



**Division 27 Master Specification for
Information Transport Systems and Spaces**

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SECTION 27 10 01 STRUCTURED CABLING GENERAL REQUIREMENTS

1.1 SCOPE:

This document describes general products and execution requirements relating to furnishing and installing Telecommunications Infrastructure consisting of communication rooms, spaces, power, pathways and cabling for Oregon State University. Backbone and horizontal cabling comprised of Copper and Fiber Optic, and support systems are covered under this document. All installations are warranted and shall be pre-registered with Ortronics/Superior Essex before work begins as does Corning Fiber systems.

The Horizontal (workstation) Cabling System shall consist of a minimum of (2) Category 6, 4-pair Unshielded Twisted Pair (UTP) Copper Cables to each work area outlet within office locations unless otherwise noted for specific locations. Category 3 cable will be required for conference room phones, classroom wall and emergency phones in addition to life safety connectivity (elevators, fire alarm, auto dialers). Category 6A will be required for all wireless access point horizontal cabling and research lab spaces. The cables shall be installed from the Work Area Outlet to the appropriate Telecommunications Room (TR) and routed to the appropriate rack or backboard serving that area and terminated as specified in this document.

All cables and related pathways, supports, terminations, and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Telecommunications contractor as detailed in this document and required by contract conditions.

Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, communication room details, equipment racks, cable routing and outlet types will be provided as project specific information by bid specification and/or bid drawings. The contractor shall meet or exceed all requirements for any infrastructure system as detailed within this document. This document shall be referenced within a projects specific scope of work.

1.2 APPROVED CONTRACTOR:

The Telecommunications contractor submitting a response regarding an Oregon State University Voice/Data Infrastructure solicitation must be an approved Ortronics Certified Installer Plus (CIP) **and** a certified Corning Cabling Systems NPI Installer. Solicitation responses from a single contractor not certified by Ortronics and Corning Fiber Systems as (CIP/NPI) will not be accepted. Solicitation responses will only be accepted from firms certified by Corning Cable Systems and Ortronics. The Telecommunications contractor is responsible for workmanship and installation practices in accordance with the Ortronics CIP Program and as the Corning Cabling Systems Program dictates.

It is the intent of Oregon State University's Campus Infrastructure Standard to ensure that a contractor is both an Ortronics CIP and a Corning NPI installer. Contractors must possess an Ortronics CIP and a Corning NPI certification within the state of Oregon to qualify for solicitation responses at the time an RFP is due for submission.

1.3 SUBMITTALS:

Submit appropriate cut sheets and samples for all products, hardware and cabling as detailed in project specifications and drawings.

Work shall not proceed without OSU Information Services written approval of the submitted items.

1.4 REFERENCES

- A. All work shall be performed in accordance with the following Codes and industry Standards, unless noted otherwise:
 - 1. NFPA 70 – National Electrical Code, current version adopted by local or State AHJ.
 - 2. ANSI/TIA/EIA 568-C – Commercial Building Telecommunications Cabling Standard, current version.
 - 3. ANSI/TIA/EIA 569-C – Commercial Building Standard for Telecommunications Pathways and Spaces, current version.
 - 4. ANSI/TIA/EIA 606-B – Administration Standard for Commercial Telecommunications Infrastructure, current version.
 - 5. ANSI/TIA/EIA 607-B – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, current version.
 - 6. IEEE 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings, pertaining to communication systems.

1.5 WARRANTY

- A. Ortronics/Superior Essex nCompass Limited Life Time warranty for horizontal subsystem.
 - 1. nCompass Category 6+ Cabling, 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 ANSI/TIA/EIA 568-C.0-2. These applications include, but are not limited to 10BASE-T, 100BASE-T, 1000BASE-T and 155 Mb/s ATM.
 - 2. Corning 25-year NPI Warranty for fiber optic riser and outside plant backbone subsystems.

1.6 SUMMARY

This Section includes general requirements specifically applicable to Division 27.

- A. The Contractor shall be responsible for:
 - 1. Providing material and labor for a complete turnkey infrastructure system. Including but not limited to: All permits, power, racks, pathway, cabling, fire safing, grounding, patch panels, testing, labeling, warranty and close out documentation.
- B. Intent of Drawings:

1. Communications plan drawings show only general locations of equipment, devices, raceways, cable trays, boxes, etc. All dimensioned locations and elevations are approximate. The contractor is responsible for the field coordination of communications work with the other trades prior to beginning work.
2. The contractor shall be responsible for the proper placement and routing of equipment, cable, raceways, cable tray, and related components; according to the Contract Documents and subject to prior review by contractor.
3. Refer all conflicts between Contract Documents to owner for resolution.

1.7 SYSTEM DESCRIPTION

- A. The owner will implement a comprehensive integrated communications distribution system, as described in paragraph B below, to provide wiring infrastructure which may be used to support one or more of the following services and systems:
 1. Telephony and Data telecommunications.
 2. Wireless systems.
 3. Facilities management systems.
 4. Audio/Video telecommunications
- B. The communications distribution system consists of the following major subsystems, as specified elsewhere:
 1. Interbuilding Backbone: The interbuilding subsystem refers to all twisted-pair and fiber optic backbone communications cabling connecting the Main Building Entrance Facility room (EF) to each building Main Distribution Frame room (MDF) in all buildings on the campus. Note: typically outside plant cables.
 2. Intra-building Backbone: The intra-building subsystem refers to all twisted-pair and fiber optic backbone communications cabling connecting the Main Distribution Frame room (MDF) to each Intermediate Distribution Frame Room (IDF) in the buildings.
 3. Telecommunication Rooms (TR): Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF).
 4. Horizontal Distribution: The horizontal distribution subsystem refers to all intra-building twisted-pair and fiber optic communications cabling connecting telecommunication rooms (IDF's) to telecommunication outlets (TOs) located at individual work areas.
 5. Work Area Distribution Subsystem: Patch cords, adapters, and devices located between the TO and station equipment.
- C. The communications distribution system is based on a combination of the following communications transmission technologies as defined by specific project specifications:
 1. 100-ohm 4-pair unshielded twisted-pair cable. (Cat 3, Cat 6, Cat 6a)

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2. 100-ohm multi-pair unshielded twisted-pair cable. (Cat 3). Note: nCompass warranty does not apply to 100- ohm multi-pair cables.
 3. 850 nm Laser Optimized 50/125-micron multimode fiber optic cable.
 4. 8.3/125-micron singlemode fiber optic cable.
 5. 8-position telecommunications jacks.
 6. 8-position telecommunications patch panels
 7. Insulation displacement connector (IDC) type field terminated wiring blocks
 8. Factory Terminated copper patch cords
 9. Rack mount fiber optic hardware
 10. Wall mounted fiber optic hardware
 11. Fiber optic connectors.
 12. Factory terminated fiber optic patch cords
- D. The work locations and limits of work are shown on the drawings.

1.8 DESIGN/ENGINEERING REQUIREMENTS

- A. BICSI RCDD Certification is required for anyone performing infrastructure design, specifications and/or drawings for solicitation and construction. All drawings issued for construction shall have valid RCDD stamp.
- B. Wireless RF Design:
1. Wireless Access Point (WAP) design, access point (AP) quantities and locations will be provided exclusively by Oregon State University IT Infrastructure/Network Operations Center (NOC) utilizing manufacturer RF design software with project drawings.
- C. Compliance by the contractor with the provisions of this specification does not relieve contractor of the responsibilities of furnishing materials and equipment of proper design, mechanically and electrically suited to meet operating guarantees at the specified service conditions.
- D. Communication room design:
1. **Minimum** communication room size for EF room shall be no less than 12'x16'.
 2. **Minimum** communication room size for MDF room shall be no less than 12' x 16' up to 624 horizontal data ports. Exceeding 624 data ports requires a larger room and additional equipment racks.
 3. **Minimum** communication room size for an IDF room shall be no less than 12' x 14' up to 624 horizontal data ports. Exceeding 624 data ports requires a larger room and additional equipment racks.
 4. All pathways, conduits, cable trays, slots and sleeves shall have no less than 50% future fill capacity when project is completed. This shall include all changes/adds to the project.
 5. All pathways, conduits, cable trays, slots and sleeves shall not have other cabling (fire alarm, Audio Visual, security etc.) routed within them.

6. Each equipment rack dedicated to network equipment shall have (2) 120V L5-20 electrical outlets installed on rear of rack, within the rear vertical wire manger, 13” off finished floor.
7. **It is the intent of this specification to ensure/protect security of our communication rooms, sensitive student information, transmission compatibilities (EMI) and preservation of space for future technologies. Low voltage systems such as Fire Alarm panels, Controlled Access/Security systems, Audio Visual, Video, Point of Sale systems and Electrical panels shall not be incorporated into communication room space, racks, cabinets or walls.**
 - A. *OSU Information Services recommends that a dedicated secure room be designated to incorporate Fire alarm, security access, Video DVR’s, HVAC controls, Audio Visual, etc. This space will have its own pathway system, sleeves, backboards and equipment rack.*
8. Audio Visual systems may require additional facilitation. Consult OSU Information Services Academic Technologies / Classroom Technology Services for specific space requirements and resources.
9. **When designing outside plant (underground) pathways a 6” concrete cap shall be specified above conduit for protection, dyed Orange. In addition, a warning/trace tape shall be specified 12” above concrete cap.**
10. Outside plant conduits shall be a minimum of 4” diameter PVC schedule 40, with a minimum of three (3) servicing a building. Conduits shall have a trace/locate wire installed and secured/labeled within each vault/handhole.

1.9 PROJECT RECORD DOCUMENTS

- A. Provide detailed project record documentation within 30 days of substantial completion of the work.
 1. Maintain separate sets of red-lined record drawings for the communications work which show the exact placement and identification of as-built system components.
 2. Provide communication pathway record drawings which indicate exact placement and routing for all components, e.g., maintenance holes, handholes, conduit, wireway, cable tray, pull boxes, enclosures, telecommunications outlet boxes, etc.
 3. Provide communication room record drawings which indicate exact placement for all components; e.g., conduit, wireway, cable tray, backboards, equipment cabinets, equipment racks, cross-connect equipment, etc.
 4. Provide communication wiring and cabling record “As-Builds” drawings and schedules which indicate exact placement, routing, and connection details for all components, e.g.,

twisted-pair and fiber optic cables, splices, cable cross-connect termination locations, enclosures, telecommunications outlets, cross-connect jumpers, patch cords, etc.

5. Provide network schematics when appropriate.

1.10 APPROVALS AND SUBSTITUTIONS

- A. Substitutions are not authorized without written approval from owners authorized representative through addendum.

PART 2 SECTION 27 11 00 COMMUNICATIONS EQUIPMENT ROOM FITTINGS

2.1 SUMMARY

- A. Telecommunications spaces will be referred as Building Entrance Facility (EF), Main Distribution Frame (MDF), Intermediate Distribution Frame (IDF), Data Center (DC).

2.2 TELECOMMUNICATIONS BACKBOARDS

- A. Wall mounted termination block fields shall be mounted on A/C 4' x 8' x .75" void free plywood. The plywood shall be mounted vertically 12" above the finished floor. The plywood shall be painted with a minimum two coats of white fire retardant paint on all (6) sides. Mounting hardware shall also be painted white for cosmetic purposes.

2.3 EQUIPMENT AND WIRING RACKS

- A. All racks and wire management shall be Ortronics as specified in project specifications and drawings. The equipment/wiring racks shall provide vertical and horizontal cable management on front and rear of each rack. Waterfall cable management shall be provided at the top of the rack for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. Racks and Vertical managers shall be white in color.

Approved manufacturers are Ortronics Mighty MM20 Channel Rack, 16.25"D channel, 7'H, 45 RU, tapped #12-24. Ortronics P/N: OR-MM20716-W

- B. Racks shall be securely attached to concrete floor using minimum 3/8" hardware or as required by local codes. Earthquake restrictions, requirements, and zoning codes shall be strictly followed.
- C. **Maintain a minimum of 36-inch clearance from the walls to the front/rear of each rack's vertical managers. When mounting equipment/cabling on vertical walls the equipment mounting depth will need consideration for maintaining 36" clearances for all front/rear of racks.**

- D. Each dedicated equipment rack shall have (2) Power distribution units (PDU) installed. Tripp-lite p/n: RS-1215-20T.
- E. All racks shall be grounded to the telecommunications ground bus bar in accordance with Section 2.9 of this document.

2.4 VERTICAL WIRE MANAGERS FOR EQUIPMENT AND WIRING RACKS

- A. Each equipment rack shall have (4) vertical wire managers installed. Two located on the front of rack, two located on the rear. Ortronics P/N: OR-MM20VMS710-W
 - 1. MM20 Vertical Manager with Cover, 10"W x 13.62"D for 7' MM20 racks.

2.5 HORIZONTAL WIRE MANAGERS FOR EQUIPMENT AND WIRING RACKS

- A. At the top and bottom, front of each equipment rack, install the following horizontal wire manager. Ortronics P/N OR-60400098

2.6 WIRE BASKET CABLE TRAY WITHIN COMMUNICATION ROOMS (EF/MDF/IDF)

- A. 12 or 24 inches wide depending on specific project details and the amount of horizontal data ports served by the communication room, 4 inches deep, black and of steel construction.
 - 1. Cablofil P/N 105/300BL OR P/N 105/600BL
- B. Black basket cable tray shall be required in all communication rooms and shall not have a liner. Cable tray installed outside communication rooms will have a color determined by A/E to match building paint schemes and tray liners will be required.
- C. All trays will be grounded per local Electric Code requirements and ANSI/TIA/EIA-607.
- D. All trays shall be cut using the Cablofil tray cutter: COUPFIL or CUTYFIL. All cut cable tray will be filed to remove burrs and painted to match color. All cutting, filing, and painting will be done outside of building.

2.7 GROUNDING AND BONDING

- A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and

building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607 Telecommunications Bonding and Grounding Standard.

- B. The main entrance facility/equipment room in each building shall be equipped with a telecommunications main grounding bus bar (TMGB). Each telecommunications room shall be provided with a telecommunications ground bus bar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached.
- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. Entering or residing in the TR or ER shall be grounded to the respective TGB or TMGB using a minimum #6 AWG green stranded copper bonding conductor and compression connectors.
- D. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and busbars shall be identified and labeled in accordance with the System Documentation Section of this specification.
- E. Busbar shall be solid copper, 12.0 inches long x 4.0 inches wide, wall-mounted, with stand-offs.

2.8 FIRESTOPPING

- A. All Penetrations through fire-rated building structures (walls and floors) shall be sealed with an approved fire stop system approved by the local fire code. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire-rated structure). Any penetration item, i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped.

PART 3 SECTION 27 13 00 COMMUNICATIONS BACKBONE CABLING.

3.1 RISER CABLE

- A. Voice riser cable shall be category 3, 24 AWG. OSU Information Services shall approve pair count to be installed.

- B. Data riser cable shall Corning singlemode fiber, 24-strands, Interlocking Armor, plenum or riser rated (NEC CODE), and terminated utilizing manufacturer pre polished duplex LC pigtail assembly. OSU Information Services shall approve pair count to be installed.

3.2 CAMPUS BACKBONE CABLE

- A. UTP cable shall be category 3, Pic-Filled, Black jacketed cable with overall sheath. PE-89.
- B. Fiber Cable shall be Corning Altos. 24 strands, OS2 rated, singlemode fiber, non-conductive and be of loose tube construction.
- C. Fusion splice all cables requiring splicing as detailed in project specifications and drawings. Mechanical splices are not acceptable anywhere within the physical system.
- E. Cable Jacket shall have a permanently attached label that identifies OSU cable number, strand/pair count and destination at every termination and/or splice as the cable enters and/or leaves a splice enclosure, vault, hand hole, building, building floor, and patch panels. The tag shall be engraved with black lettering on yellow background for fiber, white lettering with black background for UTP.
 - 1. Example: SM16,1-36 TUNNEL ENTRANCE "D"
 - 2. Example: SM04, 1-12 Plageman Hall 11-01-2018.

3.3 COPPER CABLE PROTECTION UNITS:

- A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #6 AWG green copper bonding conductor to the TMGB.

3.4 TERMINATION BLOCKS

- A. 110-Style Blocks: Ortronics OR-30200007
- B. Wiring troughs: Ortronics OR-806003194

3.5 FIBER OPTIC TERMINATION HARDWARE

- A. Fiber Optic Termination Hardware

1. Corning Fiber Optic Patch Panel Assembly Corning P/N: CCH-04U.
2. Corning Cassette 24 port, shuttered duplex LC. Corning P/N: CCHCS24A9P00RE.

3.6 BACKBONE CABLE INSTALLATION

- A. Backbone cables shall be installed separately from horizontal distribution cables.
- B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- C. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits.
- D. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
- E. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.

PART 4 SECTION 27 15 00 COMMUNICATIONS HORIZONTAL CABLING

4.1 SUMMARY

- A. Horizontal cabling may consist of a combination of the following types of cable from the MDF/IDF to the Telecommunications Outlet:
 1. Category 3: Analog voice locations. (Conference room phones, building alarms, elevator alarms, fire alarms, irrigation controllers.)
 2. Category 6: Data locations.
 3. Category 6A, Research lab spaces, wireless access points.

4.2 HORIZONTAL CABLING

- B. Category 6: Superior Essex DataGAIN, colored Green, Plenum or riser per NEC and local fire codes. Voice locations for analog equipment shall have cable color grey.
 1. Note Athletics buildings and spaces require color Orange cable and jacks.
- C. Category 6A: Superior Essex, colored Purple, plenum or riser rated per NEC and local fire codes.
 1. Note Athletics buildings and spaces require color Black cable and jacks.

4.3 MODULAR JACKS

- A. Work area outlet jack
 - 1. Ortronics category 6, voice, 8 POS, Fog White T568B. Ortronics P/N OR-6373003.
 - 2. Ortronics category 6, data, 8 POS, Green T568B. Ortronics P/N OR-TJ600-25.
 - 1. Athletics use Orange colored jack.
 - 3. Ortronics category 6A, 8 POS, Purple, T568B. Ortronics P/N OR-TJ6A-27.
 - 1. Athletics use Black jack.

4.4 WORK AREA OUTLETS

- A. Flush mounted faceplates
 - 1. Work Area Outlet: Six port TracJack faceplate, constructed from high impact thermo-plastic, with recessed label fields, mounts within a single gang wall box.
 - 1. Ortronics OR-40300545, fog white.
 - 2. Wall Phone: One port TracJack faceplate with mounting lugs for wall phone, constructed from stainless steel, mounts within a single gang wall box, RJ45.
 - 1. Ortronics OR-403STJ1WP.
- B. Dust covers
 - 1. Single port dust cover for modular openings, color to match faceplate.
 - 1. Ortronics OR-42100002, fog white.

4.5 110 VOICE TERMINATION BLOCKS

- A. Wiring Troughs
 - 1. Horizontal trough for routing of patch cords and cross-connect wire, with mounting legs.
 - 1. Ortronics P/N OR-30200140.
- B. 110 block labels (Cat 3)
 - 1. Clear plastic holder for 110 blocks with paper inserts, for blocks with legs
 - 1. Ortronics P/N OR-70400646.
 - 2. Ortronics P/N OR-70400680.

4.6 DATA PATCH PANELS AND PATCH CORDS

- A. Category 6 & 6A modular patch panels:

- a. Category 6, 48-port, Angled, 8P8C modular jack panel, high density, 6 port modules, colored black, IDC terminals, T568A/B wiring scheme. Ortronics P/N: OR-PHA66U48.
- b. Category 6A, **Wireless Access Points only**, 48-port, angled, for, 8P8C modular jack panel, high density, 6 port modules, colored white, IDC terminals, T568A/B wiring scheme. Ortronics P/N: OR-OR-PSAHJU48-W.
 - 1) Category 6A purple data jacks are required for this patch panel, 8 Pos., T568B. Ortronics P/N: OR-HDJ6A-27

B. Patch Cords

- a. Patch cords shall be included and installed by the contractor for 100% of the horizontal data ports including wireless access points. This includes work area outlet and patch panel to switch connectivity.
- b. Ortronics Category 6, green, horizontal work area outlets.
 - 1) Athletics use Orange patch cords.
- c. Ortronics Category 6A, purple, wireless access points and research lab space.
 - 1) Athletics use Black patch cords.
- d. Patch cord lengths for TO location: 10'.
- e. Patch cord length for EF/MDF/IDF patch panels/network hardware are specific to proper routing as defined by OSU Information Services. Drawing showing proper routing of patch cords is available upon request.

4.7 EXECUTION: WORK AREA OUTLETS

- A. Data jacks, unless otherwise noted in drawings, shall be located in the right side position(s) of each faceplate.
- C. Voice jacks shall occupy the left position(s) on the faceplate.

4.8 EXECUTION: HORIZONTAL DISTRIBUTION CABLE INSTALLATION:

- A. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
- B. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48-inch) intervals.
- F. Cables shall be identified by a self-adhesive machine label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606. Labels shall be installed 6" from each terminated end.

4.9 TESTING PROCEDURES

- A. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA-568-C. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

- A. All cables shall be tested in accordance with this document, the ANSI/TIA standards, the Ortronics procedures and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.
- B. Cables, jacks, connecting blocks, and patch panels shall be in their final position with the building energized.
- C. All Unshielded Balanced Twisted Pair cables shall be tested as follows:
 - 1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using an approved Ortronics certification tester (TSB 67) for category 6 and 6A compliance as specified in ANSI/TIA-568-C.

ALL TEST RESULTS WILL PROVIDE FOR 5dB OF HEADROOM (NEXT) AS PER THE nCOMPASS 6+ SOLUTION GUARANTEE.

- 2. A software copy of the test results, in the original tester software format, shall be provided to the Owner and Ortronics.
- 3. Contractor shall provide a fully functional version of the tester software for use by the Owner in reviewing the test results.
- 4. Any failed test results that cannot be remedied through re-termination (as in the case of reversed or split pairs), must be reported in writing to the Owner immediately, along with a copy of the test results.

4.10 TESTING AND ACCEPTANCE

- A. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-C.1, C.2. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

- B. All cables shall be tested in accordance with this document, the ANSI-TIA/EIA standards, the Ortronics, Superior Essex and Corning Certification Program Information Manuals and best Industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the owners authorized representative for clarification and resolution.
- C. Horizontal and riser fiber optic cabling attenuation shall be measured **bi-directionally** at both 1310 nanometer (nm) and 1550 nm operating windows using an light source and power meter.
- D. Campus Backbone single mode fiber cabling shall be tested with OTDR at both 1310 nm and 1550 nm bi-directionally.

4.11 SYSTEM DOCUMENTATION

- A. Per project contract documents.

4.12 TEST RESULTS:

- A. Submit completed test results with close out documentation on CD-ROM. Hard copy printed results are also required to be submitted via 3 ring binder(s), tabbed by BEF/MDF/IDF. Binder shall be labeled with Oregon State University Project name and project number. This applies to all Horizontal copper and all fiber optic test results.

4.13 IDENTIFICATION AND LABELING:

- A. OSP copper labels shall be engraved plastic with white letters on black background.
- B. OSP Singlemode fiber optic labels shall be engraved plastic with black letters on yellow background.
- C. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device. Specific labeling information shall be project specific and the information will be given to the contractor by OSU Network Services.
- D. All horizontal cables are to be labeled using a machine printed label at each end of the cable approximately 6 inches of the termination point. Handwritten labels shall not be used.
- E. Telecommunication Outlet labeling shall be labeled with the MDF/IDF room #, name of the network, and port #.
- F. All inside building cabling, termination, hardware, protection units, patch panels, and work area outlets shall comply with ANSI/TIA/EIA 606 labeling standard color codes.

- G. Labeling scheme information and format to be provided by OSU Network Services.
 - 1. Note all labeling information on the as-built drawings.

4.14 FINAL ACCEPTANCE & SYSTEM CERTIFICATION:

- A. Completion of the installation, in-progress inspections, receipt of the test and as-built documentation, and successful performance of the cabling system will constitute completion of the system. Upon successful completion of the installation and subsequent inspection, Oregon State University shall be provided with a numbered certificate, from Ortronics or Superior Essex and/or Corning if applicable, registering the installation.

4.15 DOCUMENT REVISIONS

- a. Removed 208V power receptacles from MDF rack.
- b. Added 6" Concrete cap and trace/warning tape OSP conduits.
- c. Added minimum OSP conduit size and quantities per building.
- d. Added trace wire for OSP conduits.
- e. Updated use of Orange and black cable, jacks, patch cords for Athletics.