**PART 1 – GENERAL**

1. **SUMMARY**
2. Section includes products and execution requirements pertaining to Division 27 systems. Copper and fiber backbone and horizontal cabling along with support systems are covered under this document.
3. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities for all structured cabling products shall be provided as required to complete the horizontal cabling for all work stations as shown on floor plans.
4. The same manufacturer’s product shall be utilized throughout the entire project for all copper and fiber optic structured cabling.
5. Specification is based on a nCompass cabling system comprised of Legrand and Superior Essex products.
6. For approved equal see 1.3 for substitution request requirements. No substituted products shall be installed except with written approval by Owner.
7. Section includes product and design attributes that support Sustainability strategies and requirements such as Environmental Product Declarations (EPDs), Health Product Declarations (HPDs), Declare and Living Product Challenge labels that support red list free requirements. These documents support various credits, imperatives and features in the LEED, WELL and Living Building Challenge green building standards.
8. Manufactured in a third-party certified Zero Waste to Landfill Facility
9. Can contribute to LEED v4 and v4.1 EPD Option 1, EPD Option 2 and Material Ingredient Reporting Option 1 credits
10. Will offset 150% of their products carbon impacts
11. **TELECOMMUNICATIONS SYSTEM WORK**
12. General:
13. Furnish all labor, materials, tools, equipment and services for the installation in accordance with general provisions of specifications and the Contract Drawings.
14. Report percentage of work completed on a monthly basis.
15. Completely coordinate with work of all other trades.
16. Provide and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation, whether or not specifically indicated in the Contract Documents.
17. Provide and install all floor penetrations, floor sleeves, conduit raceways, wall penetrations, etc. not shown on the electrical plans but needed for the routing of cabling provided herein.
18. Provide and install all cords in the work area, telecommunication rooms and equipment room.
19. Provide labor for testing horizontal and backbone cabling.
20. Provide and install fire stopping.
21. Provide and install telecommunications bonding and grounding system.
22. Provide and install complete installation for Structured Telecommunications Cabling and Physical Support System including but not limited to
23. Category 6 UTP horizontal cables.
24. Category 6 modules and patch panels.
25. Category 6 cords
26. Category 6a UTP horizontal cables.
27. Category 6a modules and patch panels.
28. Category 6a cords
29. Work area telecommunication outlets of equal performance to the horizontal cable.
30. Wall mounted outlets of equal performance to the horizontal cable
31. Multimode optical fiber premise backbone cables.
32. Single-mode
33. Optical fiber enclosures.
34. Optical fiber connectors.
35. Optical fiber patch cords.
36. Equipment mounting racks and rack enclosures.
37. Wire management
38. Field testing.
39. Conduit floor sleeves, conduit and supports required for installation of all cabling.
40. Grounding and bonding system
41. Fire stopping.
42. Purchasing
43. Purchase all materials from an authorized Distributor
44. Provide complete price breakdown of material and handling fees.
45. All material required for completion shall be new for project
46. **SUBSTITUTIONS**
47. Prior to bid
48. Any structured cabling product substitutions, from another manufacturer, shall not qualify for nCompass Limited Lifetime Standard Warranty.
49. All substitution requests shall be submitted to Engineer 10 business day prior to bid date for Owner approval.
50. All specified part numbers shall be individually address and part numbers being requested as “equal” shall be stated.
51. All part numbers being requested as “equal” shall meet all “shall” stated requirements for that product.
52. Provide supporting “equal” documentation for each individual part number. The following shall be included but not limited too.
    1. Data sheets of each part number
    2. 3rd party test results with performance guarantees highlighted
    3. Sample of each part number being requested as “equal”
53. **SUBMITTALS**
54. With Bid
55. Contractor shall submit Legrand ConCert company certificate.
56. Training certificate of telecommunications contractor doing the work shall be submitted with bid.
57. Certificate and letter shall state that contractor is a CIP-Elite (formerly CIP-ESP) or CIP within the ConCert contractor program.
58. Prior to Start of Work
59. Submittals shall be submitted in one single package. Partial submittals will not be considered.
60. Material lists, schedule of values, lists of subcontractors, and proof of Contractor qualifications shall be provided to Owner/ Engineer
61. Performance bonds, payment bonds, and insurance certifications shall be submitted by the Contractor prior to execution of the contract.
62. Shop drawings shall be submitted to Owner/ Engineer. All communication system shop drawings shall include:
63. Manufacturer’s data (specifications, “cut sheets”).
64. Wiring diagrams for all installed cabling.
65. Equipment rack/cabinet layouts.
66. Proposed labeling schemes and labeling method.
67. List of cabling distances (typical and maximum) for all structured cabling
68. Copies of training certificates for all technicians and the project manager who will support this project.
69. A list of managers and technicians certified
70. Approved manufacturer classes satisfactorily completed.
71. Contractor shall submit a test plan with the submittal package that defines the tests required to ensure that the system meets technical, operational, and performance specifications. The test plan must also meet manufacturer’s certification requirements.
72. Work shall not proceed without the Owner/ Engineer approval of the submitted items.
73. Drawings & Inspection of Site:
74. Communications floor plan drawings are to scale and typically are not dimensioned. The Contractor shall not scale drawings for equipment placement and clearances. Dimensions given on drawings shall always take precedence over scaled drawings.
75. Any existing wires, utilities, or equipment shown on the drawings are shown for general information and to the best knowledge of the Owner/ Engineer. The Contractor shall field verify all existing wires, utilities, or equipment.
76. The Contractor shall field verify distances and equipment placements coordinating locations with other trades, construction managers, and General Contractor prior to installation.
77. If possible, the Contractor shall review all site conditions prior to submitting a bid on this project. Any obvious discrepancies between the site conditions and bidding documents shall be brought to the attention of the Owner/ Engineer at the time of bidding so clarification can be made by addendum.
78. Change order requests for additional costs related to the contractors misunderstanding related to the amount of work involved and lack of knowledge related to the site conditions will not be allowed.
79. Convene pre-installation meeting 2 weeks prior to start of installation of horizontal communications cabling. This meeting will review installation timeline and allow for coordination with additional contractors on site.
80. Test Reports: Submit copies of complete reports of all testing performed to the General Contractor, with copies to the Owner/ Engineer prior to job completion.
81. After project completion
82. Contractor must register project for the nCompass standard warranty within 30 days of project completion using the Legrand online system.
83. A copy of the warranty certificate shall be submitted to the Owner/Engineer.
84. **QUALITY ASSURANCE**
85. Installation Reference Standards (all codes and standards compliance will be to the most current revision available), including applicable addendums. Cable installation shall comply with the following:
86. NEC® 2020: National Electric Code®, 2020. Use the most current revision required by location.
87. ANSI/TIA-568.0: Generic Communications Cabling for Customer Premises.
88. ANSI/TIA -568.1: Commercial Building Telecommunications Infrastructure Standard.
89. ANSI/TIA-568.2: Balanced Twisted Pair Telecommunications Cabling and Components Standard.
90. ANSI/TIA-568.3: Optical Fiber Cabling Standard.
91. ANSI/TIA-569: Telecommunications Pathways and Spaces
92. ANSI/TIA-606: Administration Standard for Telecommunications infrastructure.
93. ANSI/TIA-607: Generic Telecommunications Bonding and Grounding (Earthing) for customer premises.
94. ANSI/TIA-758: Customer Owned Outside Plant Telecommunications Infrastructure Standard
95. ANSI/TIA-526-7: Optical Power Measurements of Installed Single Mode Fiber Cable
96. TIA-526-14: Optical Power Loss Measurements of Installed Multimode Fiber Cable
97. TIA-598: Optical Fiber Cable Color Coding.
98. BICSI-TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual
99. ISO/IEC 11801-1 Part 1: General Requirements.
100. ISO/IEC 11801-2, Part 2: Office Premises.
101. Horizontal Cabling System Performance
102. Shall be a Cat 6 or Cat 6a nCompass copper cabling system as defined on the applicable nCompass data sheet.
103. Shall be backed by a Limited Lifetime Warranty guaranteeing ANSI/TIA 568 compliance
104. Materials:
105. All materials shall be UL or ETL listed and verified and shall be marked as such.
106. Products shall be regularly catalogued items of the manufacturer and shall be supplied as a complete unit in accordance with the manufacturer's standard specifications with any optional items required for proper installation unless otherwise noted.
107. Material shall be delivered to the site in the original packing.
108. Approved Products
109. 4-pair TP Horizontal Cable: Superior Essex
110. Optical Fiber Cable: Superior Essex
111. RJ45 Outlets: Legrand (Ortronics)
112. Field-terminated Plugs Legrand (Ortronics)
113. Copper Patch Cords: Legrand (Ortronics)
114. Fiber Optic Cabinets: Legrand (Ortronics)
115. Fiber Optic connectors/splices/couplers: Legrand (Ortronics)
116. Rack and Cabinet: Legrand (Ortronics)
117. Patch Panel: Legrand (Ortronics)
118. Fiber Optic Patch Cords: Legrand (Ortronics)
119. Ladder Rack Legrand (Ortronics)
120. Cable Tray & J-Hooks Legrand (Cablofil)
121. Poke-Thru Devices Legrand (Wiremold)
122. Contractor Qualifications:
123. The Contractor shall have experience in the installation and testing of similar systems as specified herein and shall have completed at least two projects of similar size and scope within the last 24 months. The Contractor shall provide references upon request (including the project name, address, date of implementation, client name, title, telephone number, and project description.)
124. The Contractor bidding on communication systems specified herein shall be certified by Data Infrastructure (part of the Data, Power & Control Division of Legrand) at a CIP-Elite (formerly CIP-ESP) or CIP level. The awarded contractor must be able to install, service, and warranty the specified product prior to the time of bid and throughout the duration of the installation; or, the bidding Contractor shall utilize a sub-Contractor(s) certified by Ortronics (d.b.a. Data Infrastructure) to install, service, and warranty the specified product. The awarded contractor must be eligible to support the nCompass™ Limited Lifetime Warranty. Manufacturer certifications shall not be project specific and should be valid for any and all projects completed by Contractor.
125. The Contractor must meet all training requirements from Ortronics as a CIP-Elite (formerly CIP-ESP) or CIP contractor. The contractor must be in good standing with minimum 30% of the technicians on site and at least one manager current with the required training.
126. The contractor is responsible for workmanship and installation practices in accordance with Ortronics Certified Contractor Program for structured cabling installation.
127. The Contractor must maintain a state Contractor’s license as required by the state.
128. The Contractor installing the structured cabling should have a RCDD functioning as project supervisor. The Contractor’s RCDD/project supervisor shall complete at a minimum the following tasks.
129. Review and submit Contractor’s shop drawings.
130. Conduct weekly site visits to review the installation and progress of the structured cabling during the communications installation phase of the project.
131. Review and sign completed punch list items.
132. Review and submit Contractor’s as-built documentation.
133. The Contractor shall provide copies of certificates for proof of manufacturer’s training, manufacturer’s certified contractor company certification and name of authorized distributor in the shop drawing submittal and at the request of the Owner/ Engineer to verify compliance with specification prior to recommendations for awarding bid.
134. **MAINTENANCE**
135. All materials used on this project shall be new. Used and refurbished equipment is not permitted. Provide equipment to site in original packaging whenever practical.
136. The contractor is responsible for scheduling all deliveries and providing proper receipt, handling, and storage of all materials. Protect all equipment from physical damages (dents, scratches, dust, water, paint, chemicals, and temperature extremes) and vandalism, or theft. The Contractor shall replace any damaged or stolen equipment. The Contractor is responsible for all equipment until final project acceptance by Owner.
137. **WARRANTY**
138. nCompass Standard Limited Lifetime warranty will be required as described below for the following systems or system components.
139. nCompass Category 6 CMP/CMR Copper and Fiber Cabling, Fiber and Copper Connectivity Hardware, and Patch Cables shall be covered by a, nCompass Limited Lifetime warranty labor, and application assurance warranty. The application assurance portion shall provide coverage for the cabling system to support the applications that are designed for the specifications outlined in TIA/EIA 568. These applications include, but are not limited to 10BASE-T, 100BASE-T, 1000BASE-T, and 155 Mb/s ATM.
140. nCompass Category 6a CMP/CMR Copper and Fiber Cabling, Fiber and Copper Connectivity Hardware, and Patch Cables shall be covered by a, nCompass Limited Lifetime warranty labor, and application assurance warranty. The application assurance portion shall provide coverage for the cabling system to support the applications that are designed for the specifications outlined in TIA/EIA 568. These applications include, but are not limited to 10BASE-T, 100BASE-T, 1000BASE-T,10GBASE-T and 155 Mb/s ATM.
141. Telecommunication Contractor must submit the following to Legrand
142. Warranty Application properly completed online using the ConCert portal.
143. Test results submitted only in the field tester’s native, electronic format for both the copper and fiber optic systems. The test results must be submitted in original native tester format. (Note: Hard copies, WORD document formats, EXCEL spreadsheet formats and PDFs will not be accepted.)
144. All tests must result in a PASS. Pass\* (marginal pass) and Fail are not acceptable test results
145. Each permanent link or channel in the network must be field tested in accordance with the TIA-568 industry standard AND nCompass testing requirements in force at the time of purchase (nCompass testing requirements take precedence over TIA when differences exist). The installed permanent links and channels must have passed all applicable TIA and nCompass performance requirements.
146. Minimum testing for copper systems includes Wire Map, Length, Attenuation, Near End Crosstalk, Far End Crosstalk, Return Loss, PS NEXT, ELFEXT, and PS ELFEXT.
     1. Field terminated plugs shall be tested in a permanent link configuration with the appropriate test equipment for field terminated plugs.
147. Minimum testing for Fiber Optic links includes horizontal and backbone, Bi-Directional Dual Wavelength, Insertion Loss and Length.
148. Once the submitted materials are reviewed, the Telecommunications Contractor will be notified in writing of acceptance or rejection. If the project is accepted, the contractor will receive a copy of the signed warranty certificate for the Owner. If rejected, contractor must fix identified issues and resubmit using ConCert portal.
149. Telecommunication Contractor shall forward the signed warranty certificate to the Owner.

**PART 2 – PRODUCTS**

1. **OPEN CABLE TRAY, LADDER RACK AND SUPPORT SYSTEM**
2. Cable Tray System
3. Cable tray shall consist of continuous, rigid, welded steel wire mesh cable management system with continuous Safe-T-Edge T welded top side to protect cable insulation.
4. Cable tray composition Carbon Steel wire, ASTM A 510, Grade 1008.
5. Approved manufacture: Cablofil
6. J Hooks
7. Provide and install J Hooks to support cables where cable tray is not installed.
8. J Hooks installed shall have a 65 lbs. static load capacity.
9. J Hooks shall have rounded edge and provide proper bend radius support of copper and fiber cables.
10. J-Hooks shall have a metal cable retainer.
11. Provide necessary attachments brackets to install J Hooks. i.e. flanges, purlin, rod/wire, angle or straight as needed.
12. Finish: Pre Galvanized
13. Approved manufacture: Cablofil
    1. CJ12H (3/4”)
    2. CJ21H (1-5/16”)
    3. CJ32H (2”)
    4. CJ64H (4”)
14. Universal Style Tubular Runway (9-inch spacing)
15. Provide and install cable runway as per drawings for Telecommunications Rooms, either 12” or 18” as specified
16. Runway shall be black
17. Approved manufacture and part numbers: Legrand
18. URT10-12B (12 in. wide)
19. URT10-18B (18 in. wide)
20. Telco Style Tubular Runway (9-inch spacing)
21. Provide and install cable runway as per drawings for Telecommunications Rooms, either 12” or 18” wide as specified
22. Runway shall be black
23. Approved manufacture and part numbers: Legrand
24. TRT10-12B (12 in. wide)
25. TRT10-18B (18 in. wide)
26. Runway (universal or telco): Straight and Corner Clamps
27. Provide and install clamps as needed.
28. Color: Black
29. Approved manufacture and part numbers: Legrand
30. P820127H (straight clamp)
31. P820147H (corner clamp)
32. Runway (universal or telco): Wall Angle Assembly (when securing to wall)
33. Provide and install wall angle assemblies as needed to secure tubular runway to wall.
34. Install 12” or 18” wall angle assemblies as needed.
35. Color: Black
36. Manufacturer & Part Number: Legrand
37. P128240HB
38. P128440HB
39. Shelf Brackets for Heavy Duty Runway Support
40. Shelf brackets attach to the wall and extend out to 24” for heavy duty runway support.
41. Provide and install 12” or 18” brackets as needed.
42. Color: Black
43. Manufacturer & Part Number: Legrand
44. P139340HB
45. P139540HB
46. Rack to Runway Junction Plate for 2-post Racks
47. Provide and install rack to runway bracket on all racks installed to secure runway to standard 2-post racks.
48. Color: Black
49. Approved manufacture and part numbers: Legrand
    1. JP0606B
    2. JP0612B
    3. JP1218B
    4. JP1824B
50. Adjustable Runway Kit for 4-post Racks
51. Adjustable Runway Kit shall include two top angle brackets and two side brackets for parallel or perpendicular mounting
52. Brackets shall create a strong bond between the rack and the runway for solid overhead cable support
53. Adjustable Runway Kit shall be RoHS compliant
54. Adjustable Runway Kit shall be Buy American Act Compliant
55. Color: Black
56. Provide and install adjustable runway kit on all racks installed to secure runway to standard 4-post racks.
57. Approved manufacture and part numbers: Legrand
    1. RRJC-S
58. Transition Pans
59. Provide and install transition pans when cable leaves runway and into rack.
60. Color: Black
61. Approved manufacture and part numbers: Legrand
62. TRP11-CM (for 12 in. runway)
63. TRP17-CM (for 18 in. runway)
64. Protective Rubber End Caps
65. Use protective end caps to conceal sharp runway edges.
66. Color: Black
67. Approved manufacture and part numbers: Legrand
68. 2-E1-25C-A
69. End Closing kit
70. Used to close off section of runway.
71. Color: Black
72. Approved manufacture and part numbers: Legrand
    1. RECBK-12B (for 12 in. runway)
    2. RECBK-18B (for 18 in. runway)
73. **LOCAL AREA NETWORK CABLE**
74. If a given application requires product(s) outside of this section of the specification to be employed, the stndard warranty will apply as long as the chosen product(s) is(are) listed on the nCompass Standard Cabling System data sheet.
75. Category 6 Horizontal Cable
76. Cable shall be 100 Ohm, 23 AWG, 4 pair solid copper.
77. Cable shall be tested to 550 MHz by the manufacturer with guaranteed performance to 250 MHz.
78. Cable shall have footage and unique alpha numeric CableID printed on the jacket every 2 feet.
79. Cable shall have ColorTip circuit identification making individual pairs easily identifiable by color.
80. Cable shall be UL listed CMP or CMR as required by installation location.
81. Cable shall contribute toward 1 LEED point under the Material and Resources credit (MRc)
82. Cable shall support of sustainable design and installation through:
    1. Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) documented via third party
    2. Manufactured in a facility that is third party certified as Zero Waste to Landfill
    3. Red List Free Available in a LSHF jacket option for Riser Rated Cable. If available, ILFI Red List Free Products should be preferred. This could be confirmed via Declare Labels, Living Product Challenge Certification which should be preferred. Red List Free letters from a manufacturer could also be acceptable.
83. Approved manufacture and part numbers: Superior Essex 77 Series CAT6
84. Plenum Rated 77-240-xB (x=jacket color)
85. Riser Rated 77-240-xA (x=jacket color)
86. Category 6a Horizontal Cable
87. Cable shall be 100 Ohm, 23 AWG, 4 pair solid copper.
88. Unshielded cable design shall be of a non-continuous metallic foil
89. Cable shall be tested to 650 MHz by the manufacturer with guaranteed electrical performance out to 500MHz
90. Cable shall have footage and unique alpha numeric CableID printed on the jacket every 2 feet.
91. Cable shall have ColorTip circuit identification making individual pairs easily identifiable by color.
92. Cable shall be UL listed CMP or CMR as required by installation location.
93. Cable shall contribute toward 1 LEED point under the Material and Resources credit (MRc)
94. Cable shall support of sustainable design and installation through:
    1. Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) documented via third party
    2. Manufactured in a facility that is third party certified as Zero Waste to Landfill
    3. Red List Free Available in a LSHF jacket option for Riser Rated Cable. If available, ILFI Red List Free Products should be preferred. This could be confirmed via Declare Labels, Living Product Challenge Certification which should be preferred. Red List Free letters from a manufacturer could also be acceptable.
95. Approved manufacture and part numbers: Superior Essex 10Gain CAT 6A
96. Plenum Rated 6A-272-xB (x=color)
97. Riser Rated 6A-272-xA (x=color)
98. Multimode Optical Fiber Cable
99. UL listed OFNP or OFNR as required by installation location
100. Cable shall be reinforced with Aramid yarn, and contain no metallic elements.
101. Optical fiber cable shall have an attenuation value not to exceed 3.0 dB per kilometer at 850 nm and 1.5 dB per kilometer at 1300 nm. Minimum Bandwidth 1500 MHz per kilometer at 850 nm and 500 MHz per kilometer at 1300 nm.
102. Multimode optical fiber cable shall have an aqua jacket
103. Approved manufacture and part numbers: Superior Essex TeraFlex® 10G-300
104. 44012NG01 (OM3 Plenum Rated, 12 strand)
105. 43012NG01 (OM3 Riser Rated, 12 strand)
106. Single-mode Optical Fiber Cable
107. UL listed OFNP or OFNR as required by installation location
108. Cable shall be reinforced with Aramid yarn, and contain no metallic elements.
109. Optical fiber cable shall have an attenuation value not to exceed 0.70 dB per kilometer at 1310 nm and 1550 nm.
110. Single-mode optical fiber cable shall have a yellow jacket
111. Approved manufacture and part numbers: Superior Essex TeraFlex® G.657.A1 Single Mode
112. 44012K101 (OS2 Plenum Rated, 12 strand)
113. 43012K101 (OS2 Riser Rated, 12 strand)
114. **Copper Termination Hardware**
115. If a given application requires product(s) outside of this section of the specification to be employed, the standard warranty will apply as long as the chosen product(s) is(are) listed on the nCompass Standard Cabling System data sheet.
116. Category 6 Module
117. Provide and install 8 position – 8 conductor non-keyed Outlets per drawing
118. Module shall support both T568B & T568A wiring configurations
119. Same module shall be used in faceplate and patch panel
120. Module’s circuit traces shall be rated to 1.5 Amps current carrying capacity
121. Module’s contacts shall have 50 micro inches of gold plating
122. Module’s contacts shall be designed to minimize spark gap erosion
123. Module shall be rear-loading
124. Module shall use lacing cap/crimp termination method
125. Module shall be keystone footprint
126. Module shall allow color coding via icon designation for each port
127. Module shall work with faceplates, surface mount boxes and panels
128. Modules shall be available in at least ten standard colors
129. Modules shall be provided in colors and quantities needed.
130. Free termination tool shall be supplied with each carton (20 jacks)
131. Approved manufacture and part numbers: Legrand
132. KT2J6-yy (yy=color; sold in qty. of 20)
133. Category 6a Module
134. Provide and install 8 position – 8 conductor non-keyed Outlets per drawing
135. Module shall support both T568B & T568A wiring configurations
136. Same module shall be used in faceplate and patch panel
137. Module’s circuit traces shall be rated to 1.5 Amps current carrying capacity
138. Module’s contacts shall have 50 micro inches of gold plating
139. Module’s contacts shall be designed to minimize spark gap erosion
140. Module shall be rear-loading
141. Module shall use lacing cap/crimp termination method
142. Module shall be keystone footprint
143. Module shall allow color coding via icon designation for each port
144. Module shall work with faceplates, surface mount boxes and panels
145. Modules shall be available in at least ten standard colors
146. Modules shall be provided in colors and quantities needed
147. Free termination tool shall be supplied with each carton (20 jacks)
148. Approved manufacture and part numbers: Legrand
149. KT2J6A-yy (yy=color; sold in qty. of 20)
150. Field-terminated Plug
151. Field-terminated Plug shall be available with cat 6 and cat 6A performance.
152. Plug shall able to be terminated to either T568A or B wiring.
153. Plug shall support 22-26AWG solid conductors and 23-27AWG stranded conductors.
154. Plug shall have 50 micro inch plated contacts
155. Meets Category 6 channel performance and supports up to 1G or meets category 6A and supports up to 10G.
156. Plug shall have easy lace wiring sled to reduce wiring time.
157. Plug shall have easy to follow attached universal wiring label to be more user friendly.
158. Plug shall have an internal printed circuitry to control / eliminate noise from conductors thru plug.
159. Plug shall not require special termination tools.
160. Plug shall support up to 5 re-terminations.
161. Plug shall be RoHS compliant.
162. Plug shall be rated for 1.5+ amps: Will support higher power PoE (60-100watt) with margin.
163. Approved manufacture and part numbers: Legrand
     1. FTPUC65E-5pk (Cat 5e/6 pack of 5)
     2. FTPUC6A-5pk (Cat 6A pack of 5)
164. Faceplates
165. Faceplates shall be available with 1, 2, 3, 4, and 6 port options
166. Faceplates shall be available in fog white, cloud white, ivory and black
167. Faceplates shall have integrated label field
168. Approved manufacture and part numbers: Legrand
169. KSFPx-yy (Single Gang; x=# ports, yy=color)
170. Blanks
171. Blanks shall be provided and installed as needed
172. Blanks shall be available in fog white, cloud white and black
173. Approved manufacture and part numbers: Legrand
174. KSB10-yy (yy=color; 10 pack)
175. Surface Mount Boxes
176. Surface Mount Boxes shall be available in 1, 2, 4 or 6 port configurations
177. Surface Mount Boxes shall be available in fog white or cloud white
178. Surface Mount Box shall be UL 2043 / plenum rated for 1-port and 2-port configurations
179. Modules shall rear-load into surface mount box
180. Surface Mount Boxes shall mount with provided hardware or adhesive strip
181. Surface Mount Box shall include a label field
182. Modules shall be the same used for faceplates and panels
183. Approved manufacture and part numbers: Legrand
184. KSSMBx-yy (x = # ports, yy=color)
185. Patch Panels
186. Provide and install patch panels as needed
187. Panel shall be 24 port or 48 port as per drawings
188. Panel shall be unloaded
189. Panel shall be available as flat or angled
190. Modules shall rear-load
191. Modules shall flush-mount
192. Angled patch panels shall mount recessed at least 1.4 inches so that the point of the angle is flush with the rack rails
193. Panel shall use same jacks as faceplates and surface mount boxes
194. Modules shall be added as needed with blanks in unused ports
195. Approved manufacture and part numbers: Legrand
196. SPKFU24 (24 port flat panel, 1RU)
197. SPKFU48 (48 port flat panel, 2RU)
198. SPAKFU24 (24 port angled panel, 1RU)
199. SPAKFU48 (48 port angled panel, 2RU)
200. Horizontal Cable Management
201. Horizontal managers shall have fingers for cable management
202. Horizontal managers shall have four 1” x 2” or 1.5” x 2” cutouts
203. Horizontal managers shall have a depth of 7.25”
204. Horizontal managers shall be 1RU or 2RU as specified
205. Horizontal managers shall be available in black or white
206. Horizontal managers shall have a tool-less cover
207. Horizontal managers shall be provided as indicated on drawings
208. Approved manufacture and part numbers: Legrand
209. SHMC1RU (1 rack unit)
210. SHMC2RU (2 rack unit)
211. Copper Patch Cords
212. Cords must be available with category 6 and category 6a performance
213. Cords must have a slim line boot
214. Category 6 / 6a cords shall be compliant with TIA category 6 / 6a channel performance
215. Cords shall be provided to owner at end completion of project.
216. Cords shall be provided in required quantities, lengths and colors
217. Approved manufacture and part numbers: Legrand
218. 576-1xx-YYY (xx = color, YYY = length in feet, Cat 6)
219. 576-Axx-YYY (xx = color, YYY = length in feet, Cat 6A)
220. **Fiber Termination Hardware**
221. Optical Fiber Enclosures
222. Fiber enclosures shall provide standard density of 72 LCs per rack unit
223. Fiber enclosure shall have front doors, rear doors and removable top panels
224. Fiber enclosures shall have rear knockouts for horizontal cabling entrances
225. Fiber enclosures shall accept adapter panels, fiber cassettes, splice cassettes or splice trays
226. Fiber enclosures shall be available in 1U, 2U and 4U sizes
227. Fiber enclosures shall be provided and installed per drawings
228. Approved manufacture and part numbers: Legrand
229. EQ01U-CHC (1RU Enclosure)
230. EQ02U-CHC (2RU Enclosure)
231. EQ04U-CVC (4RU Enclosure)
232. Optical Fiber Adaptor Panels
233. Adapter panels shall be available with 8, 12 and 24 fiber LC options
234. Adapter panels shall be available for multimode and single-mode
235. Approved manufacture and part numbers: Legrand
236. OFP-LCxxxxx (multimode or single-mode LC adapter panel)
237. OFP-BLANK (blank)
238. Optical Cassettes
239. Cassettes shall be available in multimode (OM4) and single-mode (OS2) options
240. Cassettes shall be available in 12 and 24 fiber options
241. Cassettes shall support universal polarity
242. Multimode (OM4) Cassettes shall have a maximum 1.25dB insertion
243. Single-mode (OS2) Cassettes shall have a maximum 1.05dB insertion loss
244. Approved manufacture and part numbers: Legrand
245. LM2-LC series
246. Splice Cassettes
247. Cassettes shall be available in multimode (OM4) and single-mode (OS2) options
248. Cassettes shall be available in 12 and 24 fiber options
249. Cassettes shall support universal polarity
250. Multimode (OM4) Cassettes shall have a maximum 0.25dB insertion
251. Single-mode (OS2) Cassettes shall have a maximum 0.40dB insertion loss
252. Approved manufacture and part numbers: Legrand
     1. M2LCxxx-50E2A1S (multimode, single fiber splice)
     2. M2LCxxx-50E2A1R (multimode, ribbon fiber splice)
     3. M2LCxxx-091A1S (single-mode, single fiber splice)
     4. M2LCxxx-091A1R (single-mode, ribbon fiber splice)
253. Mechanical Splice Optical Fiber Connectors
254. Optical fiber connectors shall be pre-polished
255. Optical fiber connectors shall be available with OM3 and OS2 fiber options
256. Optical fiber connectors shall terminate on 900 um (micron) cable jacket
257. Optical fiber connectors shall use a mechanical splicing termination method
258. Optical fiber connectors shall not require epoxy or polishing
259. Optical fiber connectors shall not require special tools
260. Optical fiber connectors shall be reusable
261. Optical fiber connectors shall be covered under warranty for up to three terminations
262. Optical fiber connectors shall have a VFL window that provides immediate feedback on successful termination.
263. Optical fiber LC connectors shall be provided and installed as required
264. Approved manufacture and part numbers: Legrand
265. 205KNT9GA-50T (LC OM3 multimode mechanical splice connector, white boot)
266. 205KNT9SA-09 (LC OS2 single-mode mechanical splice connector, white boot)
267. Fusion Splice-On Optical Fiber Connectors
268. Optical fiber connectors shall be pre-polished
269. Optical fiber connectors shall be available with OM3, OM4 and OS2 fiber options
270. Optical fiber connectors shall terminate on 900 um (micron) cable jacket
271. Optical fiber connectors shall use a fusion splicing termination method
272. Optical fiber connectors shall not require epoxy or polishing
273. Optical fiber LC connectors shall be provided and installed as required
274. Approved manufacture and part numbers: Legrand
275. 205KNF9GA-50T (LC OM3 multimode fusion splice-on connector, aqua boot)
276. 205KNF9GA-50E (LC OM4 multimode fusion splice-on connector, magenta boot)
277. 205KNF9SA-09 (LC OS2 single-mode fusion splice-on connector, white boot)
278. Optical Fiber Patch cords
279. Cords shall be TIA channel compliant
280. All cords shall be made in the USA
281. Multimode cords shall have 0.5dB insertion loss / 26 dB return loss or less
282. Single-mode cords shall have 0.3dB insertion loss / 55 dB return loss or less
283. Cords shall be provided to owner at end completion of project.
284. Cords shall be LC to LC required quantities and lengths
285. Cords shall be available as A-A or A-B polarity
286. Approved manufacture and part numbers: Legrand
287. L1 series
288. **Racks, Cable Management, Shelves**
289. 2-Post Rack
290. Rack shall have standard EIA universal mounting hole pattern
291. Rack shall be equipped with standard 1/2” junctioning holes for securing multiple-racks
292. Rack shall be constructed of 6061-T6 structural grade aluminum
293. 2-post rack shall feature 3” x 1-1/4” channel uprights
294. Rack shall meet EIA-310 standards
295. Rack shall be listed to the UL 2416 standard
296. Rack shall have 750 lbs. static capacity
297. Racks shall be assembled for 19” equipment and be 7' tall
298. Racks shall be black
299. Racks shall be provided as indicated on drawings for rack mounted connecting hardware and Owner furnished equipment
300. Approved manufacture and part numbers: Legrand
301. 19-84-T2SD
302. 4-Post Racks for Servers, Monitors, and Keyboards
303. 4-post rack shall have adjustable mounting rails
304. 4-post racks shall have depth adjustments in 1/2” increments
305. 4-post rack shall have rails tapped with #12-24 mounting holes
306. 4-post rack shall have standard EIA universal mounting hole pattern
307. 4-post rack shall have 1/2” junctioning holes for securing multiple-rack lineups
308. 4-post rack shall be constructed of 6061-T6 structural grade aluminum
309. 4-post rack shall meet EIA-310 standards
310. 4-post rack shall be listed to UL 2416 standard
311. 4-post rack shall have 1,000 lbs. static capacity
312. 4-post rack shall be black
313. Approved manufacture and part numbers: Legrand
314. 19-84-T4SDA1520B (45RU, 84” height, 15”-20” depth, black)
315. 19-84-T4SDA2132B (45RU, 84” height, 21”-32” depth, black)
316. Vertical Cable Management
317. Vertical Cable Manager shall have a wire frame construction with individual rack unit fingers for routing cords
318. Vertical Cable Manager shall have a dual hinged, slam latch door
319. Vertical Cable Manager shall include four cable management spools for slack fiber jumper storage
320. Vertical Cable Manager shall include twelve bend limiting clips to protect fiber entering or exiting the vertical manager
321. Vertical Cable Manager shall include all mounting hardware, including clips to hold in place for easy one-person installation
322. Vertical Cable Managers shall be provided as indicated on drawings
323. Vertical Cable Manager shall be available in 6.5” and 10.5’ widths
324. Vertical Cable Manager shall be available in Black
325. Approved manufacture and part numbers: Legrand
326. QVMS706 (single-sided, 7ft.,6” wide)
327. QVMD706 (double-sided, 7ft.,6” wide)
328. QVMS710 (single-sided, 7ft., 10” wide)
329. QVMD710 (double-sided, 7ft., 10” wide)
330. 60400687 (Vertical Management Bracket Adapter Kit)
331. WALL CABINETS
332. Swing out wall cabinets (SWM) must be available in 12RU, 18RU, and 26RU of usable space. The SWM must also be available with a solid, plexiglass, or a perforated front door.
333. Swing out wall cabinets must also have 12-24 threaded holes and a minimum load rating of 200#.
334. Vertical wall mount cabinets must be available in 4RU and 8RU. Load rating of a minimum of 150#
335. Vertical wall mount cabinets must include (2) two fixed rails and have optional a pivoting rail kit. A Zero RU patch panel mounting kit must also be available.
336. A Lever Lock panel must also be available to install small devices and non-rack mountable equipment.
337. The hinge on the door must be reversible and lockable.
338. An optional PDU mounting kit must be available.
339. Minimum warranty for any wall cabinet must be a minimum of 5 years
340. Approved manufacture and part numbers: Legrand
     1. VWMFD-4RU-36-B (36” height, 12” depth, 4RU fixed rail, full door)
     2. VWMFD-8RU-36-B (36” height, 18” depth, 8RU fixed rail, full door)
     3. VWMFD-4RU-42-B (42” height, 12” depth, 4RU fixed rail, split door)
     4. VWMFD-8RU-42-B (42” height, 18” depth, 8RU fixed rail, split door)
     5. SWM12RUXX-26-26 (25” height/12RU, XX=door type)
     6. SWM18RUXX-26-26 (35.5” height/18RU, XX = door type)
     7. SWM26RUXX-26-26 (49.5” height/26RU, XX = door type)
341. General Purpose Solid Equipment Shelf
342. Shelf shall have 2-point mounting
343. Shelf shall hold up to 75 lbs.
344. Shelf shall be solid
345. Shelf shall be 5.25”H x 17.25”W x 10.13”D
346. Shelf shall be RoHS compliant
347. Shelf shall be provided as indicated on drawings
348. Shelf shall be black
349. Approved manufacture and part numbers: Legrand
350. 60400404
351. Standards Vented Equipment Self
352. Shelf shall have 2-point mounting
353. Shelf shall hold up to 50 lbs.
354. Shelf shall have vented tray
355. Shelf shall be 4”H x 17.5”W x 16”D
356. Shelf shall be RoHS compliant
357. Shelf shall be provided as indicated on Drawings
358. Shelf shall be black
359. Approved manufacture and part numbers: Legrand
360. 604045401.
361. Four Point Equipment Shelf
362. Shelf shall use 4-point mounting to support equipment
363. Shelf shall hold up to 100 lbs.
364. Shelf shall have a fixed front flange with an infinitely adjustable rear flange
365. Shelf shall have a slotted tray
366. Shelf shall be 1.75”H x 19”W x 20”D
367. Shelf shall be RoHS compliant
368. Shelf shall be provided as indicated on drawings
369. Shelf shall be black
370. Approved manufacture and part numbers: Legrand
371. 604045681
372. Keyboard/Monitor Shelf:
373. Keyboard/monitor shelf shall accept full size keyboard
374. Keyboard/monitor shelf shall have folding tray
375. Keyboard/monitor shelf shall come equipped for installation of mouse pad tray
376. Keyboard/monitor shelf shall have mounting hardware included
377. Keyboard/monitor shelf shall be 7”H x 19”W x 15.5”D
378. Keyboard/monitor shelf shall be provided as indicated on Drawings
379. Keyboard/monitor shelf shall be Black
380. Approved manufacture and part numbers: Legrand
381. 60400550
382. Equipment Bracing Accessories
383. Bracing accessories shall have hook and loop type straps
384. Bracing accessories shall be RoHS compliant
385. Bracing accessories shall be Black
386. Server and/or monitor bracing kit shall be provided as indicated on Drawings
387. Approved manufacture and part numbers: Legrand
388. 60400523 (Server kit)
389. 70700126 (Monitor kit)
390. **Bonding and Grounding**
391. PBB (Primary Bonding Busbar)
392. PBB shall be ¼” thick electrolytic 110 alloy copper bar
393. PBB shall be 12”W x 4”H
394. PBB shall have 12 5/16” hole sets and 6 7/16” hole sets
395. PBB shall include 1-1/2” insulators and 1” off-set stainless steel mounting brackets
396. PBB shall include ½ oz. tube of antioxidant joint compound
397. PBB shall meet ANSI/TIA 607 standards
398. (1) PBB shall be provided and installed in the Main Telecommunication Room.
399. PBB shall be bonded to electrical ground
400. Approved manufacture and part numbers: Legrand
401. GB4X12TMGB
402. SBB (Secondary Bonding Busbar)
403. SBB shall be ¼” thick electrolytic 110 alloy copper bar
404. SBB shall be 10”W x 2”H
405. SBB shall have 4 5/16” hole sets and 3 7/16” hole sets
406. SBB shall include 1-1/2” insulators and 1” off-set stainless steel mounting brackets
407. SBB shall include ½ oz. tube of antioxidant joint compound
408. SBB shall meet ANSI/TIA 607 standards
409. Provide and install (1) SBB in all Telecommunication Rooms (TR) other than the main TR
410. Bond to grounding system
411. Approved manufacture and part numbers: Legrand
412. GB2X10TGB
413. Rack Bonding Busbar Kit
414. RBB shall be 1” x 19.25”
415. RBB shall be 1-1/4” thick electrolytic 110 copper alloy bar
416. RBB Kit shall have 3” bar splice plate with 2 slotted holes, (2) white delrin insulators, (2) #12-24 x 5/8” hex washer head screws, (2) #12-24 x ¾” copper flashed brass screws, (2) #2 copper flat washers, (8) #6-32 x ¼” copper flashed brass screws and (8) #6 ring terminals
417. Provide and install (1) rack bonding busbar at top of all (2 post and 4 post) equipment racks provided and installed on project.
418. RBB shall be bonded to the PBB or an SBB
419. Approved manufacture and part numbers: Legrand
420. GBH19KIT
421. Compression Lugs and Taps
422. Provide and install as needed to bond telecommunications infrastructure equipment to PBB or SBB as required
423. Approved manufacture and part numbers: Legrand
424. As Required
425. **Firestopping**
426. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped.
427. All smoke walls must be fire stopped using a 1-hour F rated UL system.
428. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the state where the work is to be performed. A drawing showing the proposed fire stop system, shall be provided to the Owner’s Technical Representative prior to installing the fire stop system(s).
429. All areas that have the fire stop compromised due to MAC work (Moves, Adds and Changes) must be restored to the original rating of the firewall (or floor). It is preferred that the products used in the original UL System are used to restore it. If the UL system will no longer restore that penetration to the original rating, the new system used must be approved by the end user or their owner’s representative.
430. Provide UL systems for the installed UL systems to the end user for proof of proper firestop installation. An example of a proper UL system for a no-maintenance system using the Hilti Speed Sleeve in a gypsum dry wall application for a 2 Hour F rating would be: W-L-3334. This is just an example of the UL systems available for to provide guidance in properly firestopping within the facility.
431. Provide a firestop rated cable management device whenever cables penetrate fire rated walls that will require frequent cable additions and changes. The fire rated device shall contain integrated intumescent firestop materials.

**PART 3 – EXECUTION**

1. **INSTALLATION: GENERAL**
2. Open Cable Support Installation
3. Contractor shall furnish and install all supports for cables specified in this section.
4. Ensure complete raceway system is installed prior to cable installation. At no time shall cables be left unsupported
5. Cable supports shall be spaced randomly, but no further than 5'-0" apart.
6. Provide all additional cable management products, sleeves or conduit raceways as required to protect exposed cabling and complete the installation of cables in a neat manner.
7. All floor penetrations shall be at columns, exterior walls or in equipment rooms.
8. Cables shall be supported at height of bottom flange of structural beams using a rigid support method (i.e. threaded rod, beam clamps, etc.).
9. Do not support cables from ductwork, sprinkler piping, water piping, waste piping, conduit, ceiling wire, or other system supports.
10. Provide independent support system for each low voltage cabling system.
11. Cable Installation
12. All communications cabling that has become abandoned as part of new renovation projects, previous renovation projects, or temporary communication cables used during the construction process shall be completely removed. Abandoned communication cables that may have future use can remain in place if labeled clear at both end and at regular intervals of the cable run. (Refer to NEC Article 800.52 for more information regarding the removal of abandoned communication cables).
13. All cables shall be bundled using plenum rated ties, loosely tied so as not to deform cable, 5'-0" on center (at mid-span).
14. All cabling shall be installed in accordance with manufacturers’ written bend radius and pulling tensions. General industry guidelines recommend the following bend radius and pulling tensions:
15. Tensile loading on a single 4-pair copper UTP cable shall not exceed 25 lbs.
16. Bend radius of a single 4-pair copper unshielded twisted pair cable shall not exceed 4 times the diameter of the cable.
17. Bend radius of multi-pair copper unshielded twisted pair and optical fiber cable shall not exceed 10 times the diameter of the cable.
18. All conduits and conduit sleeves shall have bushings or grommets shall be installed prior to the installation of communications cables to avoid damage and abrasions to cable sheathing and insulation. If bushings have been installed by the electrical Contractor, the communications cabling contract shall furnish and install bushings prior to pulling communications cabling.
19. Horizontal cable length for 4-pair copper UTP cables shall not exceed 295 feet. Prior to bidding and installation, the contactor shall review the drawings and verify no cable run exceeds 295 feet and notify the communications designer of cable runs that may exceed 295 feet.
20. Splices are not permitted in any cable unless other specified or show on drawings.
21. Avoid placing copper cables near sources of extreme heat (i.e. boilers, radiators, heat coils).
22. Maintain cable twists for all UTP cables. For terminations cable sheathing shall be stripping back no more than ½” back from termination point for all Category 6 cables.
23. All cables shall be supported by cable tray, J-hooks, or cable runway. When cables leave trays or runways, cables shall be supported by drop-outs or cable support hardware manufactured specifically for the purpose of supporting cables. J-hooks shall be installed a minimum of every 5 feet and cabling shall maintain minimal deflection and strain (less than 12” deflection). Cables shall not be supported from ceiling grid wires.
24. Cables shall not run above iron joists.
25. All cables shall be separated and bundled into like groups by cable sheathing colors.
26. Service loops shall be provided at both ends of installed horizontal and backbone cabling. A 12” service loop shall be installed in the ceiling space near workstation outlets (excessive cable shall not be coiled in outlet boxes). A 10’ service loop shall be provided in communication rooms and shall be installed to allow for future equipment rack/cabinet relocations without the need to re-terminate patch panels; the 10’ service loop shall be neatly routed on cable runway in telecommunication room.
27. Cabling entering equipment rooms shall be neatly installed on cable runway and secured with hook and loop fasteners as need. All cables running vertically on cable runway or in racks shall be secured to provide support. Cables shall always be installed vertically/horizontally or at right angles to structure.
28. Hook and loop fasteners are recommended to secure permanently installed horizontal and backbone cabling; all cable fastening methods installed in plenum ceiling spaces shall be rated for use in plenum spaces. Hook and loop fasteners shall never be secured too tight whereby potentially changing the cable integrity.
29. Separation: Maintain the following distances between cables, other system cables and other building systems:
30. One (1) foot from fluorescent lights.
31. Four (4) feet from motors and transformers
32. Three (3) feet from hot water piping or other mechanical equipment.
33. One (1) foot from electrical conduits, other systems cables or other electrical equipment.
34. All low voltage cables shall be run parallel or at right angles to building structural framework. Do not run cables diagonally across ceiling space without written authorization by the Architect’s Electrical Engineer.
35. Fire seal around all cables running through rated floors and walls. UL Systems should be contained in the submittal and available for review by building inspection.
36. H- straps included with rack shall be utilized in telecommunications rooms for all cable bundling.
37. Plastic/ nylon tie wraps shall be prohibited at any time.
38. Leave spare pull string with every outlet installed.
39. All cabling that has been shipped or stored in an environment consistent with the manufacturer’s guidelines.
    1. Cabling that has come in contact with chemicals must be discarded. Premise cabling that has been exposed to water must be discarded.
    2. Cabling stored outside of the recommended temperatures must be allowed to return to proper temperature prior to installation.
40. All cables installed in underground conduit, conduit under slab on grade, or direct buried must be rated by the manufacturer for wet locations.
41. Paint over spray, or other liquids used in the construction process, on telecommunications cables will be cause to void the ability to provide nCompass Standard Limited Lifetime Warranty as required.
42. Coordinate with general contractors, painters and other trades so all are clear that NO cables shall have paint over spray or other chemicals on them.
43. Protect installed cables at all times.
44. **INSTALLATION: COMMUNICATIONS INFRASTRUCTURE**
45. Category 6 Horizontal Cables:
46. Maximum cable lengths to be 295 feet (90 m) including service loop. Provide all necessary installation materials, tools and equipment to perform insulation displacement type terminations at all communications outlets, patch panels and 110 punch-down blocks.
47. Support and secure cables at patch panels using rear cable management bracket supplied with panel.
48. Install stuffer caps on each workstation outlet and patch panel port after cable has been terminated on 110 IDC.
49. Optical Fiber Cable:
50. All optical fiber installations shall be installed using open cabling methods. Limit cable-bending radius to 20 times the cable diameter during installation, and 10 times the diameter after installation, or per manufacturer’s guidelines, whichever is larger. Provide all required tools, materials, consumables, and equipment necessary for cleaning and field termination of optical fiber connectors. Label each end of each cable as to source and destination. Terminate optical fibers in consistent, consecutive manner at each end. Label Optical Fiber raceway cable with yellow "Caution Optical Fiber Cable" tags every 10 feet. Leave 10 feet of slack at each fiber termination point. Neatly coil slack optical fiber cable on top of rack above optical fiber patch and splice enclosure at each rack location.
51. During installation of optical fiber cable do not allow pulling tension to exceed cable manufacturer’s specification for the cable being installed. Only the strength member of the cable shall be subjected to the pulling tension.
52. All optical fiber connector tips shall be cleaned with proper cleaning tools specifically designed for optical fiber prior to inserting them into adaptor panels.
53. Racks and Enclosures:
54. Freestanding equipment racks and enclosures shall be protected free of all dust, debris and other environmental elements during construction until substantial completion walk-through.
55. Secure all racks and enclosures to floor using ½” hardware.
56. **INSTALLATION OF WIRELESS LAN SYSTEM**
57. Wireless Access Point Cabling
58. Install 20’ cable coil to allow for final placement of access point.
59. Terminate cable with Cat 6 module and surface mount box
60. Label for identification
61. **LABELING**
62. General:
63. All labels shall be permanent, machine generated labels produced by a labeling machine.
64. Labeling information will be reviewed at Pre-Install Meeting, and the Owner shall approve the labeling scheme prior to the installation of any cabling.
65. Surfaces shall be cleaned before attaching labels. All labels shall be attached firmly and vertically plumb on equipment, faceplates, patch panels termination blocks, etc.
66. All labeling of cables, equipment, and components shall be included in as-built documentation, floor plan drawings, and schematic deigns.
67. Cabling
68. All structured cables (horizontal and backbone) shall be labeled at both ends within 6” of cable termination point. Where voice backbone cables extend behind termination blocks, cable labels shall be placed at a location on the cable where the labels are visible from the front of the termination blocks.
69. Labels shall have an adhesive backing and shall wrap completely around the circumference of the cable jacket. Label and lettering sizes shall be of appropriate size in regards to cable diameter.
70. Labeling of Telecommunications Room, Equipment Racks, Termination Hardware, and Faceplates
71. Telecommunications Room shall be labeled clearly on the inside to identity what number it is.
72. Label will be three (3) characters ex “TR2”
73. First two (2) characters shall be TR for telecommunications room
74. Third character shall be a number for what TR it is.
75. Three (3) labels shall be place
76. On first visible rack entering TR. 1” tape shall be used.
77. On the PBB or SBB. ½” tape shall be used
78. On door inside of TR. ½” tape shall be used.
79. Equipment racks and cabinets are NOT required to be labeled.
80. Fiber Enclosures shall be labeled with ½” tape on the front of the enclosure.
81. Label will be one (1) character
82. Character will be an alpha character i.e. “A”
83. Place two (2) labels on the front of each fiber enclosure.
84. One on the left and one on the right. Both centered vertically.
85. Copper Patch Panels shall be labeled with ½” tape on the front of the panel.
86. Label will be one (1) character
87. Character will be an alpha character i.e. “A”
88. Place two (2) labels on the front of each patch panel.
89. One on the left and one on the right. Both centered vertically.
90. Faceplates: Work Station Outlets shall be labeled with 3/8” tape on the front of the faceplate.
91. Label for each module will be four (4) character i.e. 2B14
92. First character will be a number that represents the TR that the cable goes to i.e. “2”
93. Second character will be a letter that represents what patch panel the cable is terminated on i.e. “B”
94. The last two characters will be numbers representing the patch panel port the cable is terminated on. i.e. “14”
95. All modules in a faceplate shall be labeled with their own unique ID.
96. Voice Termination 110 Blocks shall be labeled similar to patch panels. Voice backbone cable pairs shall be labeled starting with V001 starting at the main communications room and continuing sequentially through all communications rooms.
97. **Field Testing and Cable Certification**
98. The following criteria must be met before certification testing can begin.
    1. In new construction, the above ceiling work of all trades shall be 90% complete.
    2. Work within the TR must be substantially complete. Only troubleshooting of cabling should occur in proximity of cables that have been tested
    3. Terminations must be complete and in their final positions. Dust caps must be installed on both ends of the termination and faceplates in place
99. Each permanent link or channel in the network must be field tested in accordance with the TIA-568 series industry standard AND nCompass testing requirements in force at the time of purchase (nCompass testing requirements take precedence over TIA when differences exist). The installed permanent links and channels must have passed all applicable TIA and nCompass performance requirements. Minimum testing for copper systems includes Wire Map, Length, Attenuation, Near End Crosstalk, Far End Crosstalk, Return Loss, PS NEXT, ELFEXT, and PS ELFEXT. Minimum testing for Fiber Optic links includes horizontal and backbone, Bi-Directional, Dual Wavelength, Insertion Loss and Length.
100. Field terminated plugs shall be tested in a permanent link configuration with the appropriate test equipment for field terminated plugs.
101. Permanent Link Testing shall be completed on all horizontal (station) cables as a minimum requirement.
102. If certifying using Channel Testing, patch cords used for the channel test must remain in the channel. They cannot be moved to another channel.
103. Submit test reports to the General Contractor prior to active equipment installation.
104. Category 6/6a Cable Testing:
105. All wiring shall be certified to meet or exceed the specifications as set forth in TIA/EIA-568C for Category 6/6a requirements for permanent link or channel.
106. Shall be tested with a level V accuracy tester (DSX-5000)
107. Tester shall be factory calibrated within the last 12 months at time of use.
108. Field Testing shall include the following parameters for each pair of each cable installed:
109. Store number and name
110. Test equipment manufacturer and model number
111. Cable I.D. The test sheets will be in numerical order by cable ID
112. Date of test
113. Wire map (pin to pin connectivity and polarity check) i.e. near 12345678, far 12345678
114. Length (in feet)
115. Insertion Loss
116. Near End Crosstalk (NEXT)
117. Power Sum Near End Crosstalk (PSNEXT)
118. Equal-Level Far End Crosstalk (ELFEXT)
119. Power Sum Equal-Level Far End Crosstalk (PSELFEXT)
120. Return Loss
121. Delay Skew
122. Attenuation to Crosstalk ratio (ACR)
123. DC Resistance per 100M/328 feet
124. Impedance
125. Capacitance
126. Record test results for each cable and turn over to the General Contractor two weeks prior to occupancy. Correct malfunctions when detected, and re-test to demonstrate compliance.
127. Optical Fiber Testing:
128. Pre-installation Testing:
129. Test each strand of every optical fiber cable on the reel with a light source and a power meter. Obtain the cable manufacturer power meter test results for each real used on the project. Prior to completion of project, turn over the completed optical fiber test form, optical fiber cable reel ID tags and optical fiber cable manufacturer’s test results.
130. Acceptance Testing:
131. After terminating optical fiber cables the system shall be tested using Tier 1 test format. Tier 1 testing is mandatory. Tier 2 testing, (OTDR testing), is optional.
132. Multimode optical fiber attenuation shall be tested on all individual fibers of each cable segment with an nCompass approved field certification tester.
133. Encircled Flux Compliant as required by TIA-526-14-B. Source shall be EF compliant. Matched test reference cords per TIA TSB-4979.
134. 1 Jumper reference method shall be used.
135. Verification of test reference cords are required and shall be stored automatically as part of test data.
136. 850/1300 nm wave lengths shall be tested on all fibers.
137. Bi-directionally
138. Test Results: Must be completed and turned over to the General Contractor prior to active equipment installation. Specific due dates for optical fiber will be established at pre-install meeting.
139. The Warranty Submittal must be completed online within 30 days of installation completion. Copies of all certification test reports must be submitted as part of the Warranty Submittal. Test results must be kept on file by the registrant to be resubmitted when requested by Supplier. Data must be saved and submitted in raw data and summary formats (in tester’s original format). The test data shall be submitted via online upload to contractor website. If online upload is unsuccessful, the data can be submitted via e-mail or disc.
140. **Cleanup**
141. The communications Contractor shall clean up all debris related communications cabling installation on a regular basis. Protect all equipment from damage during construction. Equipment not protected shall be replaced at the Contractor’s expense.
142. Only gentle cleaning products should be used and all cleaners shall be approved for use for the given product. NO liquid cleaners shall come in contact with premise cables.
143. If the communications contractor is not physically performing the clean, they are responsible for providing oversight to ensure integrity of the warranty.

**END OF SECTION**