October 24, 2018

Sarasota Manatee Airport Authority
Renovation of SRQ Airport Authority Boardroom, Police Department & Badging Area

The following items represent clarifications, additions, deletions, and/or modifications to the Contract Documents for the above-referenced project. This Addendum shall hereafter be regarded as part of the Contract Documents. Items not referenced herein remain unchanged. Receipt of this Addendum shall be acknowledged below and on the Bid Form.

This Addendum consists of 74 pages. The items listed below replace original items previously issued or are to be added to the Bidding and Construction Documents as indicated.

PART I – PERTAINING TO THE SPECIFICATIONS:

- In Specification volume 2 remove section 034530 – Polished Concrete System
- In Specification volume 2 replace section 274100 – Audio/Visual Systems
- In Specification volume 3 replace section 270010 – Technology General Provisions

PART II – PERTAINING TO THE DRAWINGS:

- SK-1 This sketch locates the locker room benches.
- SK-2 This sketch locates the corner guards in the Police Department and the Badging Area.
- SK-3 This sketch locates the corner guards in the Board Room.
- M2.1b revised plan per question 14.
- P4.1b revised plan per question 15.

PART III - CLARIFICATIONS AND RESPONSE TO BID QUESTIONS

Question 1: Who is the System Supply Source for Low Voltage System (Fire Alarm, Public Address, etc.) for the Sarasota Manatee Airport?

Response: The owner has a Service Contract with Johnson Controls for the Fire Alarm System; the Contractor for this project must coordinate with JCI to insure compatible devices are installed. The Airport Main Terminal Public Address System is an IED GlobalCom Announcement Control System by ALTEL Integrated Audio Visual Solutions of Florida.

Question 2: We noticed that in the Door Schedule there is a set 11 and 12 which are not shown in the Specifications. Please clarify or provide us with the required information.
Response: Refer to Specification Volume 3 Hardware Section 087100-10

Question 3: Please clarify the reference to Wood Doors as Mohawk series to match existing. Which of the Mohawk series is to be offered?

Response: Wood doors shall be Masonite Architectural Cendura HPDL. Provide Architect with a full range of colors to pick from.

Question 4: Inquiring about the polished concrete finish. I have the plans for the police department and the authority board room. I found on the floor plan room 104 in the authority room is sealed concrete. However, I did not see any rooms to receive the polished concrete in either of the sets of plans. Please advise.

Response: Polished Concrete is not in this project.

Question 5: There is no window schedule on the plans. Can the Architect provide one or at least provide window sizes? Please advise.

Response: See the Renovation of the SRQ Airport Authority Boardroom set. Sheet A3.1 Storefront type A for sizes.

Question 6: Boardroom plans page E2.1b, note (8), contractor shall demolish existing panel T4 and replace with new (42) circuit panel, the existing panel is a (54) space panel why are they taking out a 54 space panel and installing a (42) circuit, some of the new circuits are a larger number than 42. Please advise.

Response: The note should indicate to install a new 54-pole panelboard, and the panel schedule indicates a 54-pole panel. Provide new 54-pole panelboard in accordance with the panel schedule.

Question 7: We have reviewed the drawings and see minimal signage requirements. Is there a separate document or set of plans for the signage requirements? Please advise!

Response: All signage requirements are shown in drawings.

Question 8: According to the Door Schedule, Doors 201, 316 and 317 are part of the project but are not in the drawings. Should we include them in our bid or are they eliminated? Please advise.

Response: Those 3 doors should be included in this project. Door 201 is located between room Facilities Badging 200 and Training and Testing 201. Door tag is missing from plans. Door 316 is located in Restroom 316. Door 317 is located in Womens Locker Room. Door tags are shown on sheet 2.1.

Question 9: Is there a missing note 7 on Sheet T2.2p or is just a printing error? Please advise.

Response: Note 7 is not used.
Question 10: Luminaire marked as L is not in the Luminaire Schedule. Please provide an updated Luminaire Schedule.

Response: The type “L” luminaire shall be a Lithonia, Catalogue Number GTL-F-4-33L-MVOLT-4000K.

Question 11: In the finish schedule for the Authority Boardroom, Room 103, it calls for ACT-2. The Finish Selection Legend calls ACT-2 as size varies. What is the size for ACT-2? Please advise.

Response: ACT-2 Armstrong Optima TechZone 6”x 30” and 48”x30” 1” Square Tegular 9/16” Track

Question 12: According to the Responsibility Matrix, all voice/data/CATV/CCTV/Access Control/AV/Intrusion Detection, cabling, racks, electronics etc. are to be the responsibility of the owner. This was not mentioned in the pre-bid meeting. Please advise.

Response: See attached revised specification 270010 (for both projects volume 2 & 3) for revised Responsibility Matrix.

Question 13: Provide drawings and details showing the existing structural elements above the ceilings including size, location, type and height above finish floor. Also identify any steel that has spray-on fireproofing that will need to be patched due to demolition and attachment for new MEP overhead.

Response: Drawings not available. Existing steel has fireproofing. GC is responsible for patching existing fireproofing as required.

Question 14: Provide drawings and details showing the wall construction separating the work area from the non-work areas, since the HVAC shows new duct penetrations above the ceilings.

Response: Transfer duct will be relocated to avoid work in men’s restroom. See attached revised M2.1b drawing. Additional drawing information not available. Coordinate with owner during construction. Owner will provide temporary barriers.

Question 15: Provide a dimensioned layout for an acceptable repair of the existing terrazzo floor in the men’s room adjacent to the authority Boardroom, since the plumbing drawings show the new sanitary sewer connection in this area.

Response: See attached revised drawing P4.1b.

Question 16: Provide a location for the polished concrete system for the Boardroom as specified in Volume 2.

Response: See response to question 4 above.
Question 17: Provide a specification for the TV and refrigerator for the Boardroom shown on Sheet ID1.3 that is identified as “CFCI”. Provide a specification for the refrigerator at the Police Department as shown on Sheet A7.1.

Response: TV shall be Samsung QM-F Series 85” QM85F - Edge-Lit 4K UHD LED Display for Business. GC to verify clear dimensions before purchasing Refrigerator. Refrigerator shall be stainless steel, fingerprint resistant, no dispenser on door.

Question 18: To provide maximum local subcontractor and UCP/DBE participation can the work performed by the contractor’s own organization be reduced to 10% instead of 25% as outlined by Section 002113, Paragraph 3.2.

Response: 10% is acceptable.

Question 19: Provide a copy of the General Provisions, if any, since the Contract Forms, General Requirements and the Change Order Procedures in the specifications refer to these provisions.

Response: General Provisions are everything that is outlined in the specifications Volume 1.

Question 20: Provide the actual hourly cost for the owner’s inspector and architect as referenced in Article III, Paragraph 3.3 of the Contract Form.

Response: Please eliminate Paragraph 3.3.

Question 21: Confirm that there is no certified payroll requirement as noted in Article V, Paragraph 5.1.4 of the Contract Form.

Response: No certified payroll required. Please eliminate Paragraph 5.1.4.

Question 22: Verify that the project meeting minutes will be recorded by the architect or owner, since it is not clearly specified in Section 013100, Paragraph 1.8(A) 3.

Response: The Owner is to record meeting minutes and distribute to attendees.

Question 23: Confirm that a scheduling consultant and a cost/resource loaded CPM schedule as specified in Section 013200 will not be required, since it is unusual for a project of this size.

Response: A scheduling consultant and a cost/resource loaded CPM schedule are not required. GC to provide instead and updated project schedule at each OAC meeting that meets specified requirements.

Question 24: Confirm that a professional photographer as specified in Section 013233 will not be required, since it is unusual for a project of this size.

Response: A professional photographer is not required. GC to instead provide progress photos.
Question 25: Confirm that builder’s risk insurance will be provided by the owner, since it is not specifically stated in Appendix A. Also, verify that the contractor is required to purchase owner’s protective liability and list “American Infrastructure Development, Inc.” as additional insured as specified in Paragraph d and e.

Response: Owner will not provide Risk Insurance. Risk Insurance for the Contractor is not required by Owner. Contractor’s Certificate of Liability Insurance must state: Sarasota Manatee Airport Authority is added as additional insured to General Liability with respect to work performed by the Insurer.

Question 26: Will permit fees be waived or paid for by the owner? Also, will separate permits be issued for each of the three different locations?

Response: Two Sarasota County building permits have already been obtained for this project. GC will be responsible for any permit transfer fees.

Question 27: Is any material testing required? If so, provide a specification, including frequency.

Response: Refer to individual specification sections for testing requirements. No material testing for concrete is required.

Question 28: Will a common use field office be required as outlined in Section 015000, Paragraph 2.2? Also, will any erosion control or pest control be required per Paragraph 3.3(B) and (C)?

Response: No field office is required. If Contractor does need an office, it will be his responsibility to provide one. No erosion control or pest control is required.

Question 29: What percent of demolition and construction waste is required to be recycled, since a percentage is not identified in Section 017419? Also, if recycling is not required will disposal records be necessary per Paragraph 1.4?

Response: Section 01 74 19 includes definitions for recycle, salvage, etc. 1.5 Quality Assurance indicates the Contractor shall comply with authorities having jurisdiction (AHJ) requirements, and per 3.1.A shall implement approved waste management plan (Owner approved). If the Owner or AHJ don't require recycling, then there is no requirement. Disposal records are not required.

Question 30: Will existing ducts and coils within the three separate work areas be required to be cleaned as implied by Section 017700, Paragraph 3.1(B)?

Response: Section 3.1.B.m indicates the cleaning of these components are required "if units were operated without filters during construction”.

Question 31: Clarify the structural panel subfloor framing, since Section 061213 specifies steel/metal framing, whereas the drawing details show 2x SYP sleepers at the Boardroom.
Response: Wood framing is and acceptable subfloor framing. See the attached code report indicating the proper wood screw in the fastener table.

Question 32: Confirm that the patching and leveling of the existing concrete slab is minimal requiring no grinding, shot blasting, removal and replacement or any other extraordinary steps.

Response: See sheet AD1.1 and AD1.2 for slab removal extent. Coordinate with electrical and plumbing sheets.

Question 33: Will it be necessary to engage a qualified inspector to inspect the wood doors as specified in Section 081416, Paragraph 3.3(A)?

Response: This task is not required.

Question 34: Will it be necessary to engage a qualified testing agency to perform water-spray test on the aluminum windows and doors at the Boardroom as specified in Section 084113, Paragraph 3.5?

Response: A qualified testing agency is not required. GC to provide water testing.

Question 35: Will it be necessary that the Boardroom tile installer be “A Five Star Member of the National Tile Contractors Association or a Trowel of Excellence Member of the Tile Contractors Association of America” as per Section 093023, Paragraph 1.5? Also, will it be necessary the Police Department tile installer comply with Section 093013, Paragraph 1.8 which specifies minimum qualifications?

Response: This requirement is not necessary.

Question 36: Provide a location for the corner guards per Section 102650, since none are shown on the drawings.

Response: See sketch provided see SK-2 and SK-3.

Question 37: Verify that the only stainless-steel wall protection per Section 102660 is in Police Department Room 310.

Response: Room 310 Interview room is the only room requiring this wall protection.

Question 38: Provide a location for the locker benches if any are required at the Police Department.

Response: See sketch provided see SK-1.

Question 39: Note 17 on Sheet AD1.1 specifies that the Boardroom wall finish is to be removed and the existing gyp board is to remain. The existing wall finish is an adhesive applied FRP which cannot be removed without significantly damaging the drywall facing. Should the drywall be removed and replaced completely?

Response: Please remove the drywall and replace completely.
Question 40: Provide a drawing or details for the existing wall and foundation between the Boardroom and the Men's Restroom where the new sanitary sewer line is to be installed.

Response: See attached revised drawing P4.1b.

Question 41: Is there access and adequate working space above the Men's Restroom ceiling to install the plumbing vent shown on Sheet P4.1b, the transfer duct shown on Sheet M2.1b and the electrical conduits and wire shown on Sheet E2.1b related to the Boardroom?

Response: Transfer duct will be relocated to avoid work in men’s restroom ceiling. See Attached revised M2.1b drawing.

Question 42: Sheet M2.2p shows a new transfer duct outside of the work area related to the Badging. Is there access and adequate working space above these different rooms so to install this duct? Will there be any restrictions as to working hours related to installing this duct?

Response: Information not available. Work in this area will have to be coordinated with the owner. No restrictions on normal airport work hours. GC responsible for making request to work outside normal hours.

Request 1: We are requesting the Airport Authority to reconsider the execution time set up at 120 consecutive days.

Response: Contract has been extended to 180 days. See addendum 1

PART IV - CLARIFICATIONS

- Permit has been received with no comments.

Please let me know if you have any questions.

Regards,

Jenna Kiser, AIA
Project Architect
1. GENERAL CONDITIONS AND DEFINITIONS
   A. Scope: This specification section applies to all Division 27 specification sections and all Division 28 specification sections. All systems under the specification sections indicated above are also referenced in these contract documents as “technology systems”.
   B. Drawings and specifications: The words “drawings” and “specifications” used in this section refers to all contract drawings and specifications that describe the scope of work for the technology systems. These items combined create the Construction Documents.
   C. Installer and Contractor: The word “installer”, where used on the drawings or specifications without any further description, shall reference the installer of the referenced systems. The word “contractor”, where used on the drawings or specifications without any further description, shall reference the General Contractor / Construction Manager that holds the prime agreement with the Owner for the construction of this project.
   D. Provide and Install: The word "provide", where used on the drawings or specifications, shall mean: furnish, install, mount, connect, test, document, and make ready for operation. The word "install", where used on the drawings or specifications, shall mean: mount, connect, test, complete, and make ready for operation.
   E. Engineer: The word “Engineer or A&E”, where used on the drawings or specifications, refers to the design engineer that is working for the project Architect or the Owner. It does not refer to an engineer employed by the General Contractor / Construction Manager or any trades contractors working on the project.
   F. Designer / Contractor / Owner Responsibilities: Refer to attachment 2 of this specification section for “Responsibility Matrix” document outlining the responsibility of each trade on each technology system.

1.2 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS
   A. Objective: The intent of the design drawings and specifications are to provide the installer of the technology systems the necessary information to create a scope of work for bidding and construction purposes. The drawings and specifications are not intended to show every single element of the project to produce a buyout list for the installer. Unless indicated otherwise, all primary components are specifically indicated. However small components and cabling assemblies are generally not indicated in the documents.
   B. Accuracy: The drawings are diagrammatic and are not intended to show exact locations of conduit runs, outlet boxes, junction boxes, pull boxes, etc. Exact locations shall be coordinated with all trades in the field and as accepted by the Architect or Engineer during construction. Obtain all information relevant to the placing of technology systems work in the field. In cases where there is a conflict with other trades that cannot be easily resolved through coordination, proceed as directed by the Architect or Engineer.
   C. Distances: Although most drawings have a scale referenced on each sheet, the drawings are a two dimensional representation of the system. The design drawings do not indicate changes in elevation that
may cause additional lengths and/or material quantity. It is the responsibility of the installer of each technology system to field verify all distances and elevation changes prior to bidding.

D. Discrepancies: Notify the A&E of any discrepancies found during the construction of the project. Do not proceed with this portion of the project until a written resolution to the discrepancy is received. If a conflict exists between the contract documents and any applicable code or standard, the most stringent requirement shall be considered the minimum requirement for this project.

E. Existing Conditions: All existing conditions might not be indicated in the contract documents. The installer of each system shall review the site and all existing conditions thoroughly before bidding. The installer shall advise the Engineer of any issues prior to bidding.

F. Coordination: The technology systems drawings are intended to be coordinated with other design disciplines. However, the installer for other systems might have changes to their design and/or shop drawings which are not properly coordinated. The Contractor is required to produce coordination documents for specific rooms to facilitate space planning and coordination for all trades.

1.3 ABBREVIATIONS

A. Abbreviations: The following abbreviations or initials may be used:
1. ABV CLG - Above Ceiling
2. AC - Alternating Current
3. ADA - American Disabilities Act
4. AFF - Above Finished Floor
5. AFG - Above Finished Grade
6. AMP - Ampere
7. ANSI - American National Standards Institute
8. AWG - American Wire Gauge
9. BC - Bare Copper
10. CCTV - Closed Circuit Television
11. CATV - Community antenna television
12. CLG - Ceiling
13. COAX - Coaxial Cable
14. CPU - Central Processing Unit
15. DC - Direct Current
16. DEG - Degree
17. EMT - Communication Metallic Tubing
18. GND - Ground
19. IDF - Intermediate Distribution Frame (Telecom Room)
20. IMC - Intermediate Metallic Conduit
21. IN - Inches
22. IP - Internet Protocol
23. JB - Junction Box
24. KVA - Kilo-Volt-Amps
25. KW - Kilowatts
26. LBS - Pounds
27. LED - Light Emitting Diode
28. MAX - Maximum
29. MDF - Main Distribution Frame (Main Telecom Room)
30. MIC - Microphone
31. MIN - Minimum
32. MTD - Mounted
33. MTG - Mounting
34. NEC - National Communication Code
35. NECA - National Communication Contractors Association
36. NEMA - National Communication Manufacturers Association
37. NFPA - National Fire Protection Association
38. NIC - Not in Contract
39. OFE - Owner furnished equipment
40. OSHA - Occupational Safety and Health Administration
41. PB - Pullbox
42. PWR - Power
43. PVC - Polyvinylchloride
44. EF - Telecommunications Entrance Facility
45. TR - Telecommunications Room
46. TTB - Telephone Terminal Board
47. V - Volt
48. WP - Weatherproof

1.4 CODES AND STANDARDS

A. Application: The codes, standards, and practices listed in this section generally apply to all technology systems. Other codes, standards, or practices that are more specific will be referenced within the applicable specification section.

B. Requirements: All articles, products, materials, fixtures, forms, or types of construction covered in the technology system specifications are required to meet or exceed all applicable standards and requirements of the manufacturer. The technology systems installation shall be done in accordance with the requirements of ANSI, NEMA, IEEE, NEC, BICSI, and TIA documents where indicated and the manufacturer recommended best practices. Requirements indicated on the contract documents which exceed but are not contrary to governing codes or practices shall be followed.

C. Compliance and Certification: The installation shall comply with the governing state and local codes and ordinances. The complete technology system installation shall be inspected and certified by all applicable agencies to indicate the systems are in compliance with their requirements.

D. Applicability: The State of Florida codes, standards, and practices listed herein (revision date to be latest adopted) are provided as the minimum requirements. The list for all technology systems is as follows:
   1. Florida Administrative Code
   2. Florida Building Code
   3. Accessibility Requirements Manual - Florida Department of Community Affairs.

E. UL Labels: All equipment assemblies shall be new, free of defects, and shall be U.L. listed. As an alternative to UL, the equipment can be tested and listed with an approved, nationally recognized Communication Testing Agency. No equipment shall be installed without this testing and subsequent listing.

1.5 MATERIALS ALTERNATES AND SUBSTITUTIONS

A. Definitions:
   1. Basis of design: A product or group of products from an identified manufacturer that was used as the basis of system layouts and installation details as part of the Construction Documents.
   2. Prototype: A product or group of products that are not yet ready for commercial and are in the testing phase (Beta testing) of product development.
   3. Alternates: Products or manufacturers listed in the Construction Documents as comparable to the basis of design. Alternates shall follow the same system architecture and design philosophy as the basis of design.
4. Obsolete: A product that has been discontinued by the manufacturer or reached the end of life and is no longer being manufactured.

5. Substitution: A product not listed in the Construction Documents but capable of the same characteristics as the basis of design. Substitutions shall function as a direct replacement of the referenced product. The installer can propose a substitution only if all requirements of the specification are met and substitutions are approved by the Architect and/or Owner.

B. Use of prototypes. Prototypes are not allowed in any technology system.

C. Use of alternates. Alternates are allowed and the installer shall adhere to the following requirements:
   1. Where several models or manufacturers are listed as acceptable alternates each shall be regarded as equally acceptable to the basis of design. Where a manufacturer's model number is listed, this model shall set the standard of quality and performance required. Where no model is specified, the source and quality shall be based on the specified equipment criteria and subject to the Engineer's review and acceptance. Where three or more manufacturers are listed, one of the listed manufacturers shall be submitted for acceptance.
   2. The use of alternates does not allow for the change of the system architecture.

D. Use of substitutions. Substitutions are only allowed when they meet all the requirements below:
   1. Substitutions are only allowed when a particular specification section for a technology system allows the use of substitutions for that particular system.
   2. The performance of all substitution components must meet or exceed those of the basis of design. Should an installer wish to submit a substitution product, and substitutions are listed in the construction documents as acceptable, it shall be the responsibility of the installer to submit to the Engineer an item-for-item CROSS REFERENCE for all specifications of the product versus the basis of design. Substitution requests shall be submitted with a completed substitution request form indicated in Addendum 1 of this specification.
   3. The Engineer has the authority to reject a substitute request without cause and the installer shall provide the basis of design (or listed alternate) at no additional cost.
   4. Substitutions of unnamed manufacturers will not be accepted.
   5. Certification of substitutions: When a basis of design is specified to be in accordance with a trade association or government standard requested by the Engineer, the installer shall provide a certificate that the substitute complies with the referenced standard. Upon the request of Engineer, the installer shall submit supporting test data to substantiate said compliance.
   6. Substitutions that create a change in system architecture are not allowed,
      a. A substitution request that changes the system architecture requires the installer to submit the overall cost of the substitute product including the cost of changing other systems affected, the re-design cost for such systems, and any additional services costs from other firms on the design team. Without this information this substitution will not be evaluated at all.

1.6 SHOP DRAWINGS AND SUBMITTALS

A. General: Shop drawings shall be submitted as required in the specification sections for each system.

B. Shop drawings submittal quantity: Follow the Division 1 specification requirements for quantity of shop drawings and any additional submittal requirements. If the project does not have a Division 1 specification, shop drawings shall be submitted in quantity of one (1) for electronic format submittal and four (4) for hardcopies.

C. Electronic submittals: .pdf format is the only acceptable file type for electronic submittals.

D. When product data sheets of products are submitted, and the manufacturer’s cut sheets indicate several model numbers or variations of the same product, the product data sheet shall have the model number of
the submitted equipment highlighted by the installer. Submittals received with product data sheets indicating multiple model numbers without being highlighted will be rejected and not reviewed.

E. Equipment and material quantities are not reviewed by the Engineer as part of the submittal process. Equipment quantities are to be provided by the installer to meet the requirements of the construction documents. Approved shop drawings with equipment quantities or overall scope of work that is different from the construction documents does not constitute approval by the Engineer of these changes. The construction documents, along with any changes issued formally by the A&E during the construction process, are to always be followed for equipment quantities and scope of work.

F. All electronic equipment prone to obsolescence and with lead times of less than 3 months shall be submitted for approval no sooner than 12 months before the scheduled date of substantial completion of the project. Electronic equipment prone to obsolescence includes: flat panel displays, transceivers, servers, players, workstation, and routers.

G. Equipment and materials that are not installed in accordance with the construction drawings and approved shop drawings shall be replaced at the installer’s expense.

H. Multiple submissions may be required as indicated in each specification section. For final completion and testing, the Installer shall provide a submittal with the following information:
   1. Detailed course syllabus for each type of training required in the specification section.
   2. A proposed schedule of training sessions in compliance with the specification section and indicating where the training will take place.
   3. A copy of all training material to be used during each session.
   4. Test result sheets for all testing performed by the Installer as required in the specification section prior to the final system acceptance test.

PART 2 - PRODUCTS

2.1 IDENTIFICATION AND LABELING TAGS

A. All conduit, cabinets, cables, individual conductors, wiring forms, terminal blocks, and terminals shall be clearly identified with pre-printed labels or tags.

B. The only approved types of labels for technology systems installed indoors are:
   1. Non-laminated thermal transfer labels, printed with a high quality thermal transfer printer.
   2. Laminated thermal transfer labels printed with a high quality thermal transfer printer.
   3. Thermal transfer polyolefin tape printed with a high quality thermal transfer printer.
   4. Self laminated dot-matrix labels, printed with a high quality dot matrix printer.
   5. Non-laminated dot-matrix labels, printed with a high quality dot matrix printer.

C. For labeling of cables or equipment in outdoor or wet environments use only marker plates attached to cable with cable ties. Marker plates attached to equipment shall be with an adhesive designed for the material being bonded in that environmental condition. Do not use any labels with adhesive materials, unless the adhesive is rated for the application. Use different color plates for different cable types. Use only waterproof ink for writing on cable marker plates. Marker plates on equipment shall be engraved or machine lettered.

D. Hand written labels (except for outdoor marker plates), including writing on cable jackets or directly on equipment, are not acceptable and shall be corrected with approved labeling methods at no additional cost to the owner.
E. Approved manufacturers:
   1. Rhino,
   2. Brady,
   3. Panduit or
   4. approved equal

2.2 TECHNOLOGY EQUIPMENT AND MATERIALS

A. General: Each item of equipment or material shall be manufactured by a company regularly engaged in the manufacturer of the type and size of equipment specified. The equipment shall be suitable for the environment in which it is to be installed and shall be approved for the intended purpose, environment, and application. Equipment shall bear the label of the independent testing agency as indicated in paragraph 1.4.E. of this section.

B. Installation Requirements: Each item of equipment or material shall be installed in accordance with the instructions and recommendations of the manufacturer as it relates to the construction documents.

C. Required Accessories: The equipment specified in the technology systems specifications shall be provided with all required accessories for proper operation and mounting. Such accessories include items such as power supplies, power cords, rack ears, rack rails, bolts, lugs, faceplates, etc.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

A. WORKMANSHP: The installation of all material and equipment shall be performed in a neat, workmanlike, and professional manner by an adequate number of craftsmen who are knowledgeable of the requirements of the Construction Documents. They shall be skilled in the methodology and craftsmanship required to produce a high level of workmanship. Personnel who install materials and equipment shall be qualified through training and experience in order to perform their assigned tasks.

B. STANDARD OF QUALITY: To define a high level workmanship, all installation best practices described by the manufacturer, BICSI, ASIS, and infoComm standards publications shall be followed.

C. PROTECTION OF EQUIPMENT: Equipment for technology systems shall be adequately protected against any damage which may occur due to the elements or work performed by other trades at all times during construction. Equipment shall be stored in dry permanent shelters or weatherproof storage trailers. If any equipment or materials have been damaged during this time, such equipment shall be replaced at no additional cost or time extension. Damaged equipment and materials include the following conditions:
   1. Equipment that has visible scratches, cracks, or other surface coating damage.
   2. Equipment with visible indication of rust or water intrusion.
   3. Equipment that has dents that are clearly visible.
   4. Equipment that has been sprayed with paint, fire proofing materials, or any other type of chemical that was not intended to have these materials applied to it, per the construction documents.
   5. Equipment that has been damaged by fire, power surges, power sags, or lightning.
   6. Equipment that has known damage to any parts, electronic boards, or components and the damage is not overtly visible.
   7. Cables that have visible damage to the jackets; even if the cables are not broken, still provide electrical continuity, and allow for system functionality.
   8. Cables sprayed with paints that affect the warranty of the cable as defined by the cable manufacturer.
9. Equipment with screws that have stripped heads or threads.

D. CLEAN EQUIPMENT: All installed equipment like racks, cabinets, wall mounted panels, credenzas, etc. shall be free of dust at the time that space or area of the project gets the final Certificate of Occupancy and at the time of the acceptance test by the A&E.

E. IDENTIFICATION AND TAGGING: All technology system items shall be labeled and identified as specified in the Construction Documents. Such identification shall be in addition to the manufacturer's nameplates and shall serve to provide a unique identifier of the equipment and systems which it serves or controls. Refer to the identification part of each specification section for additional information. All labels of equipment and wiring shall match the labeling used in the shop drawings for the system or as approved by the Owner.

3.2 COORDINATION

A. General: The installer shall coordinate their shop drawings and installation work with those of other trades and the Owner’s contractors. Report any conflicts to the A&E. The installer shall obtain from the A&E written instructions required to make the necessary changes for the affected scope of work. All work shall be installed in coordination with all other Contractor and Owner subcontractors.

B. Adjustments: Locations of conduit and equipment shall be adjusted as required to accommodate the work of all trades with the understanding all interferences have been anticipated and encountered through coordination. The installer shall determine the exact routing and location of all contracted technology systems prior to fabrication or installation.

C. Replacement: All work shall be installed in a way that permits removal (without damage to other parts) of all system components provided under the construction documents requiring periodic replacement or maintenance. All conduits shall be arranged in a manner that clears the openings of swinging access doors and ceiling tiles.

3.3 TELECOM ROOM/EQUIPMENT ROOM READINESS

A. In any projects where the technology systems require the use of network equipment (switches, routers, firewalls, etc) provided by the Owner, the Contractor shall complete all telecom rooms to a point where they are suitable for the Owner to deploy such equipment. At a minimum the following conditions shall be met in the rooms for the Owner to install the equipment:
   1. All power outlets in the telecom rooms shall be fed from the permanent source of power. Temporary power shall not be provided.
   2. Backup power (generator and/or UPS) if provided shall be in full operation and tested.
   3. The mechanical equipment providing the cooling for the telecommunications rooms shall be fully operational with permanent filtration. Temporary cooling and filtration shall not be provided.
   4. Fire suppression systems (wet sprinkler, dry sprinkler, or clean agent) protecting the telecommunications rooms shall be fully operational and tested.
   5. All light fixtures in the telecommunications rooms shall be fully operational.
   6. All walls to the telecom rooms shall be complete, including the last coat of paint. No sanding of the wall surface will be allowed once the Owner’s equipment is installed.
   7. The ceiling and flooring of the telecommunications rooms shall be finished.
   8. The final and permanent doors to the telecommunications rooms shall be installed with a key core different from all other construction cores in the site.
   9. Telecommunications rooms shall be cleared of all stored materials inside the room.
   10. Telecommunications rooms shall be fully cleaned by the Contractor’s finish cleaning personnel. Clean is defined as not having any debris left in the room and not having dust in any rack, cabinet,
or wall mounted panel. If wiping a finger on the surfaces of such equipment leaves visible dust residue on the finger, the room will not be considered clean.

11. Hallways and rooms leading into the telecommunications rooms shall require no more sanding to be done on the walls. The floor finish shall be completed to avoid dust from these spaces moving into the telecom rooms.

12. Prior to the Owner deploying their equipment in these rooms, the Contractor shall provide disposable sticky mats at the entrance of each room to capture dust and/or dirt from shoes or boots. The sticky mats shall sized to cover the full width of the door opening plus three (3) inches on each side. The sticky mats shall contain no less than 60 sheets per unit. The sheets shall be replaced no less than once a day and will be replaced as required if worn out during the day. Sticky mats shall be provided until the project receives the final Certificate of Occupancy for the entire area served by the telecommunications room.

3.4 SYSTEMS WARRANTY AND SERVICE

A. General: At a minimum all technology systems shall include a warranty from the manufacturer and installer of the system for no less than one (1) year with the following exceptions:

1. When specific equipment manufacturers include a warranty longer than one year, the manufacturer’s warranty shall be transferred to the Owner in the same terms indicated by the manufacturer to the Installer.

B. Warranty coverage. The warranty for the technology systems shall cover the following elements:

1. All equipment, and materials.
2. The labor to replace malfunctioning parts.
3. Shipping and freight charges to send equipment back and forth from the manufacturer and/or site.
4. Any manufacturer RMA (return material authorization) charges.
5. Tool rentals such as scaffold or lifts required to access equipment.
6. The troubleshooting time to detect faults.
7. All travel time and expenses associated with the warranty service.

C. Start of warranty. For new construction projects, the warranty period for the technology systems starts the day the project receives the Certificate of Occupancy (CO). For retrofit projects for a particular system, the warranty starts when the project is accepted by A&E. For most equipment/software manufacturers the warranty period starts when the equipment is shipped from the factory, it is the responsibility of the installer of each system to provide additional warranty coverage from the manufacturer to cover the additional time of warranty up to the CO date plus one year as required.

D. Service calls. During the warranty period the Installer shall support the technology systems when called by Owner/Contractor for service. All equipment/software service shall be done by personnel trained and qualified by the manufacturer for the system and as indicated in each technology system specification section. Service calls shall be performed during normal business hours (same time zone as the project) for normal service and twenty four (24) hours a day for three hundred and sixty five (365) days in the year for emergency service. Emergency service shall be defined as the loss or failure of any critical component necessary to maintain the overall integrity and proper operation of the system. Normal service shall be defined as the loss or failure of a system component that does not compromise the full operation of the system and allows the Owner to operate the system at a minimum of 90% of intended capacity.

E. Response time for service. The maximum allowed on site response time for emergency service shall be four (4) hours and normal service shall be twenty four (24) hours.
3.5 AS BUILT DOCUMENTS

A. Production: During the course of the project the Installer shall maintain a record as-built drawing set. The set shall be maintained at the site at all times and shall be accurate, clear, and complete. The set shall show the actual location of all equipment in the installed location. The as-built drawings shall show all technology systems work completed and installed to the current stage of construction. These drawings shall be available for review by the A&E’s field representatives at all times.

B. Completion: At the completion of the work, the Installer shall transfer the record as-built drawing set information onto a second set of clean drawings with all changes marked in colored ink. This copy shall be submitted to the A&E.

C. Final: Submit full size drawings and one (1) copy of the Installer’s CAD/Autodesk Revit© files for review and acceptance.

D. Additional documents. At project completion, the Installer of the technology system shall provide updated tables, equipment schedules, configuration worksheets and labeling systems used on the project. See individual system specification sections for more detailed information on these document requirements.

END OF SECTION 27 00 10
ATTACHMENT 1 – SUBSTITUTION REQUEST FORM

Substitution Request Number: ________________

PROJECT: _____________________________ DATE: ______________

SPECIFICATION SECTION: _______________ ITEM(S): _________________________

SPECIFIED MANUFACTURER: ________________________________

SPECIFIED MODEL NO: __________________________________________

PROPOSED MANUFACTURER: ________________________________

PROPOSED MODEL NO: __________________________________________

REASON(S) FOR NOT PROVIDING SPECIFIED ITEM: ______________________________________

Attach product description, drawings, photographs, performance and test data, samples and other information necessary for side-by-side evaluation. Fill in all blanks.

A. Provide substantiated reason for requested substitution.

B. Does the requested substitution affect dimensions, locations or configurations?
   No: _______ Yes: _________
   Explain (attach drawings if necessary): ________________________________

C. What are the differences between the specified item and the requested item:
   ________________________________________________________________

D. Will the Contractor pay for any changes to the building design, including engineering and detailing costs caused by the approval?
   No: _______ Yes: _________
   Explain (if no, and describe modifications required to install or accommodate the requested change): ______
   ________________________________________________________________

E. Will approval affect the work of other trades, including the Construction schedule?
   No: _______ Yes: _________
   Explain (if yes):
   ________________________________________________________________

F. Manufacturer’s guarantees of the proposed and specified items are:
   Same: _______ Different: _________
   Explain (if different):
   ________________________________________________________________

TECHNOLOGY GENERAL PROVISIONS
27 00 10 - 10
G. Does the proposed item meet all applicable codes, ordinances and regulations for this specific application?
   No: _______ Yes: _______
   Explain (if no): ____________________________

H. Has proposed item been used locally in similar applications?
   No: _______ Yes: _______
   Explain (give nearest location): ____________________________

I. Will maintenance and service parts be locally available for the requested item?
   No: _______ Yes: _______
   Explain (if no, give nearest location): ____________________________

J. Will the requested item require waiving of any qualifications or other requirements?
   No: _______ Yes: _______
   Explain (if yes): ____________________________

K. Are there any license fees or royalties associated with the requested substitution?
   No: _______ Yes: _______
   Explain (if yes): ____________________________

L. If approved, will the Owner receive a credit for the proposed alternate material?
   No: _______ Yes: _______
   Explain (if no): ____________________________

M. Does the proposed alternate material meet the same applicable standards (ASTM, ANSI, UL, FS) as the specified item?
   No: _______ Yes: _______
   Explain (if no, attach drawings if necessary): ____________________________

N. Identify the recycled materials or components or features that lead to the claims to being “Green”: _______
   ____________________________

O. Has the required line-by-line comparison been included?
   No: _______ Yes: _______
   Explain (if no): ____________________________
The undersigned agrees to pay for the Designer’s review time and for changes to the building design, including re-
view, re-design, engineering, drawings and other costs caused by the requested substitution.

________________________________________________________________________

Signature

________________________________________________________________________

Print

The following Purchase Order or billing number is to be used for billing the Contractor for costs incurred in evaluat-
ing and if applicable accommodating the requested substitution.

________________________________________________________________________

The Engineer will not be required to approve any product that is not equal or suitable for the specific application and
functionality of this project.
### ATTACHMENT 2 – RESPONSIBILITY MATRIX

#### DESIGN AND CONSTRUCTION RESPONSIBILITIES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SYSTEM COMPONENT</th>
<th>SCOPE</th>
<th>DESIGN RESPONSIBILITY</th>
<th>PROCUREMENT RESPONSIBILITY</th>
<th>CONSTRUCTION RESPONSIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>VOICE / DATA STRUCTURED CABLING SYSTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.01</td>
<td>RACEWAYS - CONDUIT ONLY</td>
<td>Conduit, boxes, cable tray, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>1.02</td>
<td>INSIDE PREMISE WIRING</td>
<td>Structured cabling system</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>1.03</td>
<td>OUTSIDE PREMISE CABLING</td>
<td>Structured cabling system</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>1.04</td>
<td>OUTSIDE PREMISE CABLING FROM SERVICE PROVIDERS</td>
<td>Fiber and copper for services</td>
<td>VoltAir</td>
<td>Owner</td>
<td>Owner</td>
</tr>
<tr>
<td>1.05</td>
<td>PATCHING</td>
<td>Cable patching at patch panel and work area outlets</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>1.06</td>
<td>ACTIVE ELECTRONICS (NETWORKING EQUIPMENT, SWITCHES, ROUTERS, SERVERS AND COMPUTERS)</td>
<td>Equipment selection, sizing, equipment layout</td>
<td>VoltAir</td>
<td>Owner</td>
<td>Owner</td>
</tr>
<tr>
<td>2.00</td>
<td>TELEVCOMUNICATIONS ROOM FITOUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.01</td>
<td>PLYWOOD, FLOOR, AND WALL SLEEVES</td>
<td>Plywood and sleeves for cables</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>2.02</td>
<td>BONDING SYSTEM</td>
<td>Ground bar and ground bus</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>2.03</td>
<td>RACKS, WIRE MANAGERS AND LADDER TRAY</td>
<td>Racks and all passive elements</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>3.00</td>
<td>CATV DISTRIBUTION SYSTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.01</td>
<td>RACEWAYS</td>
<td>Conduit, boxes, cable tray, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>3.02</td>
<td>INSIDE PREMISE WIRING</td>
<td>Coaxial and balanced twisted pair cable</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>3.03</td>
<td>DISTRIBUTION DEVICES</td>
<td>TAPS, amplifiers, splitters, D/C</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>3.04</td>
<td>DISPLAYS</td>
<td>Displays and mounts</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>4.00</td>
<td>AUDIO VISUAL AND PAGING SYSTEMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.01</td>
<td>RACEWAYS</td>
<td>Conduit, boxes, cable tray, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>4.02</td>
<td>INSIDE PREMISE WIRING</td>
<td>AV wiring for systems (other than structured cabling)</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>4.03</td>
<td>ACTIVE ELECTRONICS</td>
<td>Projections, presentation control system, paging system, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>5.00</td>
<td>INTRUSION DETECTION SECURITY SYSTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.01</td>
<td>RACEWAYS</td>
<td>Conduit, boxes, cable tray, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>5.02</td>
<td>INSIDE PREMISE WIRING</td>
<td>Cables</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>5.03</td>
<td>ACTIVE ELECTRONICS</td>
<td>Control panels and field devices</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>6.00</td>
<td>ACCESS CONTROL SECURITY SYSTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.01</td>
<td>RACEWAYS</td>
<td>Conduit, boxes, cable tray, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>6.02</td>
<td>INSIDE PREMISE WIRING</td>
<td>Cables for card access</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
</tbody>
</table>
SECTION 27 41 00 – AUDIO/VISUAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General: The General Requirements, Conditions of the Contract, these Specifications, Drawings, Addenda and Contract Modifications (the Contract Documents), and definitions of legal entity (such as Contract, Installer, Engineer, Owner, etc…) shall apply to the work of this specification section.

B. Supplemental: Refer to the specification sections identified below for additional requirements, which are supplemented by this section.
   1. 270010 Technology General Provisions
   2. 270528 Raceways for Technology
   3. 271000 Structured Cabling System
   4. 270526 Grounding and Bonding for Communication Systems

1.2 SCOPE OF WORK (SOW)

A. General: Refer to the requirements of the related documents identified in Part 1.1 of this specification, for scope of work requirements, which are supplemented by this section. This shall constitute the basis for the “Scope of Work” for this specification.

B. System: The goal of the project is to provide a finished, complete audiovisual system with the functionality, capacity, and operability, as described in the Contract Drawings and specifications herein. The finished, complete system shall serve as a vehicle for the transport of associated system signals from designated origination points to equipment interfaces and/or identified distribution points per the Contract Documents. The scope of work for the AVS installer shall include, but not limited to the following tasks:
   1. Preparation of shop drawings, submittals, training and as-built information for the system.
   2. Procurement, installation and warranty of all AVS hardware including projectors, flat panel displays, mounts for displays, signal transceivers, players, switchers, servers, etc.
   3. Procurement, installation and warranty of all AVS cabling and wiring, including support system, and fire stopping for all low voltage cabling part of the AVS.
   4. Programming labor of the AVS, including initial software set up, software registration, and initial data input, unless otherwise noted in this specification section.
   5. Attend project plan meetings with the Owner and the Consulting Engineer (A&E) to fine tune data interchange details, network configuration and other user requirements:
   6. Provide training and close out information as indicated in this specification.

C. It shall be understood by the AVS installers that this is an integrated system where multiple pieces of equipment from different manufacturers are required to be connected/interfaced together to make the AVS operational. To allow for competitive bidding multiple manufacturers are listed in the specifications for many devices and software, but it is the sole responsibility of the AVS installers to verify that their particular equipment and software selection integrate and work seamlessly with other equipment and software from the pool of approved manufacturers. These specifications represent a design guideline and design intent but they are not intended to verify that all possible equipment and software listed in this specification work and integrate seamlessly with any equipment and software form the pool of acceptable manufacturers. Approval of submittals for the AVS by the A&E of the project does not relieve the responsibility for the AVS installers to deliver a working system. Any equipment changes required
because of incompatibility between different devices of a particular system, even after the equipment has been approved by the A&E, shall be provided at no additional cost to the owner.

D. The following items are not part of this scope of work:
   1. All networking equipment

E. The following is a list of rooms where Audio Visual systems shall be provided:
   1. 101 Conference Room
   2. 103 Authority Boardroom

F. Consumables: The Audio Visual System (AVS) Installer shall provide as part of the scope the following consumable devices:
   1. One (1) replacement lamp per each projector in the project.
   2. One (1) wind screen for each microphone in the project.

G. Spare parts: The AVS Installer shall provide as part of the scope the following spare parts:
   1. 2 speakers of each type installed on this project

1.3 INSTALLER QUALIFICATIONS

A. General: The qualifications and requirements herein apply to the specific technology identified by this specification section. Refer to the specification sections identified in Part 1.1 “Related Documents”, of this specification, for additional requirements, which are supplemented by this section.

B. Installer Qualifications: The Installer directly responsible for the work described in this specification section is also referenced as the AVS Installer. The Installer shall be a licensed and registered contractor who is, and who has been, regularly engaged in providing the installation of audiovisual systems of similar size and complexity for at least the immediate past five (5)-years.

C. Project manager requirements: The project manager for each company participating in the installation of the AVS shall be a Certified Technology Specialist (CTS) by InfoComm International. Proof of current certification shall be provided with the submittal

D. Programmer-Installer: The AVS Installer must have a factory-trained programmer/installer, for the provided Project products, in full-time employment, as part of their staff. The AVS installer needs to provide certificates of completion of training for the staff that will be taking part in the execution of this project

E. Qualification Documentation: The Installer shall provide the following documentation with their bid package, as evidence that the requirements for the Installer qualifications have been satisfied:
   1. A list of not less than five (5) references for jobs of similar size and complexity including:
      a. Project Names
      b. Locations
      c. Contact Names
      d. Contact Telephone Numbers
   2. Location (specific street address) of the office from which this installation and warranty work will be performed. It is preferred that the Installer has established and maintains a permanent office within 150 miles of the project site.
   3. Copies of Manufacturer certification certificates. It is required that the Installer possess the following certifications, at a minimum:
      a. Crestron systems certified dealer, installer and programmer.
      b. AMX certified dealer, installer and programmer.
      c. Extron certified dealer, installer and programmer
      d. List all that apply
5. Copies of Insurance and Bonding certificates.

1.4 MATERIALS ALTERNATES AND SUBSTITUTIONS

A. General: See details for alternates and substitution in specification section 270010.

B. Specific equipment: When the design drawings indicate a brand and a model number for a piece of equipment as part of the audio visual system, the AVS Installer needs to provide the same device as indicated. Substitutions for this type of equipment are not acceptable.

C. Non-specific equipment: When the design drawings do not indicate a brand and a model number for a piece of equipment as part of the audio visual system, the AVS installer is free to pick equipment that meets the minimum specifications indicated in this section. The AVS installer needs to submit the selected choice as part of the submittal process.

1.5 SHOP DRAWINGS AND SUBMITTALS

A. The AVS installer shall follow all requirements for shop drawings indicated in specification section 270010.

B. Project Start Submittals: A maximum of 60 days after the AVS installer receives a notice to proceed with the project, but no sooner than a year before substantial completion, the following information shall be submitted.
   1. Cut sheets with all specifications of every device, cables and connectors to be used in the project.
   2. One-line diagrams with all devices included in the systems. Each system in a different sheet.
   3. User interface and faceplate color submittal. The AVS installer shall prepare a separate submittal with the shape and color of all user interface plates to be approved by the Architect of the project or the Owner.
   4. Rack elevations of all AV equipment for all rooms in the project.
   5. Conduit rough-in requirements of all wall and ceiling mounted devices for all equipment part of the AVS system.
   6. An EASE® software model of the rooms part of this project to fine tune location of speakers, delays and filter required for these rooms.
   7. CobraNet® map assignment. A list of all CobraNet® channels from all rooms and all the routing shall be provided.
   8. Detailed layout of the DSP filters to be used in each DSP processor.
   9. Any installation and rigging details for loudspeaker systems or other heavy equipment part of the AV system.

C. Construction Submittals: During the construction process the AVS installer shall submit various documents for approval prior to continuing with the installation process. Here is some of the information the AVS installer needs to submit:
   1. Before starting the programming process the AVS Installer shall provide the following information:
      a. A schematic presentation of the layout of all the user interfaces in the project. The AVS Installer needs to get approval of this submittal before starting any programming.
      b. Completely fill out network configuration template provided by the engineer upon request, to explain all network devices to be used in a project and to get IP addresses from the network administrator.
      c. A layout/presentation of any digital audio programming and user interfaces that are part of the project.
d. CobraNet® map assignment. A list of all CobraNet® channels from all rooms and all the routing shall be provided.

e. Detailed layout of the DSP filters to be used in each DSP processor.

2. Any design changes whether originated by the Owner, Designer or by the AVS Installer as a VE suggestion need to follow the same submittal process described in the previous paragraph for all equipment involved on the change.

1.6 PROJECT SPECIFIC SOURCE CODE OWNERSHIP

A. Definition of project specific source code: Project specific source code includes all source code created to generate an executable file to be intended to run in any equipment used in the installation of the AVS. Examples of project specific source code include source code used to generate executable files for control processors, DSP processors and touch panels. Project specific source code does not include source code used to create programming tools and compilers or source code used to generate operating systems or application programs running in PC based workstations.

B. Ownership: Any project specific source code used in this project shall remain the exclusive property of the Owner. By accepting the contract to perform the work included in this project, the AVS installer or designer and any other companies working creating project specific code during this project relinquish the right of ownership of this source code, and waive any licensing fees or royalties for the use of source code by the Owner or any company authorized by the owner to perform changes in the source code after the project is substantially completed for an undefined period of time.

PART 2 - PRODUCTS

2.1 SYSTEM FUNCTIONS

A. Content Distribution
1. The intent of this design is to allow the distribution of any audio or video content source to be distributed to all displays in the Boardroom and Conference Room as well as displaying content to individual rooms.

B. System Signals for All Systems
1. General: The completed system shall be capable of receiving, processing, routing and distributing the associated signals, noted herein, from and to the respective devices identified under Part 2 of this specification and the Contract Documents.
2. The system shall provide an audio signal response of ±6dB un-equallized (±3dB equalized) from 65Hz to 18KHz, throughout.
3. Analog video signals through the system shall be maintained to the minimum quality requirements as follows:
   a. The system shall provide a signal response of 0.7Vpp (nominal) @ 300Mhz RGB, throughout the system channel, for all visual content.
4. Digital video signals through the system shall be capable of delivering 4K resolutions at 24fps from end to end.
5. Control signals through the system shall be maintained to the minimum level established by the control equipment manufacturer for the control protocol utilized. This level shall be correct at all connection points in the system.

C. Remote Asset Management Software
1. General: The Remote Asset Management Software (RAMS) is another tool that will be provided to the owner to control the AVS system. When referenced in this section within the room functionality, the RAMS shall be able to provide the functionality described in these paragraphs.
2. Capabilities of the RAMS. This software tool shall have the following features:
   a. Connect to all controllable rooms in the project through the owner’s IP network.
   b. Fully compatible with the controllers installed in each room part of the AVS.
   c. Be able to support all the controllable rooms in this project plus 10% expansion capacity.
   d. Be able to have at least two (2) simultaneous users on the system.
   e. A customizable graphical user interface.
   f. Unlimited Grouping features.
   g. Real-time monitoring, control and diagnostics of control systems in each room on the project.
   h. Built-in event scheduler.
   i. E-mail alerts.
   j. Built-in logging, report and chart generation.
   k. SSL Authentication
3. Computer system. The AVS Installer shall provide and install a computer system capable of running the RAMS as required by the manufacturer of the software package.
4. Software customization: The AVS Installer shall customize the user interface of the RAMS according to the owner’s request. The AVS installer shall meet with the Owner and Design engineer during the construction process and agree on the features that will be used by the owner from this tool. Once this step is done, the AVS Installer shall program the RAMS interface based on the conclusions of that meeting. At a minimum all AVS with control processors shall have the following monitoring features through the RAMS:
   a. All media players and recorders usage: start time, stop time and cumulative use.
   b. All sources connected to interface plate usage: start time, stop time and cumulative use.
   c. Projector lamp usage hours.
   d. Flat panel display usage hours.
   e. UPS monitoring, including automatic start, battery test and status, and internal temperature.
5. Database input: The AVS Installer shall fill the RAMS database with the correct information of all the rooms that have controllable AV equipment in the project.
6. At a minimum the following alarms of the AVS shall be monitored by using the RAMS:
   a. Projector in video mute for more than 1 hour.
   b. Projector turned off (not on stand-by).
   c. Projector lamp approaching 85% of estimated life time.
   d. Projector lamp bad (if reported by projector)
7. Reporting capabilities: The AVS Installer shall provide at least five (5) different reports from the RAMS. The AVS installer shall meet with the Owner and Design engineer during the construction process and agree on the fields of each report that will be used by the owner from this tool. Once this step is done, the AVS Installer shall program the RAMS reporting features to accomplish the conclusions of that meeting.
8. Training: The AVS installer shall provide two levels of training for the RAMS. Administration level training shall be provided for at least 4 hours. User level training shall be provided for 2 hours.
9. Design selection: Crestron RoomView® 6.0
D. Computer Based User Interface
   1. General: The computer based user interface (CBUI) is another way for the Owner to control the AVS. This interface is in the form of a computer software program with the following requirements:
      a. Needs to be an executable file capable of running in any Windows based PC.
      b. One file per controllable room is required.
      c. Needs to have the same user functions available inside the room in touch screens and keypads.
      d. The “look” and layout of the interface shall be the same as the one in the room.
      e. Programs shall be password protected and have SSL.
2. Delivery: The AVS Installer shall provide two (2) thumb drives with all the programs in executable and source code format inside. Each file shall be properly labeled with the room description and the room number.

E. Owner Provided Input Sources and Destination Devices
1. General: Design drawings could indicate AV equipment, part of the AVS, to be provided by owner (as OFE or owner furnished) or third parties. Such equipment is explicitly indicated as such in design drawings to distinguish it from all other equipment to be provided by the AVS installer. When such equipment is indicated in the drawings the AVS Installer shall interface with it. Refer to the design drawings for audio, video and control lines required for owner provided equipment.

2. Scope of work: It is in the scope of work of the AVS Installer to run, terminate and connect the audio, video and control lines to owner provided devices as shown in the design drawings. When control lines are indicated in the design drawings, the AVS installer shall program all control features described in each system functions per controllable room, including all features related to owner provided equipment or third party equipment.

2.2 AUDIO VISUAL MATRIX / DSP HEAD END CONFIGURATIONS

A. General: The AVS Installer shall provide a complete and operable system with the minimum functional requirements noted herein.

B. User Interfaces: The Owner shall be able to operate and receive system status information from the AV system through the following user interfaces:
   1. Touchscreens in room
   2. Computer based user interface.
   3. Remote Asset management software

C. User control: The Owner shall be able to use the above mentioned user interfaces to operate the AV system. All user interfaces shall be able to perform all tasks unless otherwise noted in the design drawings or this specification. The Owner shall be able to perform the following tasks and get the following status indication from the user interfaces:
   1. System On-Off with status indication
   2. Individual display device on/off control and audio mute.
   3. Select and route any audio and video source to any of the available audio and video output devices. Each output device shall provide indication in the user interface of the current source selected for that output.
   4. Playback control of any recorded media capable of operating in the available input sources. Status indication for playback control include end of tape indication, selected function and invalid action. The playback control shall at least provide the following functions:
      a. Play
      b. Stop
      c. Rewind
      d. Forward
      e. Fast Rewind
      f. Fast Forward
      g. Pause
      h. Frame by frame controlled playback
      i. Digital media Menu navigation controls.
   5. Selected audio output device(s) volume control. Volume level should always be set to an acceptable user level during power up. Status indication of volume level shall be provided for each controllable output device.
   6. Selected audio output device(s) volume mute. Mute status indication shall be provided at user interfaces.
8. Individual control and status indication of all features for all controllable devices
9. Audio conference control shall include dialing keypad, hang up and off hook buttons and indicators, five (5) number memory buttons, microphone mute and user recording of memory buttons. Each room shall be capable of having separate audio conferences simultaneously.

D. Special Features: The AVS shall allow the owner to perform certain automated tasks by means of using the user interfaces. Those tasks will be available only on the user interfaces mentioned within this paragraph:
1. Room assignment: The room assignment mode shall allow the owner to select the operation mode of the rooms from the following options:
   a. Each room independently.
   b. Display multiple content across multiple rooms
2. Once a room assignment mode is selected the grouped rooms shall operate as a single room for audio mode and lighting mode. Dimming, volume control, muting and source destination shall affect all grouped rooms equally.
3. Automatic source detection. When a video source is detected in any of the inputs, one of the projectors shall be turned on automatically. When there is no video signal detected in any of the inputs for more than 10 minutes and the projector on/off button has not been pressed, the system shall be set to off. If the projector on/off button has been pressed at any time the projector shall be turned off but the audio portion of the system shall be kept on until the system is manually turned off by the user.
4. Automatic preset recall. When the owner select to turn on one display devices the control system shall send a command to the lighting control panel to select the appropriate scene more suitable for the presentation mode selected. Shade control shall be part of this light setting. The AVS installer shall coordinate with the electrical installer of the project all the light commands for the light scenes
5. Display automation. Motorized Screen shall follow the operation status of the projector, regardless if the manual switch to the screen has been used to operate the screen. When the projector is on the screen shall be down and when the projector is off the screen shall be pulled up

E. Touchscreen display programming: Provide additional programming as required to perform the following functions specific to the operator / touchscreen display interface. Provide additional head end components, software, and programming necessary.
1. Presentation countdown timer. A presentation countdown timer shall be indicated at all touchscreen displays, projector, and wall mount displays. Length of countdown shall be set at the touchscreen display at the staff desk location. A countdown start button shall be programmed on the screen to start and stop the timer. When the timer reaches one minute all displays shall indicate the timer in flashing red.
2. Presenter ranking. When multiple presenters are interviewing for a project, the staff desk location shall be able to enter the name of each presenter as individual icons that can be ranked in hierarchal order from first to last. Each board member shall have the capability of ranking each presenter from first to last on their respective touchscreen. Each board members ranking will be shown to the staff desk touchscreen. The staff desk will assign final rankings and have the ability to show on the public displays.
3. Request to speak button. A button will be provided at each of the board members touchscreen displays. For everyone but the chairman, this will be a button to request to speak and have their microphone activated. For the chairman, this button will be used to allow other board members to speaker publicly through their microphone.

F. DSP Features: The AVS shall program the DSP audio processor to provide at least the following features, additional to the functionality described above:
1. All inputs and outputs shall be labeled at the physical input/output and by text blocks within the software.
2. All inputs and outputs shall be monitored by RMS metering. Metering shall also be provided throughout the audio chain where appropriate. See drawing TX.X for typical DSP block diagram.
3. If audio or video conferencing are not part of the system, microphones shall be input to a standard mic input. Each microphone channel shall have an adjustable HPF (High Pass Filter), compressor/limiter and a 3-band parametric equalizer in its path.
4. If audio or video conferencing are part of the system, microphones shall be input to an Acoustic Echo Cancellation (AEC) input. Noise reduction shall be enabled for reduction of room background noise. Prior to being fed into an Automatic Mixer (AM) with direct outputs, each microphone channel shall also have an adjustable HPF (High Pass Filter), compressor/limiter and a 3-band parametric equalizer in its path.
5. Program audio: Prior to being fed into a matrix mixer, each program channel shall also have an adjustable HPF (High Pass Filter), compressor/limiter and a 3-band parametric equalizer in its path.
6. For all audio outputs there shall be 5-band parametric equalization and 12dB of gain control (+6dB to -6dB).
7. All inputs/outputs shall be connected to a matrix mixer, which will allow for flexibility in routing, gain adjustment and presets.
8. Audio test signal generators (tone, pink noise, white noise) shall be input to the matrix mixer as well.
9. VTC (CODEC) output shall be comprised of a stereo signal mix of all program audio sources with a mix of all microphone inputs.
10. The signal to a capture system, if specified, shall be comprised of a stereo compressed signal mix of all program audio sources combined with a mix of all microphone inputs.
11. Audio mix: When program audio is used in the system, sound reinforcement speakers shall play a mixed (left and right) audio from program material at 50% of the level of the program material sent to the program speakers. Volume control adjustments including volume mute shall affect equally the program speakers and the sound reinforcement speakers when program audio is used in the system.
12. The signal to the recording system shall be a stereo compressed signal mix of all program audio sources with a mix of all microphone inputs at 50% level to each channel (left and right).
13. Mix-minus for sound reinforcement speakers, tied to the microphones in the conference table.

2.3 AUDIO EQUIPMENT CABINET

A. Provide equipment cabinets where indicated on the Construction Drawings. The equipment cabinets shall be constructed from welded steel frames and shall have a powder coat painted finish. The equipment cabinets shall have the following specifications:
1. Cabinet construction material: Welded and bolted steel frames.
2. Footprint: As indicated on design drawings 75-7/8" X 23" X 27"
3. Height: Usable height 41 RU.
4. Rack rail type: Standards EIA 19” square holes with cage nut rail located in the front and back of cabinet. Rack rails shall be adjustable for depth and shall have RUs marked and labeled.
5. Rack screw type: Cage nuts clipped to rack rails. Nuts and screws shall be provided for all slots in the rack rails and shall be constructed of steel with #10-32 threads.
7. Top panel: Solid steel.
8. Bottom panel: solid steel with no less than two brush protected openings for cables. Each opening shall be no less than 34 square inches in size.
9. Door hinge supports shall be provided on both sides of the cabinet’s front and back to allow the door swing to be reversed.
10. Bonding: The cabinet shall be provided with a factory prepared location for connecting a bonding lug at the top and bottom of the cabinet frame. The doors shall include bonding jumper to cabinet.
11. Weight capacity: UL listed for 2,500 lbs.
12. Finish: Epoxy-polyester hybrid powder coated paint on frame, rails, panels, and metal accessories.
13. Finish color: Black for all parts of the cabinet

B. Equipment cabinets shall be provided with the following accessories:
1. Top: 270 cfm minimum fan top.
2. Front: beveled plexiglass panel hinged door with keyed lock.
3. Rear: beveled vented panel hinged door with keyed lock.
4. Locking system: Locks for the front and rear doors shall be two point latching locks and shall be keyed identically for front and rear lock. All locks for each user’s cabinets shall be keyed alike and different keys provided between user groups. Coordinate with Owner keying requirements for each cabinet.
5. Leveling: Provide leveling feet and all accessories required to bolt the cabinet to the floor with 1/2 inch screws or threaded rod. Provide four casters.
6. Vertical cable managers: Provide cable wire managers in the front of the cabinet covering the full height of the rack rails. The vertical cable managers shall be as recommended by the equipment cabinet manufacturer to avoid obstructions to the rack rails and doors. The vertical cable managers shall have brush openings to run cables between the front and back of the cabinet and shall have all openings sealed to avoid air leakage between the front and back.
7. Filler panels: All un-used rack spaces shall be covered with filler panels to avoid any air flow between the front and back of cabinet. The maximum filler panel size shall be 3 RU.
8. Top 2 RU of cabinet to have vent panels.
9. Provide metal cable lashing brackets to strap all cables to the frame for proper organization and support.
10. Ground bar: All cabinets shall be provided with a vertical copper ground bar covering the complete height of the rack rails. The ground bar shall be 1/8 inch thick and 1 inch wide with threaded holes mounted to the cabinet using nylon insulation washers.

C. Required equipment cabinet certifications: Complaint with EIA 310-E and UL 2416 listed.

D. Field cuts or openings. Any cabinet with field cuts or openings will be rejected and the AVS Installer shall provide a new cabinet to remedy the condition.

E. Basis of design: Middle Atlantic BGR-41SA27.

2.4 DIGITAL MEDIA SWITCHER

A. Provide the Crestron DM switcher series in the configuration required to connect all inputs and outputs with a spare capacity of two unused input and output ports. Provide cards as required based on each input and output type.

2.5 DIGITAL SIGNAL PROCESSOR

A. Provide the Crestron Avia series DSP in the configuration required to connect all inputs and outputs.

2.6 SOLID STATE RECORDER

A. All microphone audio in the boardroom shall be recorded and stored using a solid state recorder. The recorder shall have line level inputs that are connected to the DSP for audio recording.

B. Basis of design: Tascam SD-20M
2.7 CEILING SPEAKER POWER AMPLIFIERS

A. Audio Power Amplifiers shall be 2-channel power amplifiers designed for installed sound reinforcement applications.

B. Technical

1. Frequency Response (-1 dB): 7 Hz – 50 kHz
2. High Pass Filter 18 dB/Octave: 50 Hz (-3 dB)
3. THD+Noise @ 1 kHz Full Power: <0.03%
4. Damping Factor 1 kHz @ 8 Ohms: >300
5. Input Connector: XLR balanced
6. Output Connectors: Detachable terminal block and Speakon
7. Stacking Outputs: ¼” balanced (tip-ring-sleeve) phone type
8. Input CMRR/Ref. Max Power: > 60 dB @ 1 Khz
9. Input Sensitivity/Impedance: 0 dBV / 22 k ohms
10. Signal Present Indicator: -40 dB
11. Clip Indicators: 1.5 indication before clip
12. Anticlip Limiter: Activates at 1% or 5%, internally configurable
13. Power 20 Hz – 20 KHz 1% THD (8 Ohm Stereo): 200 WRMS
14. Power 1 kHz 0.1% THD (8 Ohm Stereo): 200 WRMS
15. Peak Power 2 ohms/ 1 kHz: 2kW
16. Ind. Dist 50 Hz & 7 kHz, 4:1: <0.08%
17. Slew Rate: +/- 75V / µs
18. TIM Distortion: <0.01%
19. S+N/N 20 Hz – 20 kHz @ 1W/8 Ohms: >100dB
20. Channel Crosstalk @ 1 kHz: 75 dB

C. The Power Amplifier shall be rack-mountable.

D. Each space shall zoned separately. Provide number of outputs required to perform this.

E. Basis of design: QSC CMX Series

2.8 WALL MOUNTED CONTROL TOUCHPANEL

A. Provide Crestron TSW-752 Touch screen

2.9 COLLABORATION SYSTEM

A. Provide the Barco ClickShare CSE-200 wireless presentation system with four buttons for use in the Conference Room. This may not be shown as an input in the riser diagram on the drawings.

2.10 ASSISTED LISTENING SYSTEM

A. The Assisted Listening System shall be designed to provide auditory assistance in both personal and group situations. It shall operate on the 17 narrow-band channels in the 72-76 MHz band. The base FM transmitter shall be rack mountable and accept balanced and unbalanced audio inputs. It shall receive power from a wall plug 12 VAC transformer and includes a detachable telescoping ¼ wave antenna.

B. System Components
1. The FM Transmitter shall transmit in one of 17 FCC-approved narrow band frequencies (in the 72-76 MHz radio band) available for the transmitter. The transmitter shall identify numerically with a back lit LCD indicator the designated radio channel being transmitted. b) The FM Transmitter shall accept unbalanced line level, balanced microphone level and 70 Volt distributed audio sources.

2. The transmitter shall have Enhanced Dynamic Range (E.D.R.) feature to improve Signal to Noise and audio quality.

3. Shall have Normal and High RF transmitter settings.

4. The FM Transmitter shall have an on/off power switch.

5. The FM Transmitter LCD shall be backlit to indicate “on” status.

6. The FM Transmitter shall be mountable in a 19 inch equipment rack.

7. The FM Transmitter must have a three year parts and labor warranty.

C. Technical

2. Antenna: Detachable ¼ wave telescoping

3. Modulation: FM, +/- 25 KHz deviation

4. Frequency Response (System): 100 Hz to 10,000 Hz

5. Automatic Gain Control Range: 30 dB


7. Preemphasis: 100 micro seconds

8. Maximum Power: 80K micro Volt/m @ 3 m (25K micro V/m in Normal)

D. Provide six (6) receivers and earbud sets
1. Basis of design: Telex SR 400 with DEB-2 earbud set.

E. Provide extension cable to mount distribution antenna inside the Boardroom.

F. Basis of design: Telex ST-300 with RM-S rack mount kit

2.11 RECESSS CEILING SPEAKER

A. Provide Atlas FAP63T-W white recessed ceiling mounted speaker.

2.12 IP CLOCK

A. Provide POE powered IP digital clock with the following specifications:
1. 2.5” 4-digit (Hour : Minute)

2. Single sided

3. NTP time reference

4. DHCP or Static IP Addressable based on Owner requirements

B. The IP Clock shall be Valcom VIP-D425A

2.13 DESKTOP GOOSNECK MICROPHONE

A. The microphone shall be a unidirectional (cardioid) dynamic vocal microphone designed for professional vocal use in sound reinforcement and studio recording applications. The microphone shall include a built in spherical filter to minimize wind and breath “pop” noise. The microphone shall be of rugged construction with a proven shock mount system, and a steel mesh grille to ensure consistent performance.
B. The microphone shall be provided with a 10” gooseneck and desktop base.

C. The microphone shall include the following minimum features:
   1. Frequency response tailored for vocals with brightened midrange and bass rolloff
   2. Uniform cardioid pickup pattern that isolates the main sound source and minimizes background noise.
   3. Pneumatic shock-mount system to reduce handling noise
   4. Effective, built-in spherical wind and pop filter
   5. Included break-resistant stand adapter which rotates 180 degrees

D. Technical
   1. Frequency Response: 50 to 15,000 Hz
   2. Polar Pattern: Unidirectional (cardioid), rotationally symmetrical about the microphone axis, uniform with frequency.
   3. Sensitivity (at 1,000 Hz, open circuit voltage): -54.5 dBV/Pa (1.85 mV)
   4. Rated Impedance: 150 Ohms actual (300 Ohms actual)

E. Basis of design: Shure MX410

2.14 OVERHEAD MICROPHONE

A. The microphone shall be a supercardioid, miniature electret, condenser microphone specifically designed for miking choirs and performance groups. The microphone shall be suitable for recording as well as sound reinforcement applications. The microphone shall include a min. 4” gooseneck to allow aiming at the sound source.

B. The microphone shall include an integral preamplifier.

C. The microphone shall include the following minimum features:

D. Wide dynamic range and frequency response for accurate sound reproduction across the audio spectrum.

E. Interchangeable cartridges that provide an optimal polar pattern choice for each application.

F. Balanced, transformerless output for increased immunity to noise over long cable runs.

G. Technical
   1. Frequency Response: 50 to 17,000 Hz
   2. Output Impedance: 180 Ohms actual (EIA rated at 150 Ohms)
   3. Sensitivity (at 1,000 Hz, open circuit voltage): -33.5 dBV/Pa (21.1 mV)
   4. Maximum SPL: 122.7 dB
   5. Equivalent Output Noise (A-weighted): 26.5 dB SPL
   6. Signal to Noise Ratio (referenced at 94 dB SPL): 67.5 dB
   7. Dynamic Range at 1 kOhm Load: 96.2 dB
   8. Common Mode Rejection: 45.0 dB minimum
   9. Preamplifier Output Clipping Level (1% THD): -6.0 dBV (0.5V)

H. Basis of design: Shure MX202W/S
2.15 DOCUMENT CAMERA

A. Provide a document camera with desk stand and gooseneck that will be located at the presentation podium. This camera shall allow documents provided by the presenter to be shown on the audio/visual systems video display devices through connectivity with the Audio/Visual Systems head end equipment. Document camera shall have a minimum of 1920 X 1080 color resolution.

B. Basis of design: Elmo TX-1

2.16 AUDIO VISUAL PLATES

A. AV1 Type Plate
   1. Provide wall plate with the following connections
      a. Two (2) HDMI with touchscreen control
      b. Audio/Video system touchscreen
      c. Data

B. AV2 Type Plate
   1. Provide wall plate with the following connections
      a. HDMI
      b. USB video for document camera

C. AV3 Type Plate

D. AV4 Type Plate
   1. Provide wall plate with the following connections
      a. HDMI
      b. Data

E. AV5 Type Plate
   1. Provide wall plate with the following connections
      a. HDMI
      b. Data

2.17 WIRE, CABLE, CONNECTORS, AND ACCESSORIES

A. General: The AVS Installer shall provide the system components and materials necessary to properly install, support, and terminate all audiovisual cabling, in accordance with the related documents identified in Part 1.1 of this specification. Where the Project Electrical Installer has provided a raceway designated for use by this system, the AVS Installer shall coordinate and install all required cables into the provided raceway. The AVS Installer shall also provide and attach all required cable connectors.

B. Cable: The AVS Installer shall provide all cabling associated with, and required to, provide a complete, operable system in accordance with the Contract Documents. All cable provided by the AVS Installer shall be of a manufacture and quality consistent with the design intent, and shall be reviewed by the Engineer prior to installation.

C. Cabling in air handling spaces. The AVS Installer is responsible for determining the rating of the cables to be used for the AVS, as per current version of the National Electrical Code. If, at the bidding point the AVS Installer is not certain about the type of cables to be used in the project, the AVS Installer shall assume that all cables need to be plenum rated cables.
D. Cabling below grade: When cable part of the AVS have to be run in conduits below slab and grade level, the AVS Installer shall use only cables with water-blocking jackets.

E. Cable signals: The following is a list of signal types and the cables to be used for those signals:

1. Line level audio signal cable: Provide one (1) twisted pair cable for mono signals and two (2) twisted pair cables for stereo signals. Twisted pair cables to be 22 AWG stranded (7X30) tinned copper conductors with overall foil shield (100% coverage), with 22 AWG stranded tinned copper drain wire.

2. Microphone level audio signal cable: Provide one (1) twisted pair cable, 20 AWG stranded (7X28) tinned copper conductors, overall foil shield (100% coverage) with a 20 AWG stranded tinned copper drain wire.

3. Composite video signal, serial digital video cable: Provide one (1) RG-59 coaxial cable, 20 AWG solid 0.31” bare copper conductor, gas-injected foam HDPE insulation, Duofoil® + tinned copper braid shield (95% coverage). Characteristic impedance 75Ω.

4. Analog video, audio and control over twisted pair cable: Provide one (1) 4-pair 24 AWG twisted pairs solid bare copper conductors with polyolefin insulation. If equipment manufacturer supports the use of standard UTP Category 6 for this application, the AVS installers shall provide cables in compliance with specification section 271000 and all cables part of the AVS shall be included in the same warranty as all cables provided under specification section 271000. If equipment manufacturer recommends the use of low skew cables, only low skew cables shall be used.

5. Proprietary Control cable (i.e. Cresnet® Signal): Provide one (1) cable with 1 twisted pair 22 AWG stranded bare copper conductors with overall aluminum/polyester foil (100% coverage) and a 24 AWG tinned copper drain wire, and one (1) unshielded twisted pair, 18 AWG stranded bare copper conductors.

6. Control cable (i.e. RS-232, RS-485 Signal): Provide one (1) cable with 1 or 2 twisted pair 22 AWG stranded bare copper conductors with overall aluminum/polyester foil (100% coverage) and a 24 AWG tinned copper drain wire. Pair count depends on manufacturer’s specifications.

7. Digital video, audio and control over twisted pair. Provide one, two or more cables UTP or STP as required by transceiver equipment manufacturer to ensure the digital signal is transported properly up to 328 ft, at maximum resolution indicated in part 2.01 of this specification. If equipment manufacturer supports the use of standard UTP Category (5e, 6 or 6A) for this application, the AVS installers shall provide cables in compliance with specification section 271000 and all cables part of the AVS shall be included in the same warranty as all cables provided under specification section 271000. If equipment manufacturer requires the use of proprietary cables, only these cables shall be used in the project. The color jacket for these cables shall be different from voice/data cables. AVS installer to coordinate color jackets with structured cabling installer.

8. UTP Category cables. Provide UTP category cables for all Ethernet connection part of the AVS as indicated in design drawings, including horizontal cables, patch cords and station cables. All cables part of the AVS shall have all specifications and shall be included in the same warranty as all cables provided under specification section 271000. The color jacket for these cables shall be different from voice/data cables. AVS installer to coordinate color jackets with structured cabling installer.

9. Speaker Cable: Provide two (2) unshielded bare high conductivity ETP copper 16 AWG stranded conductors, with overall jacket.

10. S-Video cable: Provide two (2) coaxial 30 AWG stranded (7x38) .012” tinned copper conductors, foam HDPE insulation, tinned copper serve shield (90% coverage). Cable shall have inner jacket on each coaxial conductor, outer jacket for all conductors and characteristic impedance of 75Ω on each conductor.

11. RGBHV Video cable: Provide five (5) coaxial 25 AWG solid .018” tinned copper conductors, FPFA insulation, Duobond® foil plus a tinned copper interlocked serve shield (100% coverage). Cable shall have inner jacket on each coaxial conductor, outer jacket for all conductors and characteristic impedance of 75Ω on each conductor.

12. Component video signal cable: Provide three (3) coaxial 25 AWG solid .018” tinned copper conductors, Gas-injected foam HDPE insulation, Duobond® (100% coverage) plus a tinned
copper interlocked serve shield (95% coverage). Cable shall have inner jacket on each coaxial conductor, outer jacket for all conductors and characteristic impedance of 75Ω on each conductor.

13. IR control signal cable. Provide one (1) pair, unshielded twisted pair cable with 22 AWG solid copper conductors.

14. Contact closure signal cable. Provide one (1) or more unshielded twisted pair cable with 22 AWG solid conductors. Quantity of pairs as required by the application.

15. HDMI Cables. All HDMI cables longer than 10 meters (32.8 ft.) must include an adaptive cable equalizer capable of providing not less than +40 dB of cable compensation @ 825 MHz. Such device must be capable of operating automatically without the need for human intervention and must include an external AC to DC power converter that can accept 100-240VAC @ 50/60 Hz. Furthermore, such device must also include I2C correction circuitry to mitigate the effects of long cable runs on the DDC clock and DDC data signals. HDMI cables shall have the following requirements:
   a. Support HDMI v1.3 with resolutions up to 1080P with 12-bit color depth
   b. Support HDMI v1.3 Category 2 data rates (3.4 Gbit/sec.) lengths up to 7.5 meters
   c. Support HDMI v1.3 data rates up to 2.25 Gbit/sec. lengths up to 40 meters
   d. Support PC data rates up to 1.65 Gbit/sec. lengths up to 60 meters
   e. Supports PC resolutions up to 1600x1200 / 60 Hz and 1920x1200 / 60 Hz
   f. Made of AWG-22 gauge wires
   g. Triple shield for noise immunity
   h. Cable jacket shall have dual UL Ratings: UL13 (CL2) and UL758 (AWM20276) for non-plenum spaces. In plenum environments cables shall have a CL2P rating or CMP rating.
   i. RoHS compliant.
   j. Gold plated connectors

16. DVI Cables. All cables carrying DVI signals through conduit, floor slabs or longer than 10 ft. shall be HDMI cables as described in previous section with HDMI to DVI adapters in both ends.

F. Connectors and plates: The AVS installer shall provide connector and plates to terminate all wiring part of the AVS, regardless if shown or not in the design drawings. As a general guideline the AVS Installer shall follow these recommendations:
   1. Only use crimp type BNC connectors on coaxial baseband video cables. Use crimp type F connectors on RF based coaxial cables. Use only connectors with the same impedance as the cable where they will be terminated.
   2. When custom panels or plates are required in the project, the AVS Installer shall submit detail drawings of all plates for approval by the Design Engineer.
   3. Whether shown in the design drawings or not all cables coming out of an outlet box into an equipment shall have a disconnect means at the outlet box with a face plate. Faceplates with grommets are not acceptable as pass-through connections to equipment.
   4. All termination of UTP Category 6 cables shall be done in accordance to specification section 271000.

2.18 DIGITAL PROJECTOR

A. General: The digital projector referenced in this specification section and in the design drawings shall have the following specifications:
   1. Projector native image format: 16:10
   2. Projector technology: Laser
   3. Brightness: minimum 5000 ANSI Lumens
   4. Native resolution: WUXGA
   5. Contrast ratio: minimum 10000:1
   6. Lens: Manual zoom and focus
   7. Lens throw distance: as indicated in the drawings
   8. Usable resolutions: The unit shall be capable of displaying all resolutions
   9. Video input ports: (2) HDMI
10. Audio input ports: (2) unbalanced stereo inputs
11. Audio output ports: One (1) unbalanced stereo output, or a digital audio port and a third party audio converter from digital audio to analog stereo audio in RCA connectors.
13. Warranty: 3 years

B. Accessories: This projector shall be supplied with a corresponding lens to achieve the throw distance indicated in the design drawings. Projector mounts shall be provided with all projectors. Design selection for the projector mount is Chief Manufacturing Company recommended mount for the projector specified.

C. The digital projector for this project shall be the Sony Laser Projector VPL-FHZ60/W with VPLL3003 snorkel lens.

2.19 FLAT PANEL DISPLAY

A. General: flat panel displays will be provided where indicated on the drawings in the size indicated. The displays shall be capable of showing video content being displayed on the digital projector.

B. General: The flat panel display referenced in this specification section and in the design drawings shall have the following specifications:
   1. Flat panel display format: 16:9.
   2. Flat panel technology: LED
   3. Screen size diagonal: as indicated on drawings.
   4. Bezel: Bezel around screen shall be no bigger than 12 mm
   5. Brightness (cd/m2): 500
   6. Native resolution: 3840 X 2160
   7. Contrast ratio: 4700:1
   8. Refresh rate: 60 Hz.
   9. Video input ports: per Audio/Visual Systems head end equipment requirements. Basis shall be HDMI or display port
   11. Warranty: 3 years

C. Accepted manufacturers
   1. Samsung QM-F series.

D. Accessories: Flat panel mounts shall be provided with all displays as indicated in the design drawings. Design selection for the flat panel mount is Chief Manufacturing Company.

2.20 TOUCHESSCREEN DISPLAY

A. General: Touchscreen displays will be provided where indicated on the drawings. The displays shall be capable of showing video content being displayed on the public viewing projector and wall mounted displays. In addition, the operator will have the ability to interact using their fingers to scroll, vote, and perform all functions required in PART 2 of this specification section.

B. General: The touchscreen display referenced in this specification section and in the design drawings shall have the following specifications:
   1. Flat panel display format: 16:10.
   2. Flat panel technology: LCD, LED, OLED
4. Bezel: Bezel around screen shall be no bigger than 0.75”
5. Brightness (cd/m2): 250
6. Native resolution: 1920 X 1080
7. Size: 24” diagonal
8. Contrast ratio: 8000:1
9. Refresh rate: 60 Hz.
10. Video input ports: per Audio/Visual Systems head end equipment requirements. Basis shall be HDMI or display port
11. Touchscreen control: per Audio/Visual Systems head end equipment requirements to provide touchscreen control. Ability to zoom is not required.
13. Warranty: 3 years

C. Accepted manufacturers
1. Manufacturer shall be compatible with the entire Audio/Visual Systems head end equipment. Basis of design shall be Dell.

2.21 ELECTRIC SCREENS

A. General: The Electric screen referenced in this specification section and in the design drawings shall have the following specifications:
1. Screen format: 16:10
2. Screen dimensions: As shown in the design drawings ± 3 inches
3. Screen projection type: Front projection,
4. Screen case mounting: in-ceiling,
5. Tensioned screen: Yes
6. Screen gain: 1
7. Viewing angle: 45°

B. Accepted manufacturers:
1. Da-Lite,
2. Draper,

2.22 NETWORKING EQUIPMENT

A. General: All networking equipment required for the AVS shall be provided by the others unless otherwise noted in the design documents.

2.23 IDENTIFICATION AND LABELING TAGS

A. The AVS installer shall follow labeling materials indicated in specification section 270010.
PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

A. General: The AVS installer shall follow all installation practices indicated in specification section 270010.

B. Workmanship: The AVS Installer shall adhere to, at a minimum, the following installation practices:
   1. Securely mount equipment plumb and square in place. Where equipment is installed in cabinets, provide mounting bolts in all equipment rack fastening holes. All rack mount equipment shall be secured with Rackmount Solutions HTX™ security screws (STAR-TYPE or similar) provided with nylon washers between bolt heads and equipment.
   2. Where equipment (such as VHS players, monitors, DA’s etc… and other system devices) is packaged by the manufacturer without rack mount ears or braces, as part of a regular manufacture process, the Installer shall provide all required, accessory ears, brackets, and shelves, which are necessary to properly mount the equipment within the designated cabinets and rack locations.
   3. Provide appropriate ventilation panels, vents, and/or fans to assure sufficient ventilation for adequate cooling of all equipment.
   4. Confirm the polarity and phasing of system components before installation. Connect to maintain uniform polarity and phasing.
   5. Insulate all non-insulated, stranded conductors before making termination when connecting to equipment terminals.
   6. “Wire”, “wing” and “twist” NUT type connections are not permissible for any type of signal connection.
   7. All wiring is to be free from grounds loops, shorts, opens, and reversals.
   8. Neatly tie all cabling within equipment cabinets, housings, and terminal cabinets with nylon cable ties at not more than 12” intervals. Install in accordance with the latest EIA installation standards. Engineer approved wiring trough may be used in lieu of tie-wraps. Cable routing shall not braid or cross with other wires in parallel more than once.
   9. Secure all cables in equipment cabinets and terminal cabinets to provide strain relief at all raceway exits in accordance with NFPA 70 including all supplements. All plugs and receptacles are to be the grounding type.
   10. Connect all equipment power to surge/noise suppression outlet strips or associated power conditioning devices.
   11. Where system cables are extended through an exposed umbilical connection, the Installer shall harness all associated cable within a common, manufactured, flexible, sheath (ex. Snakeskin™).
   12. All racks and cabinets shall be bonded to a grounding system as required by NEC.

C. Raceways. All raceways for audio/visual devices shall have the following specifications:
   1. Refer to specification section 270528 for all raceways specification.
   2. All cables for speaker level signals, regardless of their level shall be run in separate raceways from other low voltage cables.
   3. All cables for microphone level signals, regardless of their level shall be run in separate raceways from other low voltage cables.
   4. Separation of Raceways: The owner does not allow the use of raceways or cable trays design for structured cabling systems to be used for AVS cables with the exception of fiber optic cables. Raceways for CATV system can be used for AVS distribution cables when required.
   5. Raceways for AV outlets: Outlets for AV cables shall be composed of electrical boxes (sized for the amount of connectors) and a conduit(s) to the nearest accessible ceiling space. All AV outlet boxes shall be at least 2.5” deep.
   6. All indoor rated cables can be supported with j-hooks or cable hangers above accessible ceiling spaces. J-hooks shall be spaced no longer than 4. Ft.
D. Labeling System. The labeling system for all cables shall be a system that allows for unique identifiers for each cable. Each cable has to have an indicator from where it is coming from and an indicator to where it is going to.

E. Engraving: All push buttons interfaces and connection plates part of the AVS shall be engraved with descriptive wording of the use of the button/plate. The AVS Installer shall submit and receive approval for the proposed wording in each button/plate before doing the engraving. Failure to follow this step might cause the AVS installer to replace the buttons in interfaces and/or plates where the Owner is not satisfied with the wording of the label at no additional cost to the Owner. The color of the wording in the engraving shall have high contrast with the background color of the button.

F. Installation of Screens: Whether shown in the drawings or not the AVS installer shall install all projection screens following the following installation practices:
   1. All electric screens shall be provided with a low voltage controller to be mounted inside the screen housing.
   2. All electric screens shall be provided with a control wall plate mounted at 48” A.F.F.
   3. All in-ceiling screens shall be leveled with the ceiling grid.
   4. All in-ceiling screens housing shall be plenum rated when installed in plenum spaces.
   5. All in-ceiling screens installed in hard ceilings shall include an access panel no smaller than 16”X16” to access the electrical junction box of the screen. Access panel shall be a metal panel, with a hinged door and painted the same color as the finished ceiling.

G. Projector Installation: The Installer shall adhere to, at a minimum, the following installation practices for projectors:
   1. Projector shall be provided with corresponding mounting brackets depending on the projector selected.
   2. All anchors and supports whether pre-fabricated or customs, required to mount the projector where indicated in the design drawings are in the scope of work of the AVS Installer.

H. Flat Panel Display Installation: The AVS Installer shall adhere to, at a minimum, the following installation practices for flat panel display devices
   1. All anchors and supports whether pre-fabricated or customs, required to mount the displays where indicated in the design drawings are in the scope of work of the AVS installers.
   2. All walls where flat panel displays will be installed shall be re-enforced with sheet metal behind the drywall. The extent of the re-enforcing shall be the contour of the flat panel display to be installed.
   3. When flat panel displays are installed inside a wall niche, the AVS shall provide a wall mount with adjustable depth that allows the flat panel display to be installed flush with the exterior wall.
   4. Power and AV outlets to be installed behind flat panel displays shall use an Wiremold Evolution Wall backbox or approved equa.
   5. For flat panel displays mounted on structures, the installer shall provide anchoring as approved by structure manufacturer.
   6. For flat panel displays suspended from the structure above, the installer of this system shall provide all custom brackets and pipes properly secured to the structure to mount the displays.

I. Speaker Installation: The Installer shall adhere to, at a minimum, the following installation practices for speakers:
   1. All ceiling mounted speaker shall have a support wire tie to the building structure. Ceiling speakers shall not be supported from the ceiling grid.
   2. All ceiling mounted speakers shall be installed with a backbox to prevent sound from dispersing into the plenum space and causing noise issues in adjacent rooms.
   3. When ceiling speakers are mounted in fire rated partitions, the speakers shall have UL listed speaker back boxes with a fire rating no less than the rating of the partition.
   4. All in-wall speakers shall be installed with pre-construction brackets.
J. Equipment Rigging: When speaker assemblies or arrays weigh more than 100 lbs, the AVS installers shall follow all rigging instructions from the manufacturer and shall be done by an experienced rigger. The AVS installers shall also adhere to the following practices:

1. Only the rigging equipment and method listed by the manufacturer of the equipment are approved for the installation. No substitutions are accepted.
2. Only the rigging points available in the speaker assembly are accepted as means of support.
3. All anchors and supports whether pre-fabricated or custom, required to mount the displays where indicated in the design drawings are in the scope of work of the AVS installers.
4. Shop drawings for rigging methods shall be signed and sealed by a licensed structural engineer.

K. Millwork Openings: When AV equipment like flip tops and plates will be mounted in millwork provided by the owner or third parties, the AVS installers shall provide cut out dimensions for all the AVS equipment listing location in the millwork where the cuttings need to be done. It is the AVS installer’s responsibility to install those devices in the millwork, once the openings have been done. All millwork opening shall be done by the furniture manufacturer.

L. Floor Boxes. Floor boxes used for connection to teaching lecterns, podiums, conference tables, or mixing boards shall have at least the following minimum requirements:

1. Floor boxes shall be large enough to have at least 3 different compartments, one for power one for voice/data cables and one for AV.
2. Each low voltage compartment shall have a separate raceway back to the accessible ceiling space. If speaker wires are run from the lectern, the AV compartment shall have one 1” and one ¾” conduit to the nearest accessible ceiling space. If no speaker wires are run from the lectern, at least one 1” conduit from the AV compartment to the accessible ceiling shall be provided. Additional conduits might be required depending on the application.
3. There shall be no daisy-chaining of AV conduits between adjacent floor boxes. Floor boxes shall also allow to recess the connectors from the umbilical cord tied to the lectern.
4. Floor boxes shall have a recessed component to hold connectors. Floor boxes that leave AV connectors flushed with the floor are not desirable since they become tripping hazards and could be easy broken with the lectern when moved.
5. AV compartments shall have termination plates and connectors for all cables coming from the accessible ceiling space. Pass-through cables shall not be allowed in floor boxes. All connectors shall be properly secured to the plates in the floor box. All unused compartments shall have blank plates.

M. Structured Cabling Infrastructure: The AVS Installer shall adhere to specification section 271000 for all requirements of structured cabling components to be used as part of the AV system. The structured cabling components include but are not limited to:

1. All unshielded twisted pair Category cables and fiber optic cables
2. Termination devices like termination jacks, patch panels and faceplates.
3. All UTP and fiber optics patch cords.
4. All testing procedures for Category and fiber optic cables.

3.2 REQUEST OF IP ADDRESS

A. General: The AVS installer shall follow all requirements indicated in specification section 270010 for the request of IP addresses for devices part of the AVS.

3.3 SOFTWARE PROGRAMMING AND INSTALLER TESTING

A. The software programming and testing of the AVS system will be a multi-step process. The AVS Installer shall provision in the proposal for the time indicated in each of the steps:
B. Briefing Step: A maximum of 45 days after the AVS installer receives the NTP for this project, the AVS installer shall request one or more briefing sessions with the Owner and/or design engineer to go over the expectation of each room and clarify any points that might not be clear to the AVS Installer. Some important notes about this step are:
   1. The AVS installer shall allocate at least 8 hours of meeting time
   2. Travel time will not be counted as part of the meeting time.
   3. The quantity of staff required to attend these meetings by the AVS Installer is sole decision of the AVS Installer.
   4. Before the start of this step the AVS installer shall have software programming submittals approved as described in part 1 of this specification section.
   5. The AVS Installer shall prepare meeting minutes of the key decisions made during these meetings. The approval of these meeting minutes by the Owner and Design Engineer will be accepted as approval notice of this step.

C. Shop Programming Step: Once the briefing step has been completed and approved, the AVS installer shall allocate off-site programming time to accomplish all the requirements listed in this specification and the clarifications done in the previous step. It is the sole responsibility of the AVS Installer to estimate how many man hours are required for this step. This step does not require approval by the Owner and/or design Engineer.

D. Field Verification Step: After all AVS equipment has been installed on site and the system has been programmed, the AVS Installer shall request one or more working sessions with the Owner and/or design engineer to verify in the field the functionality of the AVS system. Some important notes about this step are:
   1. The AVS Installer shall allocate at least 10 hours of working sessions.
   2. Travel time will not be counted as part of the working sessions.
   3. The AVS installer shall have different AV media and sources to test all features in the AVS system.
   4. The quantity of staff required to attend these meetings by the AVS Installer is sole decision of the AVS Installer.
   5. Physical installation of all devices will be checked by the Owner and/or the Design Engineer. Any deviations in the installation of the equipment part of the AVS from this specifications and previous meetings will be noted by the Design Engineer in a “punch list”. This punch list will be send to the AVS installer within the next 5 days of the meeting for immediate corrective action. One punch list will be prepared for each room with AVS.
   6. The AVS Installer shall prepare meeting minutes of the key decisions made during these meetings that affect the programming sequence. The approval of these meeting minutes by the Owner and Design Engineer will be accepted as approval notice of this step.

E. Final Adjustment Step: Once the previous step has been approved, the AVS Installer shall allocate time to make any corrections to the AVS system on site based on the conclusions of the previous step. It is the sole responsibility of the AVS Installer to estimate how many man hours are required for this step. This step does not require approval by the Owner and/or design Engineer.

F. Data Wiring and Fiber Optic Testing: Testing of UTP data wiring, copper patch cords, fiber optic cables and fiber optic patch cords shall be done as indicated in specification section 271000. Testing results shall be submitted as indicated in the same specification section.

G. Signal Adjustment: The AVS Installer shall ensure that the following adjustments, tests and measurements, at a minimum, have been completed:
   1. The system shall be measured and adjusted for optimum signal quality and minimum signal loss, to all audio and video signals, through the system channel, using appropriate test equipment and standardized testing procedures.
   2. The system shall be measured and adjusted for optimum signal-to-noise ratio and maximum headroom in the system electronics.
3. The system shall be measured and adjusted to eliminate distortions or degradation of signal resulting from, but not limited to, clipping, hum, noise, and RFI interference.
4. The Installer shall check the quality of each signal, at its source, and compare it against the quality of the signal at various points of its transmission through the system. The Installer shall correct the system for any significant (the lesser of 2dB or the manufacturers throughput requirements) signal distortion or loss.

3.4 SYSTEM WARRANTY AND SERVICE

A. General: The AVS installer shall follow all warranty and service requirements indicated in specification section 270010.

3.5 ENGINEER’S FINAL ACCEPTANCE TEST

A. General: The AVS installer shall follow all test requirements indicated in specification section 270010

B. As part of the Engineer’s final acceptance all sources, inputs, outputs and interfaces will be tested. Additional notes about the final acceptance test:
1. It is the sole responsibility of the AVS system installer to estimate the time allocated for this step. It is assume that at this point in time all the features of the AVS system are clear to the Owner and the AVS Installer so this step is just to make sure that all the features are working properly as agreed.
2. The AVS installer shall have different AV media and input signal generators to test all input plates and sources in the AVS system.
3. The quantity of staff required to attend these meetings by the AVS Installer is sole decision of the AVS Installer.
4. Failure to complete one or more of the previously issued punch list items or failure to correct any programming changes previously noted will revoke acceptance of the room or system being tested.
5. Final acceptance will be granted on a room by room basis.

3.6 TEST EQUIPMENT REQUIRED.

A. Test Equipment: The AVS Installer shall supply all testing instruments required for the equipment programming and system tests. The AVS Installer shall use test equipment meeting the minimum specifications, identified herein, to perform system calibrations and adjustments. The AVS Installer shall make available the same test equipment available, for inspection by the Engineer, during Final Acceptance step.

1. Direct reading Audio Impedance Meter.
   a. Minimum of three frequencies ranging from 250Hz to 4kHz.
   b. Range 1 ohm to 1M ohm.
   c. 10% accuracy.
   d. Direct reading of dBm across 600-ohm load.
2. Digital Multimeter.
   a. DC to 20kHz bandwidth.
   b. 300V range.
   c. 100mV resolution.
   d. 10M ohms input impedance.
   e. DC resistance to 0.1 ohms.
3. Dual trace oscilloscope.
   a. 450MHz minimum bandwidth.
b. 1mV/cm sensitivity.
c. Dual timebase capability.

4. Sine/Square Wave Generator.
   a. 5Hz to 5kHz bandwidth.
   b. Output level of 0dBm with less than 0.5%THD.

5. Sound Pressure Level Meter:
   a. Applicable Standards: IEC 61672-1, 60651 and 60804 Type 2, ANSI S1.4 Type 2
   b. Accuracy: ±1.5dB (ref 94dB@1KHz)
   c. Resolution: 0.1dB
   d. Digital Display: 4 digital LCD
   e. Measurement Parameters: SPL, SPL MIN/MAX, SEL, and Leq
   f. Measurement Range: 30dB to 130dB
   g. Linearity Range: 100dB
   h. Measurement Frequency Range: 31.5Hz to 8KHz
   i. Frequency Weighting: A and C
   j. Response Impulse: Fast and Slow
   k. Microphone: 1/2 " Electret condenser microphone
   l. Sampling time: updated every 0.5s
   m. Bargraph: 4dB steps, 100dB range, 125ms update

6. Digital Video Signal Test pattern generator with output for the following signal types:
   a. Composite Video
   b. Component Video
   c. RGBHV video
   d. HDMI video (1080p 24 fps)
   e. SDI

3.7 TRAINING AND INSTRUCTION

A. General: The AVS installer shall follow all training requirements indicated in specification section 270010. The AVS Installer shall provide the owner with different types of training as described herein.

B. System Administration Training. The AVS installer shall provide system administration training at the job site as described below:
   1. At least 8 hours of training shall be provided.
   2. Travel time will not be counted as part of the training sessions.
   3. Training will be broken down to a maximum of 2 sessions in different days.
   4. The objective of the system administration training will be to properly operate, troubleshoot, calibration and perform specific field repairs to AVS equipment.
   5. Field repair and calibration training will be limited to those repairs notes by the manufacturer of the equipment as field repairs done by non factory trained personnel.
   6. Training shall be done at the job site with all the equipment operational after final acceptance.
   7. Training will be limited to a maximum of 5 attendees per session.
   8. Operation and Maintenance manuals shall be delivered at the beginning of this sessions.

C. User Training. The AVS installer shall provide system administration training at the Job site as described below:
   1. At least 10 hours of training shall be provided.
   2. Travel time will not be counted as part of the training sessions.
   3. Training will be broken down to a maximum of 3 sessions in different days.
   4. The objective of the user training will be to properly operate the AVS.
   5. Training will be limited to a maximum of 20 attendees per session.
   6. User short form guides shall be provided to all attendees of the sessions.
7. Short form guides shall provide the users with quick finding ways to operate the system. If AVS operation is different from one room to the other, one separate short form guide shall be provided for each room.

D. Factory Training: The AVS installer shall provide factory training as described below:
   1. List all factory training.

3.8 AS BUILT DOCUMENTS AND CLOSE OUT INFORMATION

A. General: The AVS installer shall follow all as built and close out information requirements indicated in specification section 270010.

B. The following information shall be included in the as built drawings:
   1. Drawings indicating final floor plan locations of all AV devices
   2. One line diagrams with all devices connected in the system.
   3. Mounting details
   4. Any signed and sealed structural calculations required for the AVS

C. Additional close out information to be delivered by the AVS installer:
   1. All programming source code done by the AVS for this project for all pieces of equipment in digital format (no printed copies required).
   2. List of all IP addresses assigned to each equipment part of the AVS.
   3. Compiled executable files as requested for Computer based user interface.
   4. All printed test results.

END OF SECTION 27 41 00
SECTION 27 00 10 - TECHNOLOGY GENERAL PROVISIONS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS AND DEFINITIONS

A. Scope: This specification section applies to all Division 27 specification sections and all Division 28 specification sections. All systems under the specification sections indicated above are also referenced in these contract documents as “technology systems”.

B. Drawings and specifications: The words “drawings” and “specifications” used in this section refers to all contract drawings and specifications that describe the scope of work for the technology systems. These items combined create the Construction Documents.

C. Installer and Contractor: The word “installer”, where used on the drawings or specifications without any further description, shall reference the installer of the referenced systems. The word “contractor”, where used on the drawings or specifications without any further description, shall reference the General Contractor / Construction Manager that holds the prime agreement with the Owner for the construction of this project.

D. Provide and Install: The word "provide", where used on the drawings or specifications, shall mean: furnish, install, mount, connect, test, document, and make ready for operation. The word "install", where used on the drawings or specifications, shall mean: mount, connect, test, complete, and make ready for operation.

E. Engineer: The word “Engineer or A&E”, where used on the drawings or specifications, refers to the design engineer that is working for the project Architect or the Owner. It does not refer to an engineer employed by the General Contractor / Construction Manager or any trades contractors working on the project.

F. Designer / Contractor / Owner Responsibilities: Refer to attachment 2 of this specification section for “Responsibility Matrix” document outlining the responsibility of each trade on each technology system.

1.2 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. Objective: The intent of the design drawings and specifications are to provide the installer of the technology systems the necessary information to create a scope of work for bidding and construction purposes. The drawings and specifications are not intended to show every single element of the project to produce a buyout list for the installer. Unless indicated otherwise, all primary components are specifically indicated. However small components and cabling assemblies are generally not indicated in the documents.

B. Accuracy: The drawings are diagrammatic and are not intended to show exact locations of conduit runs, outlet boxes, junction boxes, pull boxes, etc. Exact locations shall be coordinated with all trades in the field and as accepted by the Architect or Engineer during construction. Obtain all information relevant to the placing of technology systems work in the field. In cases where there is a conflict with other trades that cannot be easily resolved through coordination, proceed as directed by the Architect or Engineer.

C. Distances: Although most drawings have a scale referenced on each sheet, the drawings are a two dimensional representation of the system. The design drawings do not indicate changes in elevation that...
may cause additional lengths and/or material quantity. It is the responsibility of the installer of each technology system to field verify all distances and elevation changes prior to bidding.

D. Discrepancies: Notify the A&E of any discrepancies found during the construction of the project. Do not proceed with this portion of the project until a written resolution to the discrepancy is received. If a conflict exists between the contract documents and any applicable code or standard, the most stringent requirement shall be considered the minimum requirement for this project.

E. Existing Conditions: All existing conditions might not be indicated in the contract documents. The installer of each system shall review the site and all existing conditions thoroughly before bidding. The installer shall advise the Engineer of any issues prior to bidding.

F. Coordination: The technology systems drawings are intended to be coordinated with other design disciplines. However, the installer for other systems might have changes to their design and/or shop drawings which are not properly coordinated. The Contractor is required to produce coordination documents for specific rooms to facilitate space planning and coordination for all trades.

1.3 ABBREVIATIONS

A. Abbreviations: The following abbreviations or initials may be used:
1. ABV CLG - Above Ceiling
2. AC - Alternating Current
3. ADA - American Disabilities Act
4. AFF - Above Finished Floor
5. AFG - Above Finished Grade
6. AMP - Ampere
7. ANSI - American National Standards Institute
8. AWG - American Wire Gauge
9. BC - Bare Copper
10. CCTV - Closed Circuit Television
11. CATV - Community antenna television
12. CLG - Ceiling
13. COAX - Coaxial Cable
14. CPU - Central Processing Unit
15. DC - Direct Current
16. DEG - Degree
17. EMT - Communication Metallic Tubing
18. GND - Ground
19. IDF - Intermediate Distribution Frame (Telecom Room)
20. IMC - Intermediate Metallic Conduit
21. IN - Inches
22. IP - Internet Protocol
23. JB - Junction Box
24. KVA - Kilo-Volt-Amps
25. KW - Kilowatts
26. LBS - Pounds
27. LED - Light Emitting Diode
28. MAX - Maximum
29. MDF - Main Distribution Frame (Main Telecom Room)
30. MIC - Microphone
31. MIN - Minimum
32. MTD - Mounted
33. MTG - Mounting
34. NEC - National Communication Code
1.4 CODES AND STANDARDS

A. Application: The codes, standards, and practices listed in this section generally apply to all technology systems. Other codes, standards, or practices that are more specific will be referenced within the applicable specification section.

B. Requirements: All articles, products, materials, fixtures, forms, or types of construction covered in the technology system specifications are required to meet or exceed all applicable standards and requirements of the manufacturer. The technology systems installation shall be done in accordance with the requirements of ANSI, NEMA, IEEE, NEC, BICSI, and TIA documents where indicated and the manufacturer recommended best practices. Requirements indicated on the contract documents which exceed but are not contrary to governing codes or practices shall be followed.

C. Compliance and Certification: The installation shall comply with the governing state and local codes and ordinances. The complete technology system installation shall be inspected and certified by all applicable agencies to indicate the systems are in compliance with their requirements.

D. Applicability: The State of Florida codes, standards, and practices listed herein (revision date to be latest adopted) are provided as the minimum requirements. The list for all technology systems is as follows:
   1. Florida Administrative Code
   2. Florida Building Code
   3. Accessibility Requirements Manual - Florida Department of Community Affairs.

E. UL Labels: All equipment assemblies shall be new, free of defects, and shall be U.L. listed. As an alternative to UL, the equipment can be tested and listed with an approved, nationally recognized Communication Testing Agency. No equipment shall be installed without this testing and subsequent listing.

1.5 MATERIALS ALTERNATES AND SUBSTITUTIONS

A. Definitions:
   1. Basis of design: A product or group of products from an identified manufacturer that was used as the basis of system layouts and installation details as part of the Construction Documents.
   2. Prototype: A product or group of products that are not yet ready for commercial and are in the testing phase (Beta testing) of product development.
   3. Alternates: Products or manufacturers listed in the Construction Documents as comparable to the basis of design. Alternates shall follow the same system architecture and design philosophy as the basis of design.
4. Obsolete: A product that has been discontinued by the manufacturer or reached the end of life and is no longer being manufactured.

5. Substitution: A product not listed in the Construction Documents but capable of the same characteristics as the basis of design. Substitutions shall function as a direct replacement of the referenced product. The installer can propose a substitution only if all requirements of the specification are met and substitutions are approved by the Architect and/or Owner.

B. Use of prototypes. Prototypes are not allowed in any technology system.

C. Use of alternates. Alternates are allowed and the installer shall adhere to the following requirements:
   1. Where several models or manufacturers are listed as acceptable alternates each shall be regarded as equally acceptable to the basis of design. Where a manufacturer's model number is listed, this model shall set the standard of quality and performance required. Where no model is specified, the source and quality shall be based on the specified equipment criteria and subject to the Engineer's review and acceptance. Where three or more manufacturers are listed, one of the listed manufacturers shall be submitted for acceptance.
   2. The use of alternates does not allow for the change of the system architecture.

D. Use of substitutions. Substitutions are only allowed when they meet all the requirements below:
   1. Substitutions are only allowed when a particular specification section for a technology system allows the use of substitutions for that particular system.
   2. The performance of all substitution components must meet or exceed those of the basis of design. Should an installer wish to submit a substitution product, and substitutions are listed in the construction documents as acceptable, it shall be the responsibility of the installer to submit to the Engineer an item-for-item CROSS REFERENCE for all specifications of the product versus the basis of design. Substitution requests shall be submitted with a completed substitution request form indicated in Addendum 1 of this specification.
   3. The Engineer has the authority to reject a substitute request without cause and the installer shall provide the basis of design (or listed alternate) at no additional cost.
   4. Substitutions of unnamed manufacturers will not be accepted.
   5. Certification of substitutions: When a basis of design is specified to be in accordance with a trade association or government standard requested by the Engineer, the installer shall provide a certificate that the substitute complies with the referenced standard. Upon the request of Engineer, the installer shall submit supporting test data to substantiate said compliance.
   6. Substitutions that create a change in system architecture are not allowed,
      a. A substitution request that changes the system architecture requires the installer to submit the overall cost of the substitute product including the cost of changing other systems affected, the re-design cost for such systems, and any additional services costs from other firms on the design team. Without this information this substitution will not be evaluated at all.

1.6 SHOP DRAWINGS AND SUBMITTALS

A. General: Shop drawings shall be submitted as required in the specification sections for each system.

B. Shop drawings submittal quantity: Follow the Division 1 specification requirements for quantity of shop drawings and any additional submittal requirements. If the project does not have a Division 1 specification, shop drawings shall be submitted in quantity of one (1) for electronic format submittal and four (4) for hardcopies.

C. Electronic submittals: .pdf format is the only acceptable file type for electronic submittals.

D. When product data sheets of products are submitted, and the manufacturer’s cut sheets indicate several model numbers or variations of the same product, the product data sheet shall have the model number of
the submitted equipment highlighted by the installer. Submittals received with product data sheets indicating multiple model numbers without being highlighted will be rejected and not reviewed.

E. Equipment and material quantities are not reviewed by the Engineer as part of the submittal process. Equipment quantities are to be provided by the installer to meet the requirements of the construction documents. Approved shop drawings with equipment quantities or overall scope of work that is different from the construction documents does not constitute approval by the Engineer of these changes. The construction documents, along with any changes issued formally by the A&E during the construction process, are to always be followed for equipment quantities and scope of work.

F. All electronic equipment prone to obsolescence and with lead times of less than 3 months shall be submitted for approval no sooner than 12 months before the scheduled date of substantial completion of the project. Electronic equipment prone to obsolescence includes: flat panel displays, transceivers, servers, players, workstation, and routers.

G. Equipment and materials that are not installed in accordance with the construction drawings and approved shop drawings shall be replaced at the installer’s expense.

H. Multiple submissions may be required as indicated in each specification section. For final completion and testing, the Installer shall provide a submittal with the following information:
   1. Detailed course syllabus for each type of training required in the specification section.
   2. A proposed schedule of training sessions in compliance with the specification section and indicating where the training will take place.
   3. A copy of all training material to be used during each session.
   4. Test result sheets for all testing performed by the Installer as required in the specification section prior to the final system acceptance test.

PART 2 - PRODUCTS

2.1 IDENTIFICATION AND LABELING TAGS

A. All conduit, cabinets, cables, individual conductors, wiring forms, terminal blocks, and terminals shall be clearly identified with pre-printed labels or tags.

B. The only approved types of labels for technology systems installed indoors are:
   1. Non-laminated thermal transfer labels, printed with a high quality thermal transfer printer.
   2. Laminated thermal transfer labels printed with a high quality thermal transfer printer.
   3. Thermal transfer polyolefin tape printed with a high quality thermal transfer printer.
   4. Self laminated dot-matrix labels, printed with a high quality dot matrix printer.
   5. Non-laminated dot-matrix labels, printed with a high quality dot matrix printer.

C. For labeling of cables or equipment in outdoor or wet environments use only marker plates attached to cable with cable ties. Marker plates attached to equipment shall be with an adhesive designed for the material being bonded in that environmental condition. Do not use any labels with adhesive materials, unless the adhesive is rated for the application. Use different color plates for different cable types. Use only waterproof ink for writing on cable marker plates. Marker plates on equipment shall be engraved or machine lettered.

D. Hand written labels (except for outdoor marker plates), including writing on cable jackets or directly on equipment, are not acceptable and shall be corrected with approved labeling methods at no additional cost to the owner.
E. Approved manufacturers:
   1. Rhino,
   2. Brady,
   3. Panduit or
   4. approved equal

2.2 TECHNOLOGY EQUIPMENT AND MATERIALS

A. General: Each item of equipment or material shall be manufactured by a company regularly engaged in the manufacturer of the type and size of equipment specified. The equipment shall be suitable for the environment in which it is to be installed and shall be approved for the intended purpose, environment, and application. Equipment shall bare the label of the independent testing agency as indicated in paragraph 1.4.E. of this section.

B. Installation Requirements: Each item of equipment or material shall be installed in accordance with the instructions and recommendations of the manufacturer as it relates to the construction documents.

C. Required Accessories: The equipment specified in the technology systems specifications shall be provided with all required accessories for proper operation and mounting. Such accessories include items such as power supplies, power cords, rack ears, rack rails, bolts, lugs, faceplates, etc.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES

A. WORKMANSHIP: The installation of all material and equipment shall be performed in a neat, workmanlike, and professional manner by an adequate number of craftsmen who are knowledgeable of the requirements of the Construction Documents. They shall be skilled in the methodology and craftsmanship required to produce a high level of workmanship. Personnel who install materials and equipment shall be qualified through training and experience in order to perform their assigned tasks.

B. STANDARD OF QUALITY: To define a high level workmanship, all installation best practices described by the manufacturer, BICSI, ASIS, and infoComm standards publications shall be followed.

C. PROTECTION OF EQUIPMENT: Equipment for technology systems shall be adequately protected against any damage which may occur due to the elements or work performed by other trades at all times during construction. Equipment shall be stored in dry permanent shelters or weatherproof storage trailers. If any equipment or materials have been damaged during this time, such equipment shall be replaced at no additional cost or time extension. Damaged equipment and materials include the following conditions:
   1. Equipment that has visible scratches, cracks, or other surface coating damage.
   2. Equipment with visible indication of rust or water intrusion.
   3. Equipment that has dents that are clearly visible.
   4. Equipment that has been sprayed with paint, fire proofing materials, or any other type of chemical that was not intended to have these materials applied to it, per the construction documents.
   5. Equipment that has been damaged by fire, power surges, power sags, or lightning.
   6. Equipment that has known damage to any parts, electronic boards, or components and the damage is not overtly visible.
   7. Cables that have visible damage to the jackets; even if the cables are not broken, still provide electrical continuity, and allow for system functionality.
   8. Cables sprayed with paints that affect the warranty of the cable as defined by the cable manufacturer.
9. Equipment with screws that have stripped heads or threads.

D. CLEAN EQUIPMENT: All installed equipment like racks, cabinets, wall mounted panels, credenzas, etc. shall be free of dust at the time that space or area of the project gets the final Certificate of Occupancy and at the time of the acceptance test by the A&E.

E. IDENTIFICATION AND TAGGING: All technology system items shall be labeled and identified as specified in the Construction Documents. Such identification shall be in addition to the manufacturer's nameplates and shall serve to provide a unique identifier of the equipment and systems which it serves or controls. Refer to the identification part of each specification section for additional information. All labels of equipment and wiring shall match the labeling used in the shop drawings for the system or as approved by the Owner.

3.2 COORDINATION

A. General: The installer shall coordinate their shop drawings and installation work with those of other trades and the Owner’s contractors. Report any conflicts to the A&E. The installer shall obtain from the A&E written instructions required to make the necessary changes for the affected scope of work. All work shall be installed in coordination with all other Contractor and Owner subcontractors.

B. Adjustments: Locations of conduit and equipment shall be adjusted as required to accommodate the work of all trades with the understanding all interferences have been anticipated and encountered through coordination. The installer shall determine the exact routing and location of all contracted technology systems prior to fabrication or installation.

C. Replacement: All work shall be installed in a way that permits removal (without damage to other parts) of all system components provided under the construction documents requiring periodic replacement or maintenance. All conduits shall be arranged in a manner that clears the openings of swinging access doors and ceiling tiles.

3.3 TELECOM ROOM/EQUIPMENT ROOM READINESS

A. In any projects where the technology systems require the use of network equipment (switches, routers, firewalls, etc) provided by the Owner, the Contractor shall complete all telecom rooms to a point where they are suitable for the Owner to deploy such equipment. At a minimum the following conditions shall be met in the rooms for the Owner to install the equipment:
1. All power outlets in the telecom rooms shall be fed from the permanent source of power. Temporary power shall not be provided.
2. Backup power (generator and/or UPS) if provided shall be in full operation and tested.
3. The mechanical equipment providing the cooling for the telecommunications rooms shall be fully operational with permanent filtration. Temporary cooling and filtration shall not be provided.
4. Fire suppression systems (wet sprinkler, dry sprinkler, or clean agent) protecting the telecommunications rooms shall be fully operational and tested.
5. All light fixtures in the telecommunications rooms shall be fully operational.
6. All walls to the telecom rooms shall be complete, including the last coat of paint. No sanding of the wall surface will be allowed once the Owner’s equipment is installed.
7. The ceiling and flooring of the telecommunications rooms shall be finished.
8. The final and permanent doors to the telecommunications rooms shall be installed with a key core different from all other construction cores in the site
9. Telecommunications rooms shall be cleared of all stored materials inside the room.
10. Telecommunications rooms shall be fully cleaned by the Contractor’s finish cleaning personnel. Clean is defined as not having any debris left in the room and not having dust in any rack, cabinet,
or wall mounted panel. If wiping a finger on the surfaces of such equipment leaves visible dust residue on the finger, the room will not be considered clean.

11. Hallways and rooms leading into the telecommunications rooms shall require no more sanding to be done on the walls. The floor finish shall be completed to avoid dust from these spaces moving into the telecom rooms.

12. Prior to the Owner deploying their equipment in these rooms, the Contractor shall provide disposable sticky mats at the entrance of each room to capture dust and/or dirt from shoes or boots. The sticky mats shall sized to cover the full width of the door opening plus three (3) inches on each side. The sticky mats shall contain no less than 60 sheets per unit. The sheets shall be replaced no less than once a day and will be replaced as required if worn out during the day. Sticky mats shall be provided until the project receives the final Certificate of Occupancy for the entire area served by the telecommunications room.

3.4 SYSTEMS WARRANTY AND SERVICE

A. General: At a minimum all technology systems shall include a warranty from the manufacturer and installer of the system for no less than one (1) year with the following exceptions:
   1. When specific equipment manufacturers include a warranty longer than one year, the manufacturer’s warranty shall be transferred to the Owner in the same terms indicated by the manufacturer to the Installer.

B. Warranty coverage. The warranty for the technology systems shall cover the following elements:
   1. All equipment, and materials.
   2. The labor to replace malfunctioning parts.
   3. Shipping and freight charges to send equipment back and forth from the manufacturer and/or site.
   4. Any manufacturer RMA (return material authorization) charges.
   5. Tool rentals such as scaffold or lifts required to access equipment.
   6. The troubleshooting time to detect faults.
   7. All travel time and expenses associated with the warranty service.

C. Start of warranty. For new construction projects, the warranty period for the technology systems starts the day the project receives the Certificate of Occupancy (CO). For retrofit projects for a particular system, the warranty starts when the project is accepted by A&E. For most equipment/software manufacturers the warranty period starts when the equipment is shipped from the factory, it is the responsibility of the installer of each system to provide additional warranty coverage from the manufacturer to cover the additional time of warranty up to the CO date plus one year as required.

D. Service calls. During the warranty period the Installer shall support the technology systems when called by Owner/Contractor for service. All equipment/software service shall be done by personnel trained and qualified by the manufacturer for the system and as indicated in each technology system specification section. Service calls shall be performed during normal business hours (same time zone as the project) for normal service and twenty four (24) hours a day for three hundred and sixty five (365) days in the year for emergency service. Emergency service shall be defined as the loss or failure of any critical component necessary to maintain the overall integrity and proper operation of the system. Normal service shall be defined as the loss or failure of a system component that does not compromise the full operation of the system and allows the Owner to operate the system at a minimum of 90% of intended capacity.

E. Response time for service. The maximum allowed on site response time for emergency service shall be four (4) hours and normal service shall be twenty four (24) hours.
3.5 AS BUILT DOCUMENTS

A. Production: During the course of the project the Installer shall maintain a record as-built drawing set. The set shall be maintained at the site at all times and shall be accurate, clear, and complete. The set shall show the actual location of all equipment in the installed location. The as-built drawings shall show all technology systems work completed and installed to the current stage of construction. These drawings shall be available for review by the A&E’s field representatives at all times.

B. Completion: At the completion of the work, the Installer shall transfer the record as-built drawing set information onto a second set of clean drawings with all changes marked in colored ink. This copy shall be submitted to the A&E.

C. Final: Submit full size drawings and one (1) copy of the Installer’s CAD/Autodesk Revit® files for review and acceptance.

D. Additional documents. At project completion, the Installer of the technology system shall provide updated tables, equipment schedules, configuration worksheets and labeling systems used on the project. See individual system specification sections for more detailed information on these document requirements.

END OF SECTION 27 00 10
ATTACHMENT 1 – SUBSTITUTION REQUEST FORM

Substitution Request Number: ________________

PROJECT: ___________________________________ DATE: ________________

SPECIFICATION SECTION: ______________________ ITEM(S): ______________________

SPECIFIED MANUFACTURER: ______________________

SPECIFIED MODEL NO: ______________________

PROPOSED MANUFACTURER: ______________________

PROPOSED MODEL NO: ______________________

REASON(S) FOR NOT PROVIDING SPECIFIED ITEM: ______________________

________________________________

Attach product description, drawings, photographs, performance and test data, samples and other information necessary for side-by-side evaluation. Fill in all blanks.

A. Provide substantiated reason for requested substitution.

B. Does the requested substitution affect dimensions, locations or configurations?
   No: ___________ Yes: ___________
   Explain (attach drawings if necessary): __

C. What are the differences between the specified item and the requested item:

   __________________________________

D. Will the Contractor pay for any changes to the building design, including engineering and detailing costs caused by the approval?
   No: ___________ Yes: ___________
   Explain (if no, and describe modifications required to install or accommodate the requested change): ______

E. Will approval affect the work of other trades, including the Construction schedule?
   No: ___________ Yes: ___________
   Explain (if yes):

F. Manufacturer’s guarantees of the proposed and specified items are:
   Same: ___________ Different: ___________
   Explain (if different): ______________________

________________________________
G. Does the proposed item meet all applicable codes, ordinances and regulations for this specific application?
   No:_________ Yes:_________
   Explain (if no):__________________________________________________________

H. Has proposed item been used locally in similar applications?
   No:_________ Yes:_________
   Explain (give nearest location):_____________________________________________

I. Will maintenance and service parts be locally available for the requested item?
   No:_________ Yes:_________
   Explain (if no, give nearest location):_____________________________________

J. Will the requested item require waiving of any qualifications or other requirements?
   No:_________ Yes:_________
   Explain (if yes):__________________________________________________________

K. Are there any license fees or royalties associated with the requested substitution?
   No:_________ Yes:_________
   Explain (if yes):__________________________________________________________

L. If approved, will the Owner receive a credit for the proposed alternate material?
   No:_________ Yes:_________
   Explain (if no):__________________________________________________________

M. Does the proposed alternate material meet the same applicable standards (ASTM, ANSI, UL, FS) as the specified item?
   No:_________ Yes:_________
   Explain (if no, attach drawings if necessary):________________________________

N. Identify the recycled materials or components or features that lead to the claims to being “Green”: ______
   _________________________________________________________________

O. Has the required line-by-line comparison been included?
   No:_________ Yes:_________
   Explain (if no):_________________________________________________________
The undersigned agrees to pay for the Designer’s review time and for changes to the building design, including review, re-design, engineering, drawings and other costs caused by the requested substitution.

____________________________________
Signature

____________________________________
Print
The following Purchase Order or billing number is to be used for billing the Contractor for costs incurred in evaluating and if applicable accommodating the requested substitution.

____________________________________

The Engineer will not be required to approve any product that is not equal or suitable for the specific application and functionality of this project.
## ATTACHMENT 2 – RESPONSIBILITY MATRIX

### DESIGN AND CONSTRUCTION RESPONSIBILITIES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SYSTEM COMPONENT</th>
<th>SCOPE</th>
<th>DESIGN RESPONSIBILITY</th>
<th>PROCUREMENT RESPONSIBILITY</th>
<th>CONSTRUCTION RESPONSIBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>VOICE / DATA STRUCTURED CABLING SYSTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.01</td>
<td>RACEWAYS - CONDUIT ONLY</td>
<td>Conduit, boxes, cable tray, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>1.02</td>
<td>INSIDE PREMISE WIRING</td>
<td>Structured cabling system</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>1.03</td>
<td>OUTSIDE PREMISE CABLING</td>
<td>Structured cabling system</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>1.04</td>
<td>OUTSIDE PREMISE CABLING FROM SERVICE PROVIDERS</td>
<td>Fiber and copper for services</td>
<td>VoltAir</td>
<td>Owner</td>
<td>Owner</td>
</tr>
<tr>
<td>1.05</td>
<td>PATCHING</td>
<td>Cable patching at patch panel and work area outlets</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>1.06</td>
<td>ACTIVE ELECTRONICS (NETWORKING EQUIPMENT, SWITCHES, ROUTERS, SERVERS AND COMPUTERS)</td>
<td>Equipment selection, sizing, equipment layout</td>
<td>VoltAir</td>
<td>Owner</td>
<td>Owner</td>
</tr>
<tr>
<td>2.00</td>
<td>TELECOMMUNICATIONS ROOM FITOUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.01</td>
<td>PLYWOOD, FLOOR, AND WALL SLEEVES</td>
<td>Plywood and sleeves for cables</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>2.02</td>
<td>BONDING SYSTEM</td>
<td>Ground bar and ground bus</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>2.03</td>
<td>RACKS, WIRE MANAGERS AND LADDER TRAY</td>
<td>Racks and all passive elements</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>3.00</td>
<td>CATV DISTRIBUTION SYSTEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.01</td>
<td>RACEWAYS</td>
<td>Conduit, boxes, cable tray, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>3.02</td>
<td>INSIDE PREMISE WIRING</td>
<td>Coaxial and balanced twisted pair cable</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>3.03</td>
<td>DISTRIBUTION DEVICES</td>
<td>TAPS, amplifiers, splitter, D/C</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>3.04</td>
<td>DISPLAYS</td>
<td>Displays and mounts</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>4.00</td>
<td>AUDIO VISUAL AND PAGING SYSTEMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.01</td>
<td>RACEWAYS</td>
<td>Conduit, boxes, cable tray, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
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<tr>
<td>4.02</td>
<td>INSIDE PREMISE WIRING</td>
<td>AV wiring for systems (other than structured cabling)</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>4.03</td>
<td>ACTIVE ELECTRONICS</td>
<td>Projectors, presentation control system, paging system, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>5.00</td>
<td>INTRUSION DETECTION SECURITY SYSTEM</td>
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<tr>
<td>5.01</td>
<td>RACEWAYS</td>
<td>Conduit, boxes, cable tray, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>5.02</td>
<td>INSIDE PREMISE WIRING</td>
<td>Cables</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>5.03</td>
<td>ACTIVE ELECTRONICS</td>
<td>Control panels and field devices</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>6.00</td>
<td>ACCESS CONTROL SECURITY SYSTEM</td>
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<td></td>
</tr>
<tr>
<td>6.01</td>
<td>RACEWAYS</td>
<td>Conduit, boxes, cable tray, etc.</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
<tr>
<td>6.02</td>
<td>INSIDE PREMISE WIRING</td>
<td>Cables for card access</td>
<td>VoltAir</td>
<td>Contractor</td>
<td>Contractor</td>
</tr>
</tbody>
</table>

TECHNOLOGY GENERAL PROVISIONS
27 00 10 - 13
1. Wall Protection (WP-1) to be 5’ AFF.
2. Refer to floor plan for accent paint locations.
3. Refer to wall legend, plans &/or sections for finish substrate.
4. Where 2 or more finishes are scheduled, see floor plan, reflected ceiling plan, or interior general finish notes:

**WALL LEGEND**
- EXISTING WALL
- NEW STUD WALL
- SHEET APPLY ONLY TO THE NUMBERED NOTES IN SHEET NOTES
- CORNER GUARD LOCATIONS
- WOMENS LOCKER RM
- MENS LOCKERS
- WEAPONS
- LVT-1
- RB-1
- PNT-1/PNT-2
- ACT-1
- GWB
- WT-1
- CERAMIC WALL TILE
- DALTILE MODERN DIMENSIONS WAVE, 4"X12" GALAXY
- GRT-1
- GROUT MAPEI 19+ PEARL GRAY
- PT-1
- PORCELAIN TILE CROSSVILLE SERIES PHYSICS, 12"X24" PROTON PHY03
- LAM-2
- PLASTIC LAMINATE - COUNTER WILSONART PREMIUM LAMINATE, AEON SCRATCH RESISTANT, GLOSS LINE FINISH DAVE GREY
- PTB-1
- CARPET TILE SHAW 5T172, 24"X24", QUARTER TURN INSTALLATION OCEAN 72535
- PNT-1/PT-1/WT-1/GRT-1
- PAINT
- SHERWIN WILLIAMS KRYPTON SW6248
- JAY BLUE SW6797
- LAMINATE RECEPTACLE BASES WILSONART continuum"
1. EXISTING SAN PIPING BELOW SLAB. CONTRACTOR SHALL DEMOLISH EXISTING FITTING AND PROVIDE A NEW FITTING CONNECTION FOR SINK. CONTRACTOR SHALL FIELD COORDINATE EXACT PIPE SIZE, LOCATION AND CUTTING.

2. EXISTING 2" VENT PIPING. CONTRACTOR SHALL PARTIALLY CUT A PIPE SECTION FOR NEW SINK'S VENT PIPING AND FITTING CONNECTION. CONTRACTOR SHALL FIELD COORDINATE EXACT CUTTING LOCATION.

3. CONTRACTOR TO PROVIDE AND INSTALL NEW SINK AND CONNECT TO EXISTING WASTE AND VENT PIPING AT POINT INDICATED.

4. CONTRACTOR TO PROVIDE AND INSTALL NEW SINK. PROVIDE AND CONNECT A NEW 1/2" DOMESTIC COLD AND HOT WATER TO SERVE SINK.

5. CONTRACTOR TO PROVIDE AND INSTALL NEW TANKLESS WATER HEATER BENEATH COUNTER. REFER TO PLUMBING LEGEND FOR WATER HEATER SCHEDULE.
Report Owner
United States Gypsum Company
700 North Highway 45
Libertyville, IL 60048

Product
USG Structural Panel Concrete Subfloor
(a.k.a. 3/4" STRUCTO-CRETE® Structural Concrete Panels)

Approved Manufacturing Locations
USG Structural Technologies, LLC
309 Hallberg Street
Delavan, WI 53115

For Evaluation Report Questions
USG Contact: Manny Hurtado, Building Codes Manager
Phone: 847-970-5179
Email: mhurtado@usg.com

General Details
The approved manufacturing plant has an approved Q.C. Manual to manufacture USG Structural Panel Concrete Subfloor and is audited quarterly by Progressive Engineering Inc. USG Structural Panel Concrete Subfloor is also known as 3/4" STRUCTO-CRETE® Structural Concrete Panels, and the contents of this PER are applicable to both product names.

Product Description
USG Structural Panel Concrete Subfloor is a noncombustible concrete sheathing panel used in conjunction with cold-formed steel, wood, or hot-rolled steel framing to form a load bearing structural floor or wall system. USG Structural Panel Concrete Subfloor is a nominal 3/4" [19mm] thick x 4' [1220mm] wide x 8' [2440mm] long. The floor panels have a Tongue and Groove edge along the 8' [2440mm] sides and the wall panels are square edged. The panels have a maximum weight of 5.3psf [25.9 kg/m²] from the manufacturing plant. The panels are a composite material consisting of alkali-resistant fiberglass and a cementitious binder.

USG Structural Panel Concrete Subfloor are noncombustible per ASTM E136 (CAN CSA S114) and have a mold resistance value of no less than 10 per ASTM D3273 and a rating of 1 or less per ASTM G21. These panel products have also been shown to be termite resistant when tested in accordance with AWPA Standard E1-13 exposure C, and comply with the VOC emission requirements of the California Department of Public Health CDPH/EHLB/Standard Method Version 1.1 (Emission testing method for CA Specification 01350).

Product Application
USG Structural Panel Concrete Subfloor is used as a single floor or as the subfloor (Concrete Subfloor) in conjunction with an underlayment to form a structural floor system to resist gravity loading, floor diaphragm loading and concentrated loading as typically found in Residential and Commercial Type I or Type II Construction. Product may also be used in wall applications in accordance with Table 8 and Table 9.

Framing
Cold-formed steel framing shall comply with AISI and have minimum yield strength of 50 ksi [345 MPa], minimum 18 ga. [40mil] or 0.0403” [1.0236mm] thickness, and minimum G60 galvanized coating. Member flanges must have a minimum width of 1-5/8" [41.27mm]. As an alternative, SPF lumber or 1/4" [6mm] A36 steel framing may also be used in conjunction with the fasteners and edge distance listed in Table 2. Typical frame spacing ranges from 12" o.c. [305mm] to 24" o.c. [610mm] for floors. See Table 4 and Table 5 for floor diaphragm shear design values.

Compliance

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Section R301.1.3</td>
<td>Section 703.5.1</td>
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<tr>
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<td>Section 703.5.2</td>
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<tr>
<td></td>
<td>Section 1607.4</td>
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<tr>
<td>Section R301.1.3</td>
<td>Section 703.5.1</td>
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<tr>
<td>Section R302.6</td>
<td>Section 703.5.2</td>
</tr>
<tr>
<td></td>
<td>Section 1607.3 &amp; 1607.4</td>
</tr>
</tbody>
</table>

• Meets or exceeds the requirements of ICC-ES AC 318 Structural Cementitious Floor Sheathing Panels, Effective July 1, 2009.
• Meets or exceeds the requirements of ICC-ES AC 319 Horizontal Diaphragms Consisting of Structural Cementitious Floor Sheathing Panels Attached to Cold-formed Steel Framing—Approved June 2005, Editorialy Revised January 2012.
Compliance Continued

- Meets the requirements of Table R301.7 Allowable Deflection of Structural Members for Joist Spacing of 24" [610mm] o.c. per the 2012 & 2015 IRC.
- Meets or exceeds the requirements for noncombustible core in accordance with Section 703.5.1 of the 2012 & 2015 IBC.
- Meets or exceeds the requirements for materials having a structural base of noncombustible material when tested in accordance with ASTM E 136 as defined in 2012 & 2015 IBC Section 703.5.2 and CAN CSA S114.
- Meets the requirements of Section R301.1.3 Engineered Design for otherwise conventional construction for buildings per the 2012 & 2015 IRC.
- For Canadian applications suitability needs to be reviewed by Architect or Engineer of record prior to use.
- Meets or exceeds the requirements of the 2012 & 2015 IBC Table 1607.1 and 2012 Ontario Building Code Table 4.1.5.9; Minimum Uniformly Distributed Live Loads and Minimum Concentrated Live Loads, when installed per manufacturer’s instructions.
- Surface Burning Characteristics - Flame Spread Index of 0 / Smoke Development Index of 0 or less when tested in accordance with ASTM E 84.
- Meets & exceeds requirements for concentrated load per ICC AC318 when tested in accordance with ASTM E661 using a 1" [25mm] and 3" [76mm] loading diameter for Wet & Dry conditions.
- Meets and exceeds the requirements of the 2015 IBC, Section 1607.4, Concentrated Live Load of 2,000 Lbs.

General Product Installation

1. USG Structural Panel Concrete Subfloor is to be installed and maintained during construction following this report and the USG installation instructions. Installation instructions must be made easily available to the product installer.
2. When cutting USG Structural Panel Concrete Subfloor, safety glasses and a NIOSH approved N-95 dust mask should be worn at all times due to dust produced by the cutting of this product.
3. Fasteners shall be flush or slightly below the surface and care must be taken to not strip out in the framing. No fastener shall be installed within 2" [51mm] of the corner of a panel and shall not be closer than the minimum distance from panel edges indicated in Table 2 of this PER.
4. The tongue and groove joints shall be oriented perpendicular to the framing.
5. The 3/4" [19mm] USG Structural Panel Concrete Subfloor is fastened to the cold-formed steel, hot-rolled steel, or wood floor framing with the applicable fasteners indicated in Table 2 of this report.
6. Install panels in a running board pattern bridging a minimum of 2 framing spans. The minimum panel width, measured parallel to the framing, shall be no less than 24" [610mm].
7. Fasteners are applied as shown on the following Screw pattern A, B & C diagrams.
8. Up to a 6" [152mm] x 6" [152mm] cutout through the panels is allowed without blocking. Up to a 44" [1118mm] x 44" [1118mm] cutout is allowed with sufficient blocking around the perimeter of the opening. Larger openings shall be designed by the Engineer of record and are beyond the scope of this report.
9. USG Structural Panel Concrete Subfloor must be protected from construction abrasive wear and impact after panel installation until the floor has its final finish applied. Refer to the USG Installation Instructions.

Product Storage

USG Structural Panel Concrete Subfloor shall be stored in a dry location. Placement of the palletized product must be on level firm ground or a floor capable of carrying the approximate 3,400 lb. [1545kg] pallet weight. Pallets shall not be stacked more than three high and must be stacked with direct alignment on the pallet below it. If a dry location is unavailable, cover pallets with a waterproof tarp or covering. Sub-freezing temperature may cause the panels to freeze together. Should this happen, move the panels to a warmer location to thaw out. Do not use tools or chemicals to loosen the panels as this will cause damage to the panels and will void the performance ratings described in this PER.

Product Labeling

Each bundle shipped of USG Structural Panel Concrete Subfloor that are covered by this PER, must have a label attached with at least the following information:
1. USG Name and Location / Plant Number
2. Date of manufacture
3. This PER Number & Pei ES Logo

Acceptable Evaluation Marks
Table 1: Physical and Mechanical Properties

USG Structural Panel Concrete Subfloor

<table>
<thead>
<tr>
<th>Test Standard</th>
<th>Requirements</th>
<th>Tested Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated Load, Wet or Dry</td>
<td>ASTM E661</td>
<td>550 lb [2.45 kN] Static</td>
</tr>
<tr>
<td>Fastener Lateral Resistance</td>
<td>ASTM D1761</td>
<td>0.108&quot; [2.7 mm] max. deflection @ 200lb [0.89 kN]</td>
</tr>
<tr>
<td>Density - Oven Dried</td>
<td>ASTM C1185</td>
<td>min. 75 lb/ft² [1200 kg/m²]</td>
</tr>
<tr>
<td>Weight, 3/4&quot; [19mm]</td>
<td>ASTM D1037</td>
<td>5.3 lb/ft² [25.9 kg/m²]</td>
</tr>
<tr>
<td>pH Value</td>
<td>ASTM D1293</td>
<td>10.5</td>
</tr>
<tr>
<td>Noncombustibility</td>
<td>ASTM D3273</td>
<td>10</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>ASTM D1185</td>
<td>&lt;15.0%</td>
</tr>
<tr>
<td>Freeze/Thaw resistance</td>
<td>ASTM C1185</td>
<td>Minimum of 75% retention of Physical Properties</td>
</tr>
<tr>
<td>Long Term Durability</td>
<td>ASTM C1185</td>
<td>min. 75% retention of physical properties</td>
</tr>
<tr>
<td>Water Vapor Transmission (Method B)</td>
<td>ASTM E96</td>
<td>Permeance 1.4 Perm</td>
</tr>
</tbody>
</table>

Notes:
1. Fastener Lateral Resistance measured with applicable fasteners in Table 2.
2. Density Measured at Equilibrium Conditioning per Section 5.2.3.1-Tested 28 days after manufacturing.
3. Absorption Measured from Equilibrium Conditioning followed by immersion in Water for 48 hours.

Table 2: Acceptable Diaphragm Fasteners

USG Structural Panel Concrete Subfloor

<table>
<thead>
<tr>
<th>Framing Type</th>
<th>Minimum Edge Distance</th>
<th>Manufacturer</th>
<th>Part No.</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>16ga [1.438mm] Cold-Formed Steel</td>
<td>1/2&quot; [13mm]</td>
<td>Grabber Construction Products, Inc.</td>
<td>CGH8158LG</td>
<td>#8 x 1-5/8&quot; winged self-drilling screw</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simpson Strong-Tie Company, Inc.</td>
<td>CBSDQ158S</td>
<td>#8 x 1-5/8&quot; winged self-drilling screw</td>
</tr>
<tr>
<td>18ga [1.0236mm] Cold-Formed Steel</td>
<td>1&quot; [25mm]</td>
<td>Grabber Construction Products, Inc.</td>
<td>CGH8158LG</td>
<td>#8 x 1-5/8&quot; winged self-drilling screw</td>
</tr>
<tr>
<td>SPF Lumber (Min. S.G. = 0.42)</td>
<td>5/8&quot; [16mm]</td>
<td>Grabber Construction Products, Inc.</td>
<td>C8200L2M</td>
<td>#8 x 2&quot;, Flat Head, Type 17, Nibs, GrabberGard,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simpson Strong-Tie Company, Inc.</td>
<td>WSNTLG2S</td>
<td>#8 x 2&quot;, Flat Head, Twin threads, Nibs</td>
</tr>
<tr>
<td></td>
<td>1/2&quot; [13mm]</td>
<td>Senco²</td>
<td>GL24AABF</td>
<td>8d Ring Shank Nails</td>
</tr>
<tr>
<td>1/4&quot; A36 Hot Rolled Steel</td>
<td>3/4&quot; [19mm]</td>
<td>Simpson Strong-Tie Company, Inc.</td>
<td>TBG1260S</td>
<td>#12 x 2-3/8&quot;, Flat Head, Strong-Drive® TB WOOD-TO-STEEL Screw</td>
</tr>
</tbody>
</table>

Notes:
1. Fastener pull-through capacity of 581-lbs [2584N] may be applied to all listed fasteners. Capacity is based upon the minimum average ultimate tested capacity for all tabulated fasteners. The engineer or designer of record shall apply an appropriate safety factor (ASD) or resistance factor (LRFD).
2. Senco 8d ring Shank nails are manufactured with a length of 2-3/8" [60mm], a head diameter of 0.266" [6.8mm], and a Shank diameter of 0.113" [2.9mm]. Equivalent 8d ring Shank nails meeting these dimensional requirements may be utilized when approved by the engineer or designer of record.
**Floor Usage**

### Table 3: Uniform Live Load Performance Rating

<table>
<thead>
<tr>
<th>Span Rating</th>
<th>Conditions</th>
<th>Live Load Rating(^1) (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12” [305mm]</td>
<td>Dry or Wet</td>
<td>512 [24.5 kPa]</td>
</tr>
<tr>
<td>16” [406mm]</td>
<td>Dry or Wet</td>
<td>283 [13.5 kPa]</td>
</tr>
<tr>
<td>24” [610mm]</td>
<td>Dry or Wet</td>
<td>120 [5.7 kPa]</td>
</tr>
</tbody>
</table>

**Notes:**

1. Live load ratings have been determined from testing based upon a minimum 120 psf [5.7 Kpa] service live load for the 24” [610mm] span rating and a maximum panel live load deflection = L/360. A factor of safety of 3.0 applied.
2. A minimum of two framing spans required per panel piece.
3. Tabulated live load ratings are valid for a service level dead load of 10 psf [0.5 Kpa] or less.

---

### Table 4 - Safety Factors and Resistance Factors for Diaphragms

<table>
<thead>
<tr>
<th>Framing Type</th>
<th>Fastener Type</th>
<th>Earthquake</th>
<th>Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ω (ASD)</td>
<td>φ (LRFD)</td>
</tr>
<tr>
<td>Steel(^1)</td>
<td>Screws</td>
<td>2.50</td>
<td>0.65</td>
</tr>
<tr>
<td>Wood(^2,3)</td>
<td>Screws or Nails</td>
<td>3.30</td>
<td>0.50</td>
</tr>
</tbody>
</table>

**Notes:**

1. Tabulated values have been evaluated for horizontal diaphragm use only.
2. Safety factors and resistance factors for USG Structural Panel Concrete Subfloor diaphragms installed over cold-formed and hot-rolled steel framing are based upon Table D5 of AISI S100-2007.
3. Safety factors and resistance factors for USG Structural Panel Concrete Subfloor diaphragms installed over wood studs are based on the worst case of the standard factors from the American Wood Council Special Design Provisions for Wind and Seismic (AWC SDPWS-2008) and those tabulated for steel framing.
4. Earthquake factors for installations over wood construction are based upon the wind factors modified by a factor of 1.4 to match the general seismic strength reduction observed in Tables 4.2A, 4.2B, 4.2C, and 4.2D of AWC SDPWS-2008.
5. Limit States Design (LSD) shall be used in combination with the load combinations found in the National Building Code of Canada (NBCC).
Table 5: Simple Beam Diaphragm Testing

USG Structural Panel Concrete Subfloor

<table>
<thead>
<tr>
<th>Fastener Spacing</th>
<th>Joist</th>
<th>Screw Pattern²,³</th>
<th>Panel Blocking</th>
<th>Sₚₙ - Nominal Shear Strength (plf)</th>
<th>X</th>
<th>Aspect Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot; [102mm]</td>
<td>12&quot; [305mm]</td>
<td>16 [1.438mm]</td>
<td>16&quot; [407mm]</td>
<td>B</td>
<td>None</td>
<td>1462 (21.3 kN/m)</td>
</tr>
<tr>
<td>6&quot; [152mm]</td>
<td>12&quot; [305mm]</td>
<td>16 [1.438mm]</td>
<td>24&quot; [610mm]</td>
<td>B</td>
<td>None</td>
<td>1395 (20.4 kN/m)</td>
</tr>
<tr>
<td>4&quot; [102mm]</td>
<td>12&quot; [305mm]</td>
<td>16 [1.438mm]</td>
<td>24&quot; [610mm]</td>
<td>C</td>
<td>None</td>
<td>1341 (19.6 kN/m)</td>
</tr>
<tr>
<td>6&quot; [152mm]</td>
<td>12&quot; [305mm]</td>
<td>16 [1.438mm]</td>
<td>24&quot; [610mm]</td>
<td>C</td>
<td>None</td>
<td>1053 (15.4 kN/m)</td>
</tr>
</tbody>
</table>

Notes:
1. Refer to Table 4 of this PER for applicable diaphragm safety (Ω) and load resistance (φ) factors corresponding to ASD, LRFD, and/or LSD design methods.
2. **Screw Pattern B** - Panel fasteners must be inset 2" [51mm] from the corners. Fastener edge distance at all panel edges must comply with distances in Table 2, as well as exception to the tongue and groove joints where the framing joists are perpendicular to the joint. The fasteners should be kept flush or slightly below the surface of the panel. At the T&G panel joints where the framing joists are perpendicular to the joint, one (1) panel fastener is required. One fastener should be 1" [25mm] and the other 2" [51mm] from the panel edge.
3. **Screw Pattern C** - Panels shall be fastened as described in Screw Pattern B with the addition of fasteners at 6" [152mm] o.c. along the metal Strap Blocking on both sides of seam.

* The values shown apply to 18 ga. Framing using the minimum of 1" [25mm] edge distance as shown in Table 2.

**Deflection Equation for Simple Beam Diaphragm**

\[
\Delta = \frac{5Vl^3}{8EAb} + \frac{Vl}{4Et} + Xle_n
\]

Where:
- \( V \) = Unit shear in the direction under consideration, plf
- \( l \) = Diaphragm length, ft.
- \( b \) = Diaphragm width, ft.
- \( E \) = Elastic modulus of steel rim chords, 29,500,000 psi
- \( A \) = Net area of steel rim chord cross section, in\(^2\)
- \( G \) = Shear modulus of USG Structural Panel Concrete Subfloor for shear, 285,714 psi
- \( t \) = Effective thickness of USG Structural Panel Concrete Subfloor for shear, 0.73 in.
- \( e_n \) = Screw joint slippage at load per screw on perimeter of interior panel
  - \( e_n \) @ 0.20Sₙ = 0.011
  - \( e_n \) @ 0.33Sₙ = 0.019
  - \( e_n \) @ 0.60Sₙ = 0.032
  - \( e_n \) @ Sₙ = 0.084
- \( X \) = Slip Co-efficient. See Table 5 above.
**Table 6: Cantilever Floor Diaphragm Testing**

**USG Structural Panel Concrete Subfloor**

<table>
<thead>
<tr>
<th>Fastener Spacing</th>
<th>Field Spacing</th>
<th>Joist Spacing</th>
<th>Screw Pattern</th>
<th>Panel Blocking</th>
<th>S&lt;sub&gt;n&lt;/sub&gt; - Nominal Shear Strength (plf)*</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot; [152mm]</td>
<td>12&quot; [305mm]</td>
<td>24&quot; [610mm]</td>
<td>B</td>
<td>None</td>
<td>487 [7.1 kN/m]</td>
<td>0.518</td>
</tr>
<tr>
<td>8&quot; [203mm]</td>
<td>12&quot; [305mm]</td>
<td>24&quot; [610mm]</td>
<td>B</td>
<td>None</td>
<td>475 [6.9 kN/m]</td>
<td>0.511</td>
</tr>
<tr>
<td>4&quot; [102mm]</td>
<td>12&quot; [305mm]</td>
<td>24&quot; [610mm]</td>
<td>A</td>
<td>None</td>
<td>713 [10.4 kN/m]</td>
<td>0.732</td>
</tr>
<tr>
<td>6&quot; [152mm]</td>
<td>12&quot; [305mm]</td>
<td>16&quot; [406mm]</td>
<td>A</td>
<td>None</td>
<td>525 [7.7 kN/m]</td>
<td>0.625</td>
</tr>
<tr>
<td>8&quot; [203mm]</td>
<td>12&quot; [305mm]</td>
<td>12&quot; [305mm]</td>
<td>A</td>
<td>None</td>
<td>465 [6.8 kN/m]</td>
<td>0.754</td>
</tr>
<tr>
<td>4&quot; [102mm]</td>
<td>12&quot; [305mm]</td>
<td>12&quot; [305mm]</td>
<td>A</td>
<td>None</td>
<td>975 [14.2 kN/m]</td>
<td>0.833</td>
</tr>
<tr>
<td>6&quot; [152mm]</td>
<td>12&quot; [305mm]</td>
<td>16&quot; [406mm]</td>
<td>A</td>
<td>None</td>
<td>915 [13.4 kN/m]</td>
<td>0.765</td>
</tr>
<tr>
<td>8&quot; [203mm]</td>
<td>12&quot; [305mm]</td>
<td>12&quot; [305mm]</td>
<td>A</td>
<td>None</td>
<td>860 [12.6 kN/m]</td>
<td>0.702</td>
</tr>
<tr>
<td>4&quot; [102mm]</td>
<td>12&quot; [305mm]</td>
<td>12&quot; [305mm]</td>
<td>A</td>
<td>None</td>
<td>1121 [16.4 kN/m]</td>
<td>0.759</td>
</tr>
<tr>
<td>6&quot; [152mm]</td>
<td>12&quot; [305mm]</td>
<td>12&quot; [305mm]</td>
<td>A</td>
<td>None</td>
<td>940 [13.7 kN/m]</td>
<td>0.541</td>
</tr>
<tr>
<td>8&quot; [203mm]</td>
<td>12&quot; [305mm]</td>
<td>12&quot; [305mm]</td>
<td>A</td>
<td>None</td>
<td>772 [11.3 kN/m]</td>
<td>0.484</td>
</tr>
<tr>
<td>6&quot; [152mm]</td>
<td>12&quot; [305mm]</td>
<td>24&quot; [610mm]</td>
<td>C</td>
<td>4&quot; [102mm] wide x 16ga. [1.438mm] Strap</td>
<td>1148 [19.8 kN/m]</td>
<td>0.354</td>
</tr>
</tbody>
</table>

**Notes:**

1. Refer to Table 4 of this PER for applicable diaphragm safety (Ω) and load resistance (φ) factors corresponding to ASD, LRFD, and/or LSD design methods.
2. 2 to 1 maximum Aspect Ratio
3. **Screw Pattern A & B** - Panel fasteners must be inset 2" [51mm] from the corners. Fastener edge distance at all panel edges must comply with Table 2 distances with exception to the tongue and groove joints where the framing joints are perpendicular to the joint. The fasteners should be kept flush or slightly below the surface of the panel. At the T&G panel joists where the framing joins are perpendicular to the joint, one (1) fastener for Pattern A and one (1) fastener for Pattern B. One fastener should be 1" [25mm] and the other 2" [51mm] from the panel edge.
4. **Screw Pattern C** - Panels shall be fastened as described in Screw Pattern B with the addition of fasteners at 6" [152mm] o.c. along the metal Strap Blocking on both sides of seam.

**Deflection Equation for Cantilever Diaphragm**

\[
\Delta = \frac{5V(2I)^3}{6EAb} + \frac{V(2I)}{4Gt} + X(e_n)
\]

Where: 
- \(V\) = Unit shear in the direction under consideration, plf
- \(t\) = Diaphragm length, ft.
- \(b\) = Diaphragm width, ft.
- \(E\) = Elastic modulus of steel rim chords, 29,500,000 psi
- \(A\) = Net area of steel rim chord cross section, in²
- \(G\) = Shear modulus of USG Structural Panel Concrete Subfloor for shear, 285,714 psi
- \(t\) = Effective thickness of USG Structural Panel Concrete Subfloor for shear, 0.73 in.
- \(e_n\) = Screw joint slippage at load per screw on perimeter of interior panel
  - \(e_n\) @ 0.20\(S_n\) = 0.011
  - \(e_n\) @ 0.33\(S_n\) = 0.019
  - \(e_n\) @ 0.60\(S_n\) = 0.032
  - \(e_n\) @ \(S_n\) = 0.084
- \(X\) = Slip Co-efficient. See Table 6 above.
Screw Pattern A

Figure 1 - Screw Pattern "A" Details

1. Two Span offset of Seams w/o Blocking, One Span w/ Blocking.
1. Two Span Minimum offset of Seams w/o Blocking. One Span offset w/ Blocking.

Figure 2 - Screw Pattern "B" & "C" Details

Screw Pattern B

DETAIL - B

Strap Block Detail for Screw Pattern C
### Table 7: Floor Anchorage Options - USG Structural Panel Concrete Subfloor\(^{1,2,3}\)

Nominal Withdrawal Capacities per Anchor

<table>
<thead>
<tr>
<th>Anchor Type</th>
<th>ASTM D 1037 Value (1 Layer)</th>
<th>Subfloor Layers</th>
<th>Distance Between Bolts, d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2&quot;</td>
<td>4&quot;</td>
</tr>
<tr>
<td>3/8&quot; SnapToggle(^5)</td>
<td>1481 lb [6588 N]</td>
<td>1</td>
<td>927 lb</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1719 lb*</td>
</tr>
<tr>
<td>1/2&quot; SnapToggle(^5)</td>
<td>1616 lb [7188 N]</td>
<td>1</td>
<td>948 lb</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1843 lb</td>
</tr>
<tr>
<td>1/4&quot;x3&quot; Peel Rivet(^6)</td>
<td>758 lb [3372 N]</td>
<td>1</td>
<td>636 lb</td>
</tr>
</tbody>
</table>

For ASD designs use minimum Ω = 4.0; For LRFD designs use maximum φ = 0.40

**Notes:**

1. TOGGLER Anchor System and peel rivet capacity is based on random anchors purchased from a distributor and have not been evaluated for installations other than that described in Table 7 and Figure 3. This **PER** verifies the USG Structural Panel Concrete Subfloor capacity only, and actual toggler anchor capacity without panel failure shall be verified by the engineer or designer of record through the SnapToggle anchor or peel rivet manufacturer.

2. TOGGLER Anchor System shall be installed with a maximum torque setting of 200 in-lb [23 N-m].

3. Anchors have been evaluated for use general component connections to the USG Structural Panel Concrete Subfloor (i.e. auditorium seating, lightweight equipment, etc.). Final application must be reviewed and approved by the engineer or designer of record.

4. TOGGLER Anchor System 3/8" SnapToggle\(^5\) (Item No. BC) w/ a Grade 8 Hex Head Bolt. Ultimate withdrawal occurred at a maximum tested shear per pair of 232 lb [1032 N] for one-layer and 430 lb [1913 N] for two layers.

5. TOGGLER Anchor System 1/2" SnapToggle\(^5\) (Item No. BD) w/ a Grade 5 Hex Head Bolt. Ultimate withdrawal occurred at a maximum tested shear per pair of 294 lb [1308 N] for one-layer and 600 lb [2669 N] for two layers.

6. Peel Rivets manufactured by SFS Intec (Part No. TPR-L-6, 3x76). Ultimate withdrawal occurred at a maximum tested shear per pair of 167 lb [743 N] for a single layer of USG Structural Panel Concrete Subfloor.

\(^*\) Denotes Toggler Failure by Strip out.

**Figure 3 - Typical Toggler Bolt Application**
### Table 8
Tested Static Wall Shear Values using 16ga. [54mil] or 0.0538" [1.438mm] X 3-5/8" [92mm] flange Steel Studs 16" [406mm] o.c.

<table>
<thead>
<tr>
<th>Sides Sheathed</th>
<th>Strap at Seam</th>
<th>Sheathing Orientation</th>
<th>Fastener Perimeter</th>
<th>Spacing Field</th>
<th>Ultimate Load in plf</th>
<th>G' Lbs./in</th>
<th>Ultimate Load kN/m</th>
<th>G' N/mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>no</td>
<td>Vertical</td>
<td>8&quot; [203mm]</td>
<td>12&quot; [305mm]</td>
<td>914</td>
<td>6185</td>
<td>13.3</td>
<td>1083</td>
</tr>
<tr>
<td>Single</td>
<td>no</td>
<td>Vertical</td>
<td>6&quot; [152mm]</td>
<td>12&quot; [305mm]</td>
<td>1320</td>
<td>7416</td>
<td>19.2</td>
<td>1299</td>
</tr>
<tr>
<td>Single</td>
<td>no</td>
<td>Vertical</td>
<td>4&quot; [102mm]</td>
<td>12&quot; [305mm]</td>
<td>1726</td>
<td>8647</td>
<td>25.1</td>
<td>1514</td>
</tr>
<tr>
<td>Single</td>
<td>yes</td>
<td>Horizontal</td>
<td>8&quot; [203mm]</td>
<td>12&quot; [305mm]</td>
<td>984</td>
<td>5535</td>
<td>14.3</td>
<td>969</td>
</tr>
<tr>
<td>Single</td>
<td>yes</td>
<td>Horizontal</td>
<td>6&quot; [152mm]</td>
<td>12&quot; [305mm]</td>
<td>1402</td>
<td>7269</td>
<td>20.4</td>
<td>1273</td>
</tr>
<tr>
<td>Single</td>
<td>yes</td>
<td>Horizontal</td>
<td>4&quot; [102mm]</td>
<td>12&quot; [305mm]</td>
<td>1821</td>
<td>9003</td>
<td>26.5</td>
<td>1577</td>
</tr>
<tr>
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<td>Horizontal</td>
<td>8&quot; [203mm]</td>
<td>12&quot; [305mm]</td>
<td>1901</td>
<td>13287</td>
<td>27.7</td>
<td>2327</td>
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<td>6&quot; [152mm]</td>
<td>12&quot; [305mm]</td>
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<td>22677</td>
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<td>3971</td>
</tr>
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<td>4&quot; [102mm]</td>
<td>12&quot; [305mm]</td>
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<td>32067</td>
<td>48.8</td>
<td>5616</td>
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**Note:**
1. The Ultimate Load does not include a safety factor and walls have not been evaluated for cyclic design loads.

### Table 9
Tested Static Wall Shear Values using 16ga. [54mil] or 0.0538" [1.438mm] X 3-5/8" [92mm] flange Steel Studs 24" [610mm] o.c.

<table>
<thead>
<tr>
<th>Sides Sheathed</th>
<th>Strap at Seam</th>
<th>Sheathing Orientation</th>
<th>Fastener Perimeter</th>
<th>Spacing Field</th>
<th>Ultimate Load in plf</th>
<th>G' Lbs./in</th>
<th>Ultimate Load kN/m</th>
<th>G' N/mm</th>
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</thead>
<tbody>
<tr>
<td>Single</td>
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<td>Vertical</td>
<td>8&quot; [203mm]</td>
<td>12&quot; [305mm]</td>
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<td>5882</td>
<td>11.9</td>
<td>1030</td>
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<td>12&quot; [305mm]</td>
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<td>7736</td>
<td>17.5</td>
<td>1355</td>
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<td>12&quot; [305mm]</td>
<td>1584</td>
<td>9590</td>
<td>23.1</td>
<td>1679</td>
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<td>12&quot; [305mm]</td>
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<td>5117</td>
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<td>1679</td>
<td>9590</td>
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<td>19945</td>
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<td>3135</td>
<td>3971</td>
<td>45.7</td>
<td>4940</td>
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</table>

**Note:**
1. The Ultimate Load does not include a safety factor and walls have not been evaluated for cyclic design loads.