ADDENDUM NO. 2
September 10, 2024

Re: SAND CREEK ES HVAC REPLACEMENT
DEFERRED MAINTENANCE - PHASE 4
Anoka-Hennepin School District 11, Anoka, MN
ATS&R Project Number: 21046.3
Anoka Bid No. 25011B

TO ALL CONTRACTORS

The following are clarifications and/or changes to the Plans and Specifications August 15, 2024 for the above-named Project, to be Bid on September 12, 2024 @ 2:00 PM..

ENCLOSURE: ***Certification Page.***

Electrical/Technology: Revised Section 27 15 00 and Revision Drawings E4.1 and E7.1.

INTRODUCTORY INFORMATION

1. Document 00 01 05 of the Project Manual:

    a. Refer to Certification Page, included as an enclosure with this Addendum.

ELECTRICAL SPECIFICATIONS

2. Section 27 15 00 of the Specifications:

    a. ***Delete*** Section 27 15 00 in its entirety and replace with ***NEW Revised Section 27 15 00*** in its entirety. ***(REFER TO ENTIRE SECTION FOR CHANGES),*** included as an enclosure with this Addendum.

ELECTRICAL DRAWINGS

3. Sheet E4.1 of the Drawings:

    a. Replace Sheet E4.1 with Revised Sheet E4.2, Revision 2, (clouded revision(s), included as an enclosure with this Addendum.

4. Sheet E7.1 of the Drawings:

    a. Replace Sheet E7.1 with Revised Sheet E7.1, Revision 1, (clouded revision(s), included as an enclosure with this Addendum.

END OF ADDENDUM

DOCUMENT 00 01 05

CERTIFICATION PAGE

PROJECT:

SAND CREEK ELEMENTARY SCHOOL
HVAC REPLACEMENT- PHASE 4
12156 Olive Street NW
Coon Rapids, Minnesota 55448

ARCHITECT'S CERTIFICATION:

I hereby certify that this Plan, Specification, or Report was prepared by me or under my direct supervision and that I am a duly Licensed Architect under the laws of the State of Minnesota.

Name David M. Maroney, AIA

Signature _____

Date August 15, 2024 License No. 20992

MECHANICAL ENGINEER'S CERTIFICATION:

I hereby certify that this Plan, Specification, or Report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Name Blayne J. Parkos, PE

Signature _____

Date August 15, 2024 License No. 46630

ELECTRICAL ENGINEER'S CERTIFICATION:

I hereby certify that this Plan, Specification, or Report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Name Nicholas Achina, PE

Signature _____

Date August 15, 2024 License No. 40408

END OF DOCUMENT

SECTION 27 15 00

HORIZONTAL DATA CABLING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Provide additions and modifications to the existing horizontal data cabling system that currently exists in the building.

B. **Data Cabling Systems as Described Herein Shall Be Standards Compliant and Support the Following Network Formats**:

1. Analog and Digital Voice Circuits.

2. Ethernet 10BaseT.

3. 100BaseTX and 1000BaseTX.

4. 10GBaseT.

C. Cabling systems shall be installed in accordance with these Specifications and specifications of agencies listed in references. Note: Anoka-Hennepin School District has specific requirements for the installation of voice and data jacks onto the patch panels. The Contractor shall pay special attention to the details on the Drawings.

1.02 CONTRACTOR AND INSTALLER QUALIFICATIONS

A. The Data Cabling Contractor shall have a minimum of 5 years experience in the installation and service of data cabling communications systems.

B. The following installer requirements <u>will be enforced</u>:

1. Each installer working on the job site installing copper data cable shall be required to have a minimum of a BICSI Installer 1 copper certification and have identification of such on their person and will present that documentation when requested by the Owner or the Architect/Engineer. Installer/technicians not having the certification or identification of the certification will be told to leave the job by either the Owner or the Architect/Engineer.

2. Each installer working on the job site installing fiber optic cable shall be required to have a BICSI Installer 2, optical fiber certification and have identification of such on their person and will present that documentation when requested by the Owner or the Architect/Engineer. Installer/technicians not having the certification or identification of the certification will be told to leave the job by either the Owner or the Architect/Engineer.

3. If an installer is not installing the copper or optical fiber cabling in conformance to BICSI published standards and these specifications they will be immediately required to correct the installation to meet those standards.

C. The work shall only be preformed by Minnesota Department of Labor and Industry licensed power limited technicians (PLT) and registered (unlicensed) technicians (RT) under the direct supervision of a PLT. Direct supervision means the PLT is physically present and supervising the RT the entire working day. Installers shall have identification of PLT or RT license on their person and will present that documentation when requested by the Owner or the Architect/Engineer.

1.03 PRE-CONSTRUCTION MEETING

A. The Division 27 Contractor is required to attend a pre-construction meeting with the Architect's Technology Designer, Architect's Project Field Administrator and Owner's Construction and Technology Representatives. The meeting shall be scheduled before installation by the Division 27 Contractor. The following Contractor personal shall be required to attend:

1. Division 27 Contractor Project Manager.

2. Division 27 Contractor Project lead Installer with PLT license and BICSI Installer 2 certification.

B. The Architect shall organize the pre-construction meeting with all parties required to be in attendance.

1.04 STANDARDS

A. **Installation shall meet the following Industry Standards**:

1. ANSI/TIA/EIA-568-C.
2. ANSI/TIA/EIA-569-B.
3. TIA/EIA-606-A.
4. ANSI/ NECA/BICSI 568-2001.
5. NECA/BICSI Bonding and Grounding Installation Standard.
6. Underwriters Laboratories.

1.05 SHOP DRAWINGS

A. Project Shop Drawings shall be submitted in PDF format for review by the Architect.

B. **Materials Shall Be Documented, Including**:

1. Cable Specifications.

2. Termination Equipment Specifications.

3. Cable Support and Management Equipment.

4. Equipment Support Equipment.

5. Certificates of Training for Project Managers, Technicians, and Installers.

C. **The Shop Drawing Shall Be Prepared Specifically for this Project and Shall Include the Following**:

1. Title sheet clearly defining the project name, address and telephone number of Contractor, date of submittal and subcontractors. The title sheet shall have blank space for Architect's review stamp.

2. Complete material list listing manufacturer, model number and description of all materials.

3. Manufacturer's specification sheets for all equipment.

1.06 SYSTEM DESCRIPTION

A. **Data Cabling System**:

1. Provide a horizontal data cabling system comprising of Category 6 grade cable, outlet assemblies, etc. All cable runs shall be terminated on a patch panel in the data equipment rack and on the outlet jack.

2. Data outlets shall include an RJ45 Category 6 jack (white in color), Category 6 cable (white in color), stainless steel cover plate, labeling and testing. Jacks shall be mounted in a Decora style insert to allow them to be combined in the same plate with an HDMI jack in Decora style.

3. Most existing classroom data cables shall be reused. These shall be removed from the existing jacks and coiled at the corridor wall in each classroom by Division 27. They shall be reinstalled onto new jacks by this work in the new C1A outlet. Maintain all of the existing jack labeling for these jacks. Refer to the Drawings for cables to be reused. Test these cables after termination as a part of this work. The C1A outlet will be mounted in new surface raceway provided by Division 26. Provide coverplates compatible with the surface raceway for these outlets.

4. Provide data outlet assemblies at each above ceiling D1 outlet shown on the Drawings The assembly shall:

   a. Provide a testable permanent link in drop ceilings to mechanical equipment.

   b. Complete plenum-rated system of cable, connectors, patch cords, boxes, and brackets.

   c. Supports ANSI/TIA TSB-162-A standards.

   d. Works with standard drop-ceiling hardware such as drop wire or rods.

   e. In-ceiling mounting bracket for the surface outlet box. The bracket shall be mounted to a support wire for the suspended ceiling.

   f. Plenum rated 1 port surface outlet box with white RJ45 jack.

   g. Category 6 white 10 foot long plenum rated patch cord.

5. Provide 15 feet of service loop at each above ceiling outlet for adjustment of outlet location that may be required.

B. **Wireless Access Points**:

1. Division 27 shall remove the existing wireless access points. Each access point shall be labeled with the room it was removed from and reinstalled in that same room. Division 27 shall move the existing cables to the classroom corridor wall to be protected during construction. The cables shall be reused. Division 27 shall move the outlet back to the center of the classroom and install the wireless access points when appropriate for the construction schedule.

C. **Voice Cabling System**:

1. The existing voice outlets shall be removed. New voice jacks shall be provided in the C1A outlet.

2. Provide a horizontal cabling system comprising of Category 6 grade cable and jacks. The voice jacks shall be mounted into the C1A outlet assemblies. All cable runs shall be terminated onto the existing blocks at the existing voice terminal blocks. All new voice cables shall be terminated where the old cables were removed. Maintain all of the existing jack labeling for these jacks.

3. Voice outlets shall include an RJ45 Category 6 jack (blue in color), Category 6 cable (blue in color), labeling and testing.

D. **Audio and Video Cabling System**:

1. Division 27 shall remove the existing video projector system from the existing projector mount. The projector and mount may be either wall or ceiling mounted. Refer to the Drawings for type in each classroom. The projector shall be reinstalled in the same classroom it was removed from at a time appropriate for the construction schedule. Each existing video projection system includes an “Apple TV” device that shall be reinstalled with the video projector.

2. Provide passive cabling system to extend the HDMI audio and video signals from the C1A outlet to the video projector. The cable shall be a commercial rated and plenum rated. Consumer grade cables are not acceptable. Plug the HDMI cable directly into video projector at the C1B outlet location. All excess cable shall be neatly coiled in the ceiling.

3. Provide cabling system for stereo audio from the video projector audio output (C1B location) to the classroom sound enhancement amplifier (C1C location). Video projector and sound enhancement amplifier are provided by the Owner. Plug directly into video projector audio output and sound enhancement amplifier line level input. The cable shall be factory pre-connectorized, commercial rated and plenum rated. Consumer grade cables are not acceptable.

    a. In some classrooms, where noted on the Drawings, the C1C outlet shall include a wall plate. The wall plate shall be two-gang stainless steel Decora style with two brushed openings for neatly routing the cables through.

4. Route the audio and video cables concealed above the ceiling. At the video projector route the cables concealed in the projector mount pole. All spare cable shall be neatly coiled above the ceiling.

5. In most classrooms the sound enhancement amplifier will be mounted inside a tall cabinet on the top shelf.

E. **Data Cable**:

1. 4-pair Unshielded Twisted Pair (UTP) type cable.

2. TIA 568-C.2 Category 6. Category classification shall be printed on cable.

3. UL listed Category 6.

4. Nominal outside diameter shall not exceed 0.225 inch.

5. Cable shall meet National Electric Code CMP (plenum) rated insulation and jacket material.

6. Color shall be white.

F. **Voice Cable**:

1. 4-pair Unshielded Twisted Pair (UTP) type cable.

2. TIA 568-C.2 Category 6. Category classification shall be printed on cable.

3. UL listed Category 6.

4. Nominal outside diameter shall not exceed 0.225 inch.

5. Cable shall meet National Electric Code CMP (plenum) rated insulation and jacket material.

6. Color shall be blue.

G. **Data Jacks (on outlets and patch panels)**:

1. 8-pin modular outlets rated by manufacturer to meet the following minimum performance criteria.

2. EIA/TIA 568-C.2 Category 6.

3. Each jack shall have 110 Type IDC connection for horizontal cable termination on back.

4. UL Listed for Category 6.

5. Standard Keystone style interface.

6. Exposed labeling on outlets shall identify them by category.

7. Pin configuration shall be T568B.

8. Jacks shall be mounted into outlet modules and modular patch panel.

9. Color shall be white.

H. **Wireless Access Point Jacks (on outlets and patch panels)**:

1. 8-pin modular outlets rated by manufacturer to meet the following minimum performance criteria.

2. EIA/TIA 568-C.2 Category 6A.

3. Each jack shall have 110 Type IDC connection for horizontal cable termination on back.

4. UL Listed for Category 6A.

5. Standard Keystone style interface.

6. Exposed labeling on outlets shall identify them by category.

7. Pin configuration shall be T568B.

8. Jacks shall be mounted into outlet modules and modular patch panel.

9. Color shall be orange.

I. **Voice Jacks**:

1. 8-pin modular outlets rated by manufacturer to meet the following minimum performance criteria.

2. EIA/TIA 568-C.2 Category 6.

3. Each jack shall have 110 Type IDC connection for horizontal cable termination on back.

4. UL Listed for Category 6.

5. Standard Keystone style interface.

6. Exposed labeling on outlets shall identify them by Category.

7. Pin configuration shall be T568B.

8. Jacks shall be mounted into outlet modules.

9. Color shall be blue.

J. **Outlet Wallplates**:

1. Mounting for jacks at outlets.

2. Single-gang and dual-gang stainless-steel wallplates

3. Accept snap-in connectors and adapters.

4. Single-gang wallplate shall provide 4 ports.

5. UL Listed and compliant with ANSI/TIA/-568-C.0 specifications.

6. Fit standard NEMA electrical boxes.

7. Mounting screw holes shall be slotted to permit leveling in out of level wall boxes, and shall be hidden behind labeling identification windows at the top and bottom of each wallplate opening.

8. Brushed 304 stainless-steel finish.

K. **HDMI Jacks in Outlets:**

1. Shall consist of an HDMI pass thru jack in RJ45 configuration.

2. Color shall be white.

3. Provide HDMI cable to interconnect HDMI jacks in outlet to video projector.

L. **HDMI Cables:**

1. Shall be a high performance HDMI cable, ultra flexible, plenum rated. CMP rating shall be printed on cable.

2. Commercial grade rating with guaranteed performance to 50 feet.

3. Provide length of cable as required. Part number for a 35 foot length is specified and should work in all rooms, field verify.

M. **Audio Cables:**

1. Shall be a high performance stereo cable, plenum rated. CMP rating shall be printed on cable.

2. 3.5mm Stereo Male connectors on each end.

3. Commercial grade rating.

4. Provide length of cable as required. Part number for a 35 foot length is specified and should work in all rooms, field verify.

N. **Data Patch Panels**:

1. 48-port unloaded patch panel.

2. Jack ports labeled vertically.

3. 2U 19" rack mounted.

4. Two rows of 24 jacks with label strips.

5. UL Listed.

O. **Labeling and Documentation:**

1. The contractor is responsible to follow the label plan shown on the Drawing details.

2. All cables are to be individually labeled at each end. Labels shall be wrapping around, non- smear type so that the print is covered by a clear tape. Labels are to be secured to the cable jacket within 6" from the cable jacket ends for each copper cable.

3. Labels at the drop location faceplate shall be machine made and placed appropriately. Lettering shall be readable. Hand written labels are not acceptable.

4. Labels at the patch panel shall be self-adhesive type made to secure to a metal surface. Label print to be machine made, and readable. Hand written labels are not acceptable.

5. All drop locations shall be labeled.

6. Test reports are to be printed and assembled in binders as well as submitted in native electronic format as well readable in industry standard software (e.g. Adobe Acrobat PDF, Microsoft Word, Excel). Contractor shall provide all appropriate software and licensing to allow the District to view the electronic form of the test results.

7. The contractor shall provide all test records and cable records in an electronic format that is approved by the District.

P. **Testing**: Cable systems shall be 100% tested and documented with a processor based tester. Owner shall receive all test results in electronic format.

Q. **Cable Supports**:

1. The cable supports shall include j-hook type or plastic mesh support fabric with a minimum of 1-inch wide cable surface with rounded edges.

2. Sized as required for the quantities of cables.

3. Supports shall be fastened to dedicated hanger wire, wall or structural ceiling as applicable to support the weight of the cables.

4. Sufficient cable length should be provided in the telecommunications room to allow future movement of the patch panel within the rack. Cables should be neatly bundled in the wiring closet using velcro ties and any excess cable coiled neatly.

R. **Cable Fastening Systems Shall Include**:

1. Non-Metallic Cable Ties. Cable ties may be used in all areas except communications rooms and closets. Cable ties installed in plenum spaces shall be plenum rated.

2. Non-Metallic Hook and Loop Reusable Cable Ties (Velcro). Reusable ties shall be used in communications rooms and closets.

1.07 ADDITIONAL COMMUNICATIONS OUTLETS

A. Include material and labor in the bid for (5) additional data drops to be located as directed by the Owner. These shall include jack, cover plate, Cat 6 cable to telecommunications room, testing and labeling as specified. These data drops can be added to existing outlets or can be new individual outlets (D1, D2, etc.).

1.08 FIRESTOPPING SYSTEM DESCRIPTION

A. **General Requirements**: Where fire rated masonry and gypsum board walls and floor penetrations for communications cabling exist, seal both sides with firestopping sealant or firestopping foam as applicable to penetration size.

B. **Performance Requirements**:

1. Firestopping materials shall meet requirements of ASTM E814 to achieve a fire rating equal to the fire rating of the substrate or assembly being penetrated.

2. Surface Burning: Firestopping materials shall meet requirements of ASTM E84 with a flame spread/fuel contributed/smoke developed rating of 25 or less.

C. **UL Design**: Meet requirements of UL Designs Series U900 as applicable.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One manufacturers brand shall be used for each component throughout the Project. One manufacturers product line shall be used for all termination equipment at both outlet end and at administration end of all cabling.

2.02 DATA CABLE PRODUCTS

A. **Approved Cable Manufacturers**:

1. Berk-Tek
2. General Cable
3. Mohawk/CDT
4. Hitachi
5. Belden
6. Commscope
7. Hubbell
8. Superior/Essex
9. West Penn

B. Leviton products numbers are used to define a level of features and performance but are not intended to indicate a preference.

C. **Data Cable:**

1.	Manufacturer:	Leviton
2.	Model Number:	LANmark-1000 Enhanced Cat 6 Plenum Rated Cable Part No. 10032091 (white)
3.	Quantity:	As Required

D. **Voice Cable:**

1.	Manufacturer:	Leviton
2.	Model Number:	LANmark-1000 Enhanced Cat 6 Plenum Rated Cable Part No. 10032093 (blue)
3.	Quantity:	As Required

2.03 TERMINATION EQUIPMENT

A. **Approved Manufacturers**:

1. Panduit
2. Ortronics
3. Belden
4. Hubbell
5. Leviton

B. Leviton product numbers are used to define a level of features and performance but are not intended to indicate a preference.

C. **Data Jacks**:

1. Manufacturer: Leviton
2. Model Number: 61110-RW6 (white)
3. Quantity: As Required to equip all outlets and patch panels

D. **Voice Jacks**:

1. Manufacturer: Leviton
2. Model Number: 61110-RL6 (blue)
3. Quantity: As Required to equip all outlets and patch panels

E. **HDMI Jacks**:

1. Manufacturer: Leviton
2. Model Number: 40834-W (white)
3. Quantity: As Required to equip all outlets

F. **HDMI Extension Cables:**

1. Manufacturer: Cables to Go
2. Model Number: 41192 - (model number is for 35 foot length. Field verify length required)
3. Quantity: As Required

G. **Audio Extension Cables:**

1. Manufacturer: Cables to Go
2. Model Number: 40517- (model number is for 35 foot length. Field verify length required)
3. Quantity: As Required

H. **Blank Keystone Inserts:**

1. Manufacturer: Leviton
2. Model Number: 41084-BW
3. Quantity: As Required to equip all outlets.

I. **One Gang Four Port Outlet Face Plates:**

1. Manufacturer: Leviton
2. Model Number: 43080-1L4
3. Quantity: As Required to equip all one gang outlets.

J. **Data Patch Panels**:

1. Manufacturer: Leviton (no substitutions)
2. Model Number: 49255-48N
3. Quantity: As Required

K. **In-Ceiling Surface Box for D1 outlet:**

1.	Manufacturer:	Leviton
2.	Model Number:	49223-CBC, in-ceiling bracket
3.	Model Number:	41089-1WP surface box
4.	Quantity:	One for each in-ceiling D1 outlet shown on Drawings

2.04 Cable J-Hook Supports:

A. Approved Manufacturers: B-Line, Nvent Caddy, Panduit, Thomas and Betts, Unistrut, Cablofil

2.05 FIRESTOPPING

A. **Acceptable Manufacturers For Sealant**: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows or approved equal:

1. Dow Corning Corporation, Midland, MI, “Type 790 or 795 Sealant”
2. GE Silicones, Waterford, NY, “Silpruf”
3. Hilti Construction Chemicals, Inc., Tulsa, OK, “Type CS 601 Firestop Sealant”
4. W. R. Grace and Company - Conn., Construction Products Division, “FlameSafe IPC FS1900 Series”
5. Isolatek International, “Cafco TPS (Through Penetration System)”
6. Mameco International, Inc., "Vulkem 921"
7. Nelson Firestop Products, A Unit of General Signal, “Nelson CLK”
8. Nuco-Pak, Inc., “Self Seal Products”
9. RectorSeal Bio Fireshield, Houston, TX, “Biotherm 100/200"
10. The RectorSeal Corporation, "Metacaulk 835+"
11. 3M Electrical Products Division, St. Paul, MN, "3M Brand Fire Barrier CP 25N/S"
12. Tremco, Inc., Beachwood, OH, "Dymeric"
13. United States Gypsum Company, “Firecode Compound”
14. Specified Technologies, Inc., ”Spec Seal Series SSS”

B. **Fire Rating Classification**: Fire blocking insulation backer material shall be tested and classified under requirements of ASTM E119 time temperature fire exposure.

PART 3 - EXECUTION

3.01 QUALITY ASSURANCE

A. Except where specifically noted otherwise, all equipment supplied shall be the standard product of a single manufacturer of known reputation and experience in the industry. The Contractor shall have attended the manufacturer's installation and service school and upon request must show proof of attending such training.

3.02 INSTALLATION

A. **Protection of Equipment**: Until final acceptance of work by Owner, Contractor shall protect all materials and equipment from damage.

1. Equipment racks, and other components stored or installed on-site, shall be protected with a minimum polyethylene or equivalent covering, to protect equipment from moisture, plaster, cement, paint, or other work of other trades.

2. Protective coverings shall be further constructed of plywood sheeting or other materials for strength if required by site conditions.

3. If, during shipment or installation, finish of equipment becomes chipped or scratched, Contractor shall touch up or refinish surfaces to match original finish.

B. Contractor is responsible for means and methods of construction, and for the safety of personnel.

C. Contractor is responsible to protect Owner’s furnishings from damage due to their activities in occupied spaces and to clean up any debris created as a result of their work.

D. It is the responsibility of the Contractor to notify the Architect if they suspect cables will exceed the 100 meter maximum length Prior to installing the cables.

E. Cabling systems and all associated equipment shall be installed in a neat and professional manner and shall conform to all EIA/TIA and BICSI standards.

F. The maximum horizontal cable length shall not exceed 90 meters (295 feet). 10 meters is allowed for cords in the work area, and for patch cords or jumpers in the telecommunications rooms.

G. Maximum pulling tension for a 4 pair horizontal cable is 25 lbf. If excessive pulling tensions occur during installation and the cable performance is compromised the cable shall be replaced at no cost to the Owner. Use intermediate cable pulls within the overall cable run as necessary to avoid exceeding the maximum pulling force.

H. **Minimum Bend Radius**: 4 pair cables have a 1 inch Minimum Bend Radius. Exceeding the minimum bend radius can distort the cable geometry and result in degradation of transmission performance. If the minimum bend radius is exceeded and the cable performance is compromised the cable shall be replaced at no cost to the Owner. Two main locations will be checked:

1. At the work station wall outlet. After the cable is terminated, too often the remaining cable is jammed into the wall outlet, or worse, wrapped around itself and shoved into the outlet. The installers shall gently work the excess cable length back through the wall outlet into the ceiling space.

2. At the wiring closet, during routing of the cable to the terminal block or patch panel. Provide gently sweeping curves along the cable path, avoiding sharp bends or changes in direction. Every effort should be made to ensure the path the cable follows has smooth gradual sweeps at any transition point.

I. **Painting of Category Cable**: Telecommunications cable shall not be painted. The Contractor shall protect cables that are exposed to painting! Cabling that is painted shall be replaced at Contractor's expense.

1. Manufacturer's Warranty will be voided if the cable is exposed to "painting or other chemical exposure".

2. The jacketing materials are "porous" and have little resistance to moisture. Water based paints will significantly alter the cable performance ratings.

3. Painting will alter the flame and/or smoke characteristics of the plenum rated cable.

4. Painting cables will obscure the flame rating designations and Category designations, which are required to be printed on the jacket.

5. Painting will reduce the cables ability to dissipate heat, important in PoE applications.

J. **Over Stressing**: Eliminate cable stress caused by tension in suspended cable runs and tightly cinched cable bundles. Excessive cable loading or stress can also occur if a cable is incorrectly suspended in a cable run. Provide cable support spacing of 60 inch centers minimum.

K. Avoid twisting of cable during installation. Excessive twisting may result in distortion of cable geometry, and in severe cases, tears in the jacket. Any damaged cables shall be replaced at no cost to the Owner.

L. **Cabling Handling and Installation**:

1. Do not walk or step on high performance data cable. Do not run over high performance cable with hand trucks or forklifts. This can exert excessive force on the cable, distorting the geometry, and/or crushing the pairs, resulting in electrical shorts and reduced performance.

2. Do not use staples, either from a staple gun or mounting in a traditional manner with a hammer. Staples can exert excessive force on the cable and distort the pair geometry.

3. Do not attach cables to threaded rod.

4. Do not support or attach cables to any structure provided by other trades.

5. D-Rings, nail-on clamps or velcro straps all offer acceptable cable management techniques without compressing the cable.

6. Do not run cable near sources of heat, as this may negatively impact cable attenuation.

7. Maintain a 24 inch minimum spacing between cables and sources of EMI, such as fluorescent lights or power lines.

8. If a cable run is long, or if several bends are in the conduit, intermediate pull boxes shall be used to separate one pull into two or more shorter pulls. A cable shall not be pulled through more than two 90 degree bends at one time. If three or more 90 degree bends in a continuous run are unavoidable, the cable shall be installed from a central point, unreeled into a figure-eight, and then backfed to complete the installation.

M. **Termination**: The installer must be acquainted with the connector manufacturer's installation instructions. The correct tools, wire layout and untwist lengths are critical in Category 6 installations. Modular jacks shall have the pair color code marked on the jack. Maintain T568B color code throughout the installation. Changing pin pair assignment can result in crossed pairs. The Contractor shall use the Manufacturer recommended tools to terminate the cable. Terminate with connecting hardware of the same category or higher. Any link that has substituted a lower category component is automatically classified to that lower category.

N. The maximum allowable amount of untwisting during cable termination to connecting hardware shall not exceed 0.5 inch for Category 6 cables. Exceeding the recommended length of untwisting will cause performance problems. Cables terminated that exceed the maximum untwist of 0.5" shall be replaced or reterminated at no additional cost. Any cables replaced shall be retested if the cable testing has already been completed.

O. Installation shall be in strict accordance with Manufacturer’s nationally published installation instructions.

P. Device plates shall be vertically plumb with edges flush to wall and covering outlet box.

Q. Cable ties shall not be tightened to the point of compressing cables. Ties shall be tightened to just support the cables without distortion of the individual cables within a bundle. Use cable supports wherever possible to minimize cable tie usage. If, in the opinion of the Architect, cable ties have compressed the cables sufficiently to cause damage to or compromises the performance of the cables, the cables shall be replaced at no additional cost. Any cables replaced shall be retested if the cable testing has already been completed.

R. **Service Loops**:

1. Provide a minimum of 10 feet of extra cable at Patch Panel end of each cable. Loop shall be a single U “fold back” of cable.

2. Do not provide a coiled loop at either end of cable, a slack loop at workstation end before cable enters a raceway is acceptable.

S. **Cable Pathways**:

1. Cables shall be concealed except in Equipment Rooms, Entrance Facilities, and Telecommunications Rooms where cable management systems are provided.

2. Exposed cable may be installed in open trusses above 12 feet, provided they are supported by cable hooks and do not sag below bottom of trusses. Again, do not over tighten cable ties to pull cables straight.

3. Install cables routed above accessible ceilings and in utility areas in cable hook assemblies, cable trays or in conduits. Cables shall be supported by one of these three methods along its entire path.

4. Cables supported by cable support hooks shall be supported at intervals of 5 feet or less along their entire length. Hooks shall have a minimum of 1 inch of surface for cables to rest on. Less will result in cables at bottom of bundles to be compressed and distort the geometry of the cable pairs.

T. Where ties are used to support from a hanging rod, wire or vertical support member, one tie shall be wrapped around the support and a second tie shall support the cable.

3.03 CABLE SYSTEM TESTING

A. **Perform the Following Tests for All Cables**:

1. For 100 percent of the pairs perform testing as described in EIA/TIA 568-C.1, Chapter 11, Field Testing of Structured Cabling. Record the results of the test with cable identification and provide as part of the as-built drawings. Any cable that fails shall be reterminated and retested. If the cable fails the additional testing the cable shall be replaced and retested. Tests shall be performed after permanent labeling has been installed on cables, jacks, and panels. The following minimum tests shall be performed:

a. Wire Map test.

b. Length measurement test.

c. Propagation Delay (PD).

d. Delay Skew (DS).

e. Insertion Loss (IL).

f. Return Loss (RL).

g. Near End Crosstalk (NEXT).

h. Attenuation-to-Crosstalk Ratio-Far-End (ACR-F).

i. Attenuation-to-Crosstalk Ratio-Near-End (ACR-N).

j. Power Sum Crosstalk.

3.04 FINAL INSPECTION

A. **The Contractor Shall Provide Competent Personnel Familiar with the Installation for a Final Inspection of the System with the Architect and Owner's Representative**:

1. The final checkout shall use the Specifications and drawings as checklist that all features and equipment have been provided as specified.

2. The Contractor's personnel shall be able to demonstrate all features of the system. Provide a minimum of 1 hour for the final checkout.

3. The cabling system shall be spot checked. The Contractor shall be prepared to test the selected cables to demonstrate the cables pass the tests and accurately match the submitted cable test results.

4. The outlets shall be spot checked. The Contractor shall be prepared to remove the cover plates and show how the jacks are terminated properly and any spare cable is not jammed back into the box exceeding the minimum bend radius of the cable.

B. The Contractor shall provide a copy of the complete cable test results at this time.

C. The final inspection shall be scheduled by the Architect and Owner's representative.

D. If discrepancies are found that cannot be corrected immediately and a second inspection is required the Contractor shall provide personnel as required until the system is accepted.

E. If painted, damaged or otherwise improperly installed cables are found or cables that do not pass the spot check tests the cables shall be replaced immediately and retested. The Architect and Owner's representative shall have final determination of cables require replacement.

3.05 AS-BUILT DOCUMENTS

A. **As-built Documents Shall Be Submitted for Material, and Communications Systems Configurations as Follows**:

1. The following information shall be submitted electronically in PDF format:

a. Project cover sheet.

b. Contractor's information including contact information for service and warranty calls.

c. Full material list of all equipment used.

d. Manufacturer's specification catalog sheets for each piece of equipment.

e. Test results of each individual jack and cable.

2. The following information shall be submitted on 1/8" scale drawings in PDF format:

a. Locations of all outlets with each jack labeling, including outlets located above finished ceilings.
b. "As-Built" details of each type of outlet including labels.

B. The project close out and final payments will not be made until all as-built documentation has been successfully submitted.

END OF SECTION