearance is available for servicing.							
Control Panel: Power supplies verified for proper capacity.							
Control Panel: Grounding is checked and Adequate							
Graphical screens checked and indicating required information							
Zone Air Space (ZAS): Systems complete and functional							
ZAS: Occupancy switch installed per manufacturer's instructions.							
ZAS Temperature sensor (TS): Installed per manufacturer's instructions							
ZAS TS: Confirm sensor not affected by other thermal influences							
ZAS TS: Devices accessible							
VFD							
VFD powered (wired to controlled equipment)							
VFD interlocked to control system							
Static pressure or other controlling sensor properly located per drawings and calibrated							
Static pressure or other controlling sensor calibrated							
Drive location not subject to excessive temperatures							
Drive location not subject to excessive moisture or dirt							
Drive size matches motor size							
Internal setting designating the model is correct							
Input of motor FLA represents 100% to 105% of motor FLA rating							
Appropriate Volts vs Hz curve is being used							
Accel and decel times are around 10-50 seconds, except for special applications. Actual decel = _____ Actual accel = _____							

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
Lower frequency limit not less than 25% for VAV fans and around 10-30% for chilled water pumps. Actual = _____							
Upper frequency limit set at 100%, unless explained otherwise							
Unit is programmed with full written programming record on site							
TAB							
Installation of system and balancing devices allowed balancing to be completed following specified NEBB or AABC procedures and contract documents							
Final							
Smoke and fire dampers and unpowered TU's are open							
Startup report completed with this checklist attached							
Safeties installed and safe operating ranges for this equipment provided to the commissioning agent							
If unit is started and will be running during construction: have quality filters on RA grills, etc. to minimize dirt in the ductwork and coils and in any finished areas. Verify moisture migration is not a problem, due to improper pressures between spaces.							

- **The checklist items of Part 4 are all successfully completed for given trade.** YES NO

5. Operational Checks (These augment mfr's list. This is not the functional performance testing.)

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
Supply fan rotation correct							
Return/exhaust fan rotation correct							
Fans > 5 Hp Phase Checks: (%Imbalance = $100 \times (\text{avg.} - \text{lowest}) / \text{avg.}$) Record all 3 voltages in cell. Imbalance less than 2%?							
Record full load running amps for each fan. _____ rated FL amps x _____ service factor = _____ (Max amps). Running less than max?							
Return /exhaust fan acceptable noise & vibration							
Supply fan has no unusual noise or vibration							
Inlet vanes aligned in housing, actuator spanned, modulate smoothly and proportional to input signal and BAS readout							
All dampers (OSA, RA, EA, etc.) stroke fully without binding and spans calibrated and BAS reading site verified (follow procedure in Calibration and Leak-by Test Procedures). List dampers checked: _____							
Valves stroke fully and easily and spanning is calibrated (follow procedure in Calibration and Leak-by Test Procedures). List each actuated valve here when spanned: _____							
Valves verified to not be leaking through coils when closed at normal operating pressure (follow procedure in Calibration and Leak-by Test Procedures).							
The HOA switch properly activates and deactivates the unit							
Specified sequences of operation and operating schedules have been implemented with all variations documented							

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
Specified point-to-point checks have been completed and documentation record submitted for this system							

- **The checklist items of Part 5 are all successfully completed for given trade.** ☐ YES ☐ NO

6. Sensor and Actuator Calibration []

All field-installed temperature, relative humidity, CO, CO₂ and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated using the methods and tolerances given in the Calibration and Leak-by Test Procedures document. All test instruments shall have had a certified calibration within the last 12 months: Y/N_____. Sensors installed *in* the unit at the factory with calibration certification provided need not be field calibrated.

Sensor or Actuator & Location	Location OK	1st Gage or BAS Value	Instr. Measured Value	Final Gage or BAS Value	Pass Y/N?	Sensor & Location	Location OK	1st Gage or BAS Value	Instr. Measured Value	Final Gage or BAS Value	Pass Y/N?
Freeze Alarm Temp Sensor						Outside Air Flow Measuring station					
Relief Air Actuator						Filter Differential Pressure (DP) Switch					
Outside Air Actuator						Return Air Smoke Detector					
Preheat Coil Control Valve Actuator						Supply Air Smoke Detector					
Return fan Static Pressure Sensor						Supply Air temperature Sensor					
Supply Fan Static Pressure Sensor						Return Low Pressure Switch					
Cooling Coil Control Valve Actuator						Return Fan CT					
Return Air Temperature Sensor											
Supply Fan CT											
Mixed Air Temp. Sensor											

Gage reading = reading of the permanent gage on the equipment. BAS = building automation system. Instr. = testing instrument. Visual = actual observation. The Contractor's own sensor check-out sheets may be used in lieu of the above, if the same recording fields are included and the referenced procedures are followed.

- **All sensors are calibrated within required tolerances** ☐ YES ☐ NO

Notes:

-- END OF CHECKLIST--

Occupancy Sensor Prefunctional Checklist

Building Name _____

PC-_____ Occupancy Sensor-_____

Associated checklists: _____

1. Submittal / Approvals

Submittal: The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. ____ List attached.

_____ Mechanical Contractor	_____ Date	_____ Controls Contractor	_____ Date
_____ Electrical Contractor	_____ Date	_____ Sheet Metal Contractor	_____ Date
_____ TAB Contractor	_____ Date	_____ General Contractor	_____ Date

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column to the right of an item refers to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CxA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor, ____ = _____.

Approvals: This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ Commissioning Agent	_____ Date	_____ Owner's Representative	_____ Date
------------------------------	---------------	---------------------------------	---------------

2. Requested documentation submitted (This section to be completed by CxA)

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						
Equipment manufacturer's submittals, dimensional data, etc.							
Installation and startup manual							
Startup documentation							
O&M manuals							

- **Documentation complete as per contract documents** ____ YES ____ NO

3. Model verification

1 = as specified, 2 = as submitted, 3 = as installed. Enter requested data. Check if Okay. Enter note number if deficient.

Equip Tag-->					
Photoelectric Sensor					
Manuf. 1					
2					
3					
Model 1					
2					
3					
Serial # 3					

- *The equipment installed matches the specifications for given trade* ☐ YES ☐ NO

4. Installation Checks

Enter data as requested. Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag-->						Contr.
General Installation							
Equipment tag & nameplate permanently affixed							
Installation is per manufacturer's instructions							
Sensor undamaged and clean							
All electrical connections complete							
Terminations tight							

- *The checklist items of Part 4 are all successfully completed for given trade.* ☐ YES ☐ NO

NOTES:

-- END OF CHECKLIST --

APPENDIX

B

SAMPLE FUNCTIONAL PERFORMANCE TESTS

Domestic Hot Water Heater Functional Test

Building Name _____

FT-_____ Hot Water Heater WH-_____

Associated checklists: _____

Functional Performance test: Contractor shall verify operation of the domestic hot water system as per specification including the following:

“Contr.” abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CxA = commissioning authority, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, PC = plumbing contractor, TAB = test and balance contractor, ____ = _____.

- A. Verify there is no load on the system and the system water temperature is at setpoint before starting tests. Record system setpoints: Aqua-stat Setpoint = _____°F; Heater Setpoint = _____°F. [Contr = ____]
- B. Adjust the aqua-stat to 5°F above initial setpoint, and verify circulation pump energizes and circulates the return hot water to the heaters. (Pass, Fail) [Contr = ____]
Failure corrective action: _____
- C. Adjust hot water heater setpoint to 5°F below initial operating temperature and verify heaters enable and heat the water to the adjusted setpoint and then disable. (Pass, Fail) [Contr = ____]
Failure corrective action: _____
- D. Verify proper operation of boiler safeties. [Contr = ____]
 1. Low water flow. (Pass, Fail)
Failure corrective action: _____
 2. Flame failure. (Pass, Fail)
Failure corrective action: _____
 3. Pressure relief. (Pass, Fail)
Failure corrective action: _____
 4. High limit temperature control. (Pass, Fail)
Failure corrective action: _____
- E. Return all system setpoints to original settings when testing is complete.

Field Notes:

Certification: We, the undersigned, have witnessed the above functional performance tests and certify that the item tested has met the performance required in this section of the specifications.

Signature and Date

Commissioning Authority (CxA)	
Contractor’s Mechanical Representative (MC)	
Contractor’s Electrical Representative (EC)	
Contractor’s TAB Representative (TAB)	
Contractor’s Plumbing Representative (PC)	
Design Agency Representative	
Using Agency’s Representative	

Air Handling Unit Functional Test

Building Name _____

FT-_____ Air Handling Unit AHU-_____

Associated checklists: _____

Functional Performance test: Contractor shall verify operation of air handling unit as per specification including the following:

“Contr.” abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CxA = commissioning authority, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor, ____ = _____.

- F. Ensure that a slight negative pressure exists on inboard side of the outside air damper throughout the operation of the damper. Modulate OA, RA, and EA dampers from fully open to fully closed positions. Static Pressure: _____ in.-wg. (Pass, Fail) [Contr = ____]

1. If testing fails describe corrective action and indicate the results of the corrective action (Pass, Fail) below:

- G. The following shall be verified when supply and return fans operating mode is initiated: [Contr = ____]

1. All dampers in normal position prior to fan start. (Pass, Fail)

Failure corrective action: _____

2. All valves in normal position prior to fan start. (Pass, Fail)

Failure corrective action: _____

3. System safeties allow start if safety conditions are met. (Pass, Fail)

Failure corrective action: _____

4. VFD fan controller shall “soft-start” fans. (Pass, Fail)

Failure corrective action: _____

5. Modulate all VAV Boxes to minimum air flow and verify that the static pressure does not exceed the high static pressure shutdown setpoint. VFD Speed Actual: _____; Static Pressure Setpoint: in.-wg.; Static Pressure Actual: _____ in.-wg. (Pass, Fail)

Failure corrective action: _____

6. Return all VAV boxes to Automatic control and verify they return to normal operation. (Pass, Fail)

Failure corrective action: _____

7. Economizer automatically enables or disables based on enthalpy comparison of outside air to return air and dampers are positioned as required. (Pass, Fail)

Failure corrective action: _____

8. Verify all other systems, such as exhaust fans and fan coil units, that are interlocked with the operation of the AHU are enabled when AHU is in the occupied mode of operation. (Pass, Fail)

Failure corrective action: _____

H. Occupied mode of operation – economizer de energized.

[Contr = ____]

1. Outside air damper at minimum position. (Pass, Fail)

Failure corrective action: _____

Return air damper open. (Pass, Fail)

Failure corrective action: _____

Relief air damper at minimum position. (Pass, Fail)

Failure corrective action: _____

2. Chilled water control valve modulation to maintain leaving air temperature set point. Setpoint ____°F; Actual ____°F; BAS Reading ____°F. (Pass, Fail)

Failure corrective action: _____

3. Supply Fan VFD controller receiving signal from duct static pressure sensor modulating fan to maintain supply duct static pressure setpoint. Setpoint ____ inches-wg Actual ____ inches-wg. (Pass, Fail)

Failure corrective action: _____

4. Return Fan VFD controller receiving signal from duct static pressure sensor modulating fan to maintain return duct static pressure setpoint. Setpoint ____ inches-wg Actual ____ inches-wg. (Pass, Fail)

Failure corrective action: _____

5. Dehumidification sequence responds to return air/space humidity sensors and controls chilled water valve and heating hot water to maintain space relative humidity setpoint. Setpoint ____%RH; Actual ____%RH.

Failure corrective action: _____

6. Humidification sequence responds to return air/space humidity sensors and enables the humidifier to maintain space relative humidity setpoint. Setpoint ____%RH; Actual ____%RH.

Failure corrective action: _____

7. Hot water control valve modulating to maintain leaving air temperature set point. Setpoint ____°F; Actual ____°F; BAS Reading ____°F. (Pass, Fail)

Failure corrective action: _____

I. Occupied mode of operation – economizer energized.

[Contr = ____]

1. Outside air damper modulated to maintain mixed air temperature set point. Setpoint ____°F, Actual ____°F, Outside air damper position ____% open. (Pass, Fail)

Failure corrective action: _____

2. Relief air damper modulates with outside air damper according to sequence of operation. Relief air damper position ____% open. (Pass, Fail)

Failure corrective action: _____

3. Chilled water control valve modulation to maintain leaving air temperature set point. Set-point ____°F Actual ____°F. (Pass, Fail)
Failure corrective action: _____
 4. Verify hot water control valve is locked out during economizer operation. (Pass, Fail)
Failure corrective action: _____
 5. Supply Fan VFD controller receives signal from duct static pressure sensor and modulates fan to maintain supply duct static pressure set point. Setpoint ____inches-wg Actual ____inches-wg. (Pass, Fail)
Failure corrective action: _____
 6. Return Fan VFD controller receives signal from duct static pressure sensor and modulates fan to maintain return duct static pressure set point. Setpoint ____inches-wg Actual ____inches-wg. (Pass, Fail)
Failure corrective action: _____
- J. Unoccupied/off mode of operation: [Contr = ____]
1. All dampers return to normal off/unoccupied positions when unit shuts down. (Pass, Fail)
Failure corrective action: _____
 2. Observe fans start and dampers return to normal unoccupied mode position when space temperature calls for heating and/or cooling. (Pass, Fail)
Failure corrective action: _____
 3. Verify space temperatures maintained as specified in sequence of operation. (Pass, Fail)
Failure corrective action: _____
- K. The following shall be verified when the supply and return fans off mode is initiated: [Contr = ____]
1. All dampers in normal position. (Pass, Fail)
Failure corrective action: _____
 2. All valves in normal position. (Pass, Fail)
Failure corrective action: _____
 3. Fans de-energize. (Pass, Fail)
Failure corrective action: _____
- L. Verify the chilled water coil control valve operation by setting all VAV's to maximum and minimum cooling. Supply Air Temperature Setpoint: ____°F. [Contr = ____]
1. Max cooling (Position all VAV boxes to Maximum position):
Air Temp Entering Coil: ____°F; Air Temp Leaving Coil: ____°F; BAS Supply air temp reading: ____°F, Verify cooling valve operation. (Pass, Fail)
Failure corrective action: _____
 2. Min cooling (Position all VAV boxes to Minimum position):
BAS Supply air temp reading: ____°F, Verify cooling valve operation. (Pass, Fail)
Failure corrective action: _____

M. Verify the hot water coil control valve operation by setting all VAV's to maximum and minimum heating.
Supply Air Temperature Setpoint: _____°F. [Contr = ____]

1. Max heating (Position all VAV boxes to the Minimum position):

Air Temp Entering Coil: _____°F; Air Temp Leaving Coil: _____°F; BAS Supply air temp reading: _____°F, Verify heating valve operation. (Pass, Fail)

Failure corrective action: _____

2. Min heating (Position all VAV boxes to the Maximum position):

BAS Supply air temp reading: _____°F, Verify heating valve operation. (Pass, Fail)

Failure corrective action: _____

N. Safeties/Alarms: [Contr = ____]

1. When the smoke detector in the supply/return duct is tripped, supply and return fans shutdown, dampers close, and alarm is initiated. (Pass, Fail)

Failure corrective action: _____

2. When the supply/return duct high static pressure exceeds the setpoint, the fans shutdown, dampers close, and an alarm is initiated. (Pass, Fail)

Failure corrective action: _____

3. Verify alarm is initiated when supply fan and return fan fail to start when commanded on. (Pass, Fail)

Failure corrective action: _____

4. Verify alarm is initiated when filter differential pressure reading is out of range. (Pass, Fail)

Failure corrective action: _____

5. Verify safety shutdown initiated by low temperature protection thermostat. (Pass, Fail)

Failure corrective action: _____

O. Verify occupancy schedule is programmed into time clock/building management system. (Pass, Fail)
[Contr = ____]

Failure corrective action: _____

Field Notes:

Certification: We, the undersigned, have witnessed the above functional performance tests and certify that the item tested has met the performance required in this section of the specifications.

Signature and Date

Commissioning Authority (CxA) _____

Contractor's Mechanical Representative (MC) _____

Contractor's Electrical Representative (EC) _____

Contractor's TAB Representative (TAB) _____

Contractor's Controls Representative (CC) _____

Design Agency Representative _____

Using Agency's Representative _____

Occupancy Sensor Functional Test

Building Name _____

FC-_____ Occupancy Sensors Room-_____

Associated checklists: _____

The commissioning agent will select occupancy sensors to be spot-checked during the functional performance test. The number of occupancy sensors selected shall not exceed 20%.

Functional Performance test: Contractor shall verify operation of occupancy sensors as per specification including the following: (Y, N, NA)

- P. Sensor type confirmed
type:_____
- Q. Sensor in proper location to limit false tripping _____
- R. Appropriate "lights on" level
fc:_____
- S. Appropriate "lights off" level
fc:_____
- T. Elapsed time has been set and recorded
min:_____
- U. Coverage outside the area has been minimized _____

Field Notes:

Certification: we the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance required in this section of the specifications.

Signature and Data

Commissioning Authority (CxA) _____

Contractor's Electrical Representative _____

Contractor's Controls Representative _____

Design Agency Representative _____

Using Agency's Representative _____

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 07 62 00 – Sheet Metal Flashing and Trim

Corresponding to RFQ Item: 102

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.
2. Formed low-slope roof sheet metal fabrications.
3. Formed wall sheet metal fabrications.

B. Related Requirements:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers and blocking.
2. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal flashing and trim integral with roofing and metal soffit and fascia panels.

1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.

5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 6. Include details of termination points and assemblies.
 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
 8. Include details of edge conditions.
 9. Include details of special conditions.
 10. Include details of connections to adjoining work.
 11. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches (1:10).
- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
 4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
- B. All coping and gravel stop/fascia cap shall be manufactured in accordance with ANSI/SPRI ES1 standard to comply with the International Building Code. Shop fabricated components are not permitted.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Provide manufacturer's warranty for coping and gravel stop/fascia cap, when installed per manufacturer's instructions. Warranty will not exceed the life of the roof membrane on which the product was originally installed.
 - 1. 20 Year, 110 mph Wind Warranty.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. FM Approvals Listing:
 - 1. FM Approvals' requirements are minimum quality standard.
 - 2. Manufacture and install copings and roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Coping and gravel stop/fascia cap shall comply with the following:
 - 1. All face heights tested per ANSI/SPRI ES-1 Standard to a design pressure of 150 lbs./ft² to comply with the International Building Code.
 - 2. Meet Factory Mutual 1-195 approved for wind up lift protection.

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

- B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

- A. Except coping and gravel stop/fascia cap, Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

Except coping and gravel stop/fascia cap. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- G. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- H. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Downspouts: Fabricate downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
1. Fabricate from the following materials:
 - a. Aluminum: 0.032 inch thick.

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- B. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper. Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.

- C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:

1. Aluminum: 0.024 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- ~~A. Copings: Fabricate in minimum 96-inch long, but not exceeding 12-foot long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, weld watertight. Shop fabricate interior and exterior corners.~~

- ~~1. Coping Profile: As indicated on drawings.~~

- ~~2. Joint Style: Butted with expansion space and 6-inch wide, concealed cover plate.~~

- ~~3. Fabricate from the Following Materials:~~

- ~~a. Aluminum: 0.050 inch thick.~~

A. Coping:

1. Metal:

- a. .050 inch aluminum.

2. Finish:

- a. Custom Kynar-500 color as selected by the Architect.

3. Construction:

- a. Coping cap: length of 12 feet 0 inches, width to be manufactured to job requirements.

- b. Coping vertical face and back leg: Height manufactured to job requirements.

- c. Concealed splice plates: 8 inch wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.

- d. Anchor/Support Cleat: 20 gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat normally 12 inch wide at 4 foot 0 inch on center. Mechanically fastened as indicated and detailed.

4. Fasteners: 1-1/2 inch stainless steel.

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~~B. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch long, but not exceeding 12-foot long sections. Furnish with 6-inch wide, joint cover plates. Shop fabricate interior and exterior corners.~~

~~1. Joint Style: Butted with expansion space and 6-inch wide, concealed cover plate.~~

~~2. Fabricate from the Following Materials:~~

~~a. Aluminum: 0.050 inch thick.~~

B. Gravel Stop/Fascia Cap: Decorative metal fascia with continuous galvanized steel waterdam to terminate single-ply roofing at perimeter.

1. Fascia Metal:

a. .050 inch aluminum.

2. Finish:

a. Custom Kynar-500 color as selected by the Architect.

3. Fascia: standard 12 feet 0 inches lengths with matching concealed joint splice plates.

4. Waterdam: Continuous 24 gauge commercial type G-90 galvanized steel at 12 feet 0 inches standard lengths.

5. Fasteners: 1-1/4 inch Galvanized Ring Shank Roofing Nails.

6. Single-Ply Application, Snap-On Version with 24 gauge spring clips 4 foot o.c.

a. Face height(s) as indicated on drawings.

C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.

D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

3.2 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Apply slip sheet, wrinkle free, directly on substrate before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

- A. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of welds and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 5. Torch cutting of sheet metal flashing and trim is not permitted.
 - 6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate:
1. Wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
 2. Any substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Downspouts: Join sections with 1-1/2-inch telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.
 2. Connect downspouts to underground drainage system.
- C. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
 2. Loosely lock front edge of scupper with conductor head.

3. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.
- D. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below scupper discharge.

3.5 ROOF FLASHING INSTALLATION

- A. Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. ~~Gravel Stop/Fascia Cap/~~~~Roof Edge Flashing:~~ Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of anchor and washer at 36-inch centers unless otherwise indicated.

3.6 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING AND PROTECTION

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

END OF SECTION 07 62 00

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 00 45 13 – Contractor Qualification Statement

Corresponding to RFQ Item: 104



CONTRACTOR'S QUALIFICATION STATEMENT

RFQ: WSH13095

CONTRACTOR'S QUALIFICATION STATEMENT

West Virginia Department of Health and Human Resources

The undersigned certified under oath that the information provided herein is true and sufficiently complete so as not to be misleading. This document should be submitted by the apparent low bidder(s) within three (3) days after the bid opening and must be submitted prior to the award of a contract.

SUBMITTED TO: **West Virginia Department of Health and Human Resources**
 One Davis Square
 Suite 100, Room 116
 Charleston, WV 25301

SUBMITTED BY: Firm Name: _____

Address: _____

Phone: _____

Fax: _____

Email: _____

Principal Office Location: _____

QUALIFICATION STATEMENT SUBMITTED FOR

(INSERT PROJECT NAME):



CONTRACTOR'S QUALIFICATION STATEMENT

TYPE OF WORK:

Site Preparation	_____	General Construction	_____
Roofing	_____	Plumbing	_____
HVAC	_____	Sprinkler	_____
Electrical	_____	Other	_____

(File separate form for each Classification of Work)

ORGANIZATION:

Please provide the following information concerning your organization:

TYPE OF ENTITY: Corporation_____ Individual_____

 Partnership_____ Other_____

NAME OF PRINCIPAL, OWNERS OR PARTNERS:

Name	Position	Years of Service with Organization
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Number of years this organization has been in business? _____

Have members of this organization operated under former names/businesses? If "yes," list name, type of entity and names of principal, owners or partners. Yes ____ No ____



CONTRACTOR'S QUALIFICATION STATEMENT

Provide a brief description of the general type of construction the firm performs.

Please indicate the work you intend to subcontract or perform for this project.

	Perform	Subcontract		Perform	Subcontract
Earthwork	_____	_____	Plumbing	_____	_____
Concrete	_____	_____	HVAC	_____	_____
Masonry	_____	_____	Electrical	_____	_____
Structural	_____	_____	Other_____	_____	_____
Roofing	_____	_____	Other_____	_____	_____
Sprinkler	_____	_____			

Please provide information regarding your company's participation in a drug program that meets the objectives, applicable laws and regulations for a drug free workplace including the use of tobacco and alcohol on school properties.

Please provide information regarding the experience and skill of the bidder's work force and that of the bidder's designated subcontractors. Attach additional information, if required. (Marked as Attachment __.)



CONTRACTOR'S QUALIFICATION STATEMENT

EXPERIENCE:

If you have completed hospital construction work or similar construction, or completed work on DHHR projects, provide a list of projects with individual references that can verify the quality of your work, your ability to construct within budget and your ability to work within the proposed schedule. Attach additional information, if required. (Marked as Attachment __.)

Project

Reference

_____	_____
_____	_____
_____	_____

Please list (marked as Attachment __) all major construction projects (hospitals or other projects) your organization has in progress providing the name of project, owner, architect, contract amount, bonding company, insurance carrier, percentage complete and scheduled completion date.

Please list (marked as Attachment __) major projects (hospitals or other projects) your organization has completed in the past five years, giving the name of project, owner, architect, contract amount, bonding company, date of completion and percentage of the cost of the work performed with your own forces. Note whether or not each project was completed on schedule.

APPRENTICESHIP PROGRAM:

Please provide information regarding your company's and subcontractor's participation in a bonafide apprenticeship program that is approved by the U.S. Department of Labor, U.S. Bureau of Apprenticeship Training and is administered in compliance with the rules and regulations of the WV Department of Labor. [See DOL 42-7-3.1(i)] (Marked as Attachment __)

REGULATORY COMPLIANCE:

At any time during the past five years, has your firm, or any of its owners or officers been found in violation or in default in any of the following categories: (Attach detailed explanation for all Yes answers.)

Worker's Compensation Laws	Yes _____	No _____
Unemployment Compensation Laws	Yes _____	No _____
Federal and State Prevailing Wage Laws	Yes _____	No _____
Fair Labor Standards Act	Yes _____	No _____
Compliance with fringe benefit contributions	Yes _____	No _____



CONTRACTOR'S QUALIFICATION STATEMENT

(i.e., health insurance and pension benefits)

Immigration Reform and Control Act (IRCA)

Yes _____ No _____

INSURANCE AND BONDS:

Please list name of current insurance carrier and number of projects insured by carrier:

Insurance Carrier

Number of Projects

(Marked as Attachment __, if required)

Please list name of bonding company(s)/agent(s) utilized for projects constructed during the last five years:

Bonding Company

Bonding Company/Agent

CLAIMS AND SUITS: (Attach detailed explanation for all Yes answers)

Has your organization ever failed to complete any Construction work it has been awarded?

Yes _____ No _____ (If the answer is yes, please describe in full)

Within the last five years, has any officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract?

Yes _____ No _____ ? (If the answer is yes, please describe in full)

Revised 9/11

Has there been in the last ten (10) years, or is there now pending or threatened, any litigation, arbitration, investigation, or governmental or regulatory proceeding involving claims in excess of



CONTRACTOR'S QUALIFICATION STATEMENT

\$100,000 or requesting a declaratory judgment or injunctive relief with respect to the construction or operation of any building which your firm, its principals, predecessors or affiliates constructed?

Yes ____ No ____ Is there any potential claim, demand, litigation, arbitration, investigation, governmental proceeding or regulatory proceeding involving your firm, or its principals, predecessors or affiliates?

Yes ____ No ____ If the answer to either of the preceding questions is "yes," please describe in full in an attachment.

In addition to the litigation, arbitration, investigation or governmental or regulatory proceeding referred to in the preceding paragraphs, is there any litigation, arbitration, investigation or governmental or regulatory proceeding now pending or threatened to which your firm is or may be a party, or are you aware of any potential claim or demand, which might otherwise affect the capacity of your firm to perform with respect to your involvement with the West Virginia Department of Health and Human Resources, whether or not it concerns other work which you have undertaken?

Yes ____ No ____ If so, please describe in full.

Is your company currently in default on any departments to the state or political subdivisions that in aggregate exceeds \$1,000? See WV Code 5A-3-10a.

At any time during the past five (5) years has your firm, or any of its owners or officers, been debarred or otherwise deemed ineligible to bid on or be awarded a public works contract or perform work as a subcontractor on a public works contract, under the laws of the federal government, state, county or municipal authority? Yes ____ No ____

At any time during the last five (5) years has your firm, or any of its owners or officers, been convicted of a crime relating to the awarding of a contract for a public works construction project, or the bidding or performance of a public works project?

Is there any person owing ten (10) percent or more of this company, or officer of the company, that is currently, or at the time of the bid, on the Worker's Compensation Employer Violator System? If yes, provide name of individual. Yes ____ No ____

BANKRUPTCY:

Has your firm, its principals, predecessors, or affiliates been the subject of any proceeding under the federal bankruptcy laws or any other proceeding under state or federal law in which a court or government agency has assumed jurisdiction over any of the assets or business of your firm, its principals, predecessors or affiliates? Yes ____ No ____



CONTRACTOR'S QUALIFICATION STATEMENT

If so, please identify the proceedings, the court or governmental body and the date such jurisdiction was assumed in an attachment. _____

FINANCIAL CONDITION:

*Financial Statements are required for every contractor and subcontractor working on a DHHR funded project. This confidential statement is kept on file in the DHHR office and is valid for one calendar year. Once expired, a new statement will be required as a condition of future bid awards. The Contractor Qualification Statement is considered incomplete unless this financial information is provided.

Please attach your organization's last two (2) years financial statements including your latest balance sheet and income statement showing the following:

Current Assets (e.g., cash, joint venture accounts, accounts receivable, accrued income, deposits, materials inventory and prepaid expenses);

Net Fixed Assets;

Other Assets;

Current Liabilities (e.g., accounts payable, notes payable, accrued expenses, provision for income taxes, advances, accrued salaries and accrued payroll taxes);

Other Liabilities (e.g., capital, capital stock, authorized and outstanding shares par values, earned surplus and retained earnings).

Name and address of firms attached financial statement and date thereof.



CONTRACTOR'S QUALIFICATION STATEMENT

CHANGE ORDER HISTORY:

Describe each instance within the last five (5) years where change orders applied for during construction amounted in the aggregate to more than five percent (5%) of the (Revised 6/09) contract price for any building which your firm constructed, or in which actual construction costs exceeded the contract price by more than five percent (5%). (Exclude owner requested change orders).

Marked as Attachment __, if required)

Change Order/Construction

Project	Cost Overrun Amounts
<hr/>	<hr/>
<hr/>	<hr/>
<hr/>	<hr/>

REFERENCES:

Please list below trade references:

Please list below bank references:

Please list below completed project owner references:



CONTRACTOR'S QUALIFICATION STATEMENT

SIGNATURE AND NOTARY:

Dated at _____ this _____ day of _____, 20__.

Name of Organization: _____

By: _____

Title: _____

State of _____, County of _____

Subscribed and sworn before me this _____ day of _____, 20__.

Notary Public: _____

My Commission Expires: _____

Notary Seal

DHHR – Contractors Qualification Statement**ARTICLE 6 – POST BID INFORMATION WSH13095****6.1 Contractor Qualification Statement.**

6.1.1 A completed Contractor Qualification Statement will be required of any Contractor and/or subcontractor to be submitted to the Department of Health and Human Resources for review. This confidential information will be used by the DHHR for evaluation of the low bid contractors on the project. The contractor qualification statement will only be required once annually and updated documents will be required from low bid contractors once the current contractor qualification statement has expired. The Qualification Statement should be submitted 72 hours after the close of the bid opening and must be submitted prior to the award of a contract and will be used in the bid review process by the owner (DHHR).

6.1.2 The confidential reviewed financial statement section of this document should be submitted to the DHHR by the apparent low bidder(s) and their subcontractors within 72 hours of the close of the bid opening and must be submitted prior to the execution of contracts or agreements between the DHHR and the contractor(s). The latest available financial information must be used. Minimum requirements for financial statements are:

- a. Accountants compilation report;
- b. Balance sheet;
- c. Income statement;
- d. Statement of changes in retained earnings;
- e. Statement of cash flows; and
- f. Notes to the financial statement.

6.1.3 In addition to the financial statement, the apparent low bid contractor(s) should submit a completed Affidavit of Debt Paid to the owner (DHHR) within 72 hours of the close of the bid and the Affidavit must be submitted prior to the award of a contract.

6.1.4 Construction contractors or subcontractors or equipment/material suppliers whose demonstrated pattern of poor and/or non-compliant work performance has been documented by the DHHR, project administrators and/or designers, or whose infractions of the State Prevailing Wage Rate codes has been documented by multiple citations from the West Virginia Department of Labor or whose contract has been terminated for just cause as described in the latest DHHR approved AIA Contract Document General Conditions, will be placed on probation and prohibited from bidding any additional projects funded by the DHHR for a minimum period of one year beginning at the time of probationary status. Such contractor may be removed from probationary status pending review of their continued work history performance by the DHHR at the conclusion of their probationary period.

6.1.5 In order to provide opportunity for any contracting, subcontracting or equipment/material firm cited for poor or non-compliant work to appreciably improve the quality of their performance prior to being placed on probation, the DHHR staff will utilize the following procedure:

- a. The cited firm shall be noticed in writing of the DHHR's concern, with appropriate documentation to illustrate the poor or non-compliant work, and advise the firm as to the possibility of being placed on probation.
- b. Upon continued poor/non-compliant work performance, the firm cited shall appear before the Chief Operations Officer of the DHHR to present his reasons for failure to respond positively with improved performance after the initial notice.
- c. Continued failure to improve poor or non-compliant performance will result in the probation. The contractor will be invited to appear at the DHHR meeting to discuss the citations and justify his uninterrupted participation.
- d. Probationary status of a firm may be revoked or continued by the DHHR's Construction Committee upon review and deliberation of any DHHR staff recommendation at the conclusion of the probationary period.



CONTRACTOR'S QUALIFICATION STATEMENT

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 26 36 00 – Transfer Switches

Corresponding to RFQ Item: 105

SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Division 20 – Mechanical, Electrical and Plumbing General Requirements applies to and forms a part of all specifications. Articles of this section shall govern unless superseded by specific stipulations of that Division of the Specifications.
- C. General notes on all drawings apply to and form a part of the Specifications.

1.2 SUMMARY

- A. Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switches.
 - 2. Bypass/isolation switches.
 - 3. Remote annunciation and control systems.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
 - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- C. Qualification Data: For manufacturer.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
 - 1. Features and operating sequences, both automatic and manual.
 - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain automatic transfer switches and bypass/isolation switches through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA ICS 1.
- F. Comply with NFPA 70.
- G. Comply with NFPA 99.
- H. Comply with NFPA 110.
- I. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Contactor Transfer Switches:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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- a. Caterpillar; Engine Div.
- b. Generac Power Systems, Inc.
- c. Kohler Power Systems; Generator Division.
- d. Onan/Cummins Power Generation; Industrial Business Group.
- e. Russelectric, Inc.
- f. Eaton/Cutler Hammer.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 - 2. Switch Action: Double throw; mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Switching. ~~Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.~~ Four-pole switches shall be required. Provide neutral pole switched simultaneously with phase poles. No overlapping neutral shall be permitted.
- H. ~~Neutral Terminal: Solid and fully rated, unless otherwise indicated.~~
- I. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

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- J. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- K. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- L. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.
- H. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:
 - 1. Fully automatic make-before-break operation.
 - 2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
 - 3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.

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- a. Initiation occurs without active control of generator.
 - b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.
4. Failure of power source serving load initiates automatic break-before-make transfer.
- I. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
- J. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.
- K. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.
- L. Automatic Transfer-Switch Features:
 1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

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- a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

2.4 BYPASS/ISOLATION SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
 1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.
 2. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations.
 3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
 4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
 5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.
 6. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
 7. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
- C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.5 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
 1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 2. Switch position.

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3. Switch in test mode.
4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

1. Indicating Lights: Grouped for each transfer switch monitored.
2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.6 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
1. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 4 inches in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support.
- B. Identify components according to Division 26 Section "Identification for Electrical Systems."

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

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3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
 - 5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- C. Testing Agency's Tests and Inspections:
 - 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

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2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
- D. Coordinate tests with tests of generator and run them concurrently.
- E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- F. Remove and replace malfunctioning units and retest as specified above.
- G. Prepare test and inspection reports.
- H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 1 Section "Demonstration and Training."
- B. Coordinate this training with that for generator equipment.

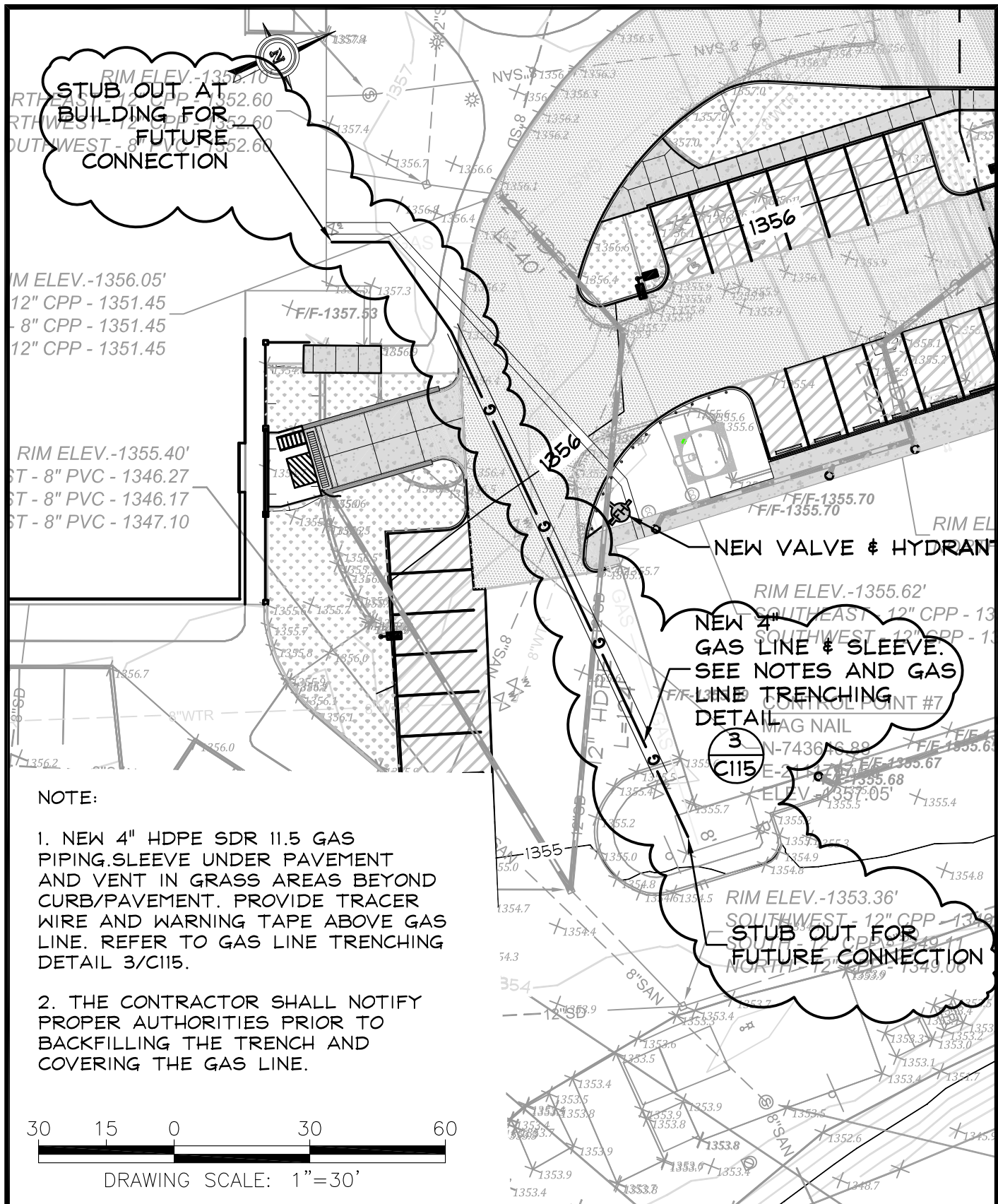
END OF SECTION 26 36 00

WSH13095

William Sharpe Hospital
50 Bed Addition

Sketch SKC-4

Corresponding to RFQ Item: 106



NOTE:

1. NEW 4" HDPE SDR 11.5 GAS PIPING. SLEEVE UNDER PAVEMENT AND VENT IN GRASS AREAS BEYOND CURB/PAVEMENT. PROVIDE TRACER WIRE AND WARNING TAPE ABOVE GAS LINE. REFER TO GAS LINE TRENCHING DETAIL 3/C115.

2. THE CONTRACTOR SHALL NOTIFY PROPER AUTHORITIES PRIOR TO BACKFILLING THE TRENCH AND COVERING THE GAS LINE.



DRAWING SCALE: 1"=30'

CADD FILE:

12-0115-DESIGN.dwg

DRAWN BY:

JHY

CHECKED BY:

LLM

DATE:

2/19/2013

SCALE:

1"=30'

WILLIAM R. SHARPE, JR. HOSPITAL 50 BED ADDITION
WESTON, WEST VIRGINIA

**ADDENDUM #4, RFQ RESPONSE 106
GAS LINE FUTURE CONNECTION REF SHT C114**

JOB NO: 04-12-0237

WSH 13095

SKC:

4

TRIAD
TRIAD ENGINEERING, INC.

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SCOTT DEPOT, WV 25560

WSH13095

William Sharpe Hospital
50 Bed Addition

Specification Section 07 21 00 – Thermal Insulation

Corresponding to RFQ Item: 107

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building Insulation of the following types:
 - a. Under-slab perimeter, board type.
 - b. Foundation walls, board type.
 - c. Thermal insulation in exterior walls, board type.
 - d. Metal furring for board type insulation in exterior walls.
 - e. Thermal insulation in exterior walls, batt type.
2. Related Sections:
 - a. Insulation for low slope roofing is specified in Division 07 Section "EPDM Roofing."
 - b. Sound insulation for interior partitions is specified in Division 09 Section "Gypsum Board."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- C. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Combustibility Characteristics: As determined by testing identical products according to ASTM E 136 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.

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2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Extruded-Polystyrene Board Insulation:
 1. DiversiFoam Products.
 2. Dow Chemical Co.
 3. Owens-Corning Co.
- B. Metal-Wrapped Plastic Board Insulation:
 1. Centria.
 2. ~~Dow Chemical~~.
 2. Hunter Panels
 3. Owens Corning.
- C. Glass-Fiber Insulation:
 1. Certain Teed Corporation.
 2. Knauf.
 3. Owens-Corning Fiberglas Corporation.
 4. Johns-Manville.
- D. Mineral Fiber Insulation:S
 1. Fibrex
 2. Owens Corning
 3. Roxul, Inc.
 4. Thermafiber

2.2 RIGID PLASTIC BOARD INSULATION:

- A. Underslab / Foundation Wall: Extruded Polystyrene, Rigid, ASTN C-578, Type IV, 25 psi.

2.3 METAL-WRAPPED PLASTIC BOARD INSULATION

- A. Provide one of the following products:
 1. Dow Thermax
 2. ~~Owens-Corning Foamular CC~~
 2. Hunter Xci Class A.
 3. Centria Metalwrap Series 200H

B. Metal furring for support of Metal-Wrapped Plastic Board Insulation:

1. Galvanized Z-furring, 25-gage.

2.4 BLANKET/BATT INSULATION:

A. Type: Glass fiber or mineral slag fiber, ASTM C-665, Type I.

1. Foil-scrim-kraft facer.

2.5 ACCESSORIES:

A. Adhesives and mechanical anchors.

B. Protection board.

C. Crack sealers and tapes.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions and recommendations applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical surfaces, set insulation units either using manufacturer's recommended adhesive or loosely laid, according to manufacturer's written instructions.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with

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adhesive or use mechanical anchorage to provide permanent placement and support of units.

- B. Metal Wrapped Plastic Board Insulation: Install Z-furring to retain insulation.
- C. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
 - a. Exterior Walls: Set units with facing placed toward interior of construction.
- D. Miscellaneous Voids: Install batt insulation in miscellaneous voids and cavity spaces where indicated and/or where required to prevent gaps in insulation

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00