SECTION 27 13 00

COMMUNICATIONS BACKBONE CABLING

PART 1 – GENERAL

1.1 PURPOSE

A. This guideline is intended to provide useful information to the Professional Service Provider (PSP) to establish a basis of design. PSP is to apply the principles of this section such that the University of Texas at Arlington (UTA) may achieve a level of quality and consistency in the design and construction of their facilities. Deviations from these guidelines must be approved by UTA and may require justification through Life Cycle Cost (LCC) analysis and submitted to UTA for approval.

1.2 **LESSONS LEARNED AND DESIGN CONSIDERATIONS**

A. Telecommunications Contractor shall review and adhere to all of University of Texas at Arlington Standards of Installation for Network Cabling.

1.3 SUMMARY/OVERVIEW

A. This section includes the backbone cabling portion of a structured cabling system (SCS) including:
   1. Optical fiber
   2. Copper and coaxial backbone cabling
   3. Splicing
   4. Termination and patch cables

B. Provide all backbone cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in Communications rooms.

C. Related Sections
   1. Section 27 00 00 – Communications
   2. Section 27 05 26 – Grounding and Bonding for Communications Systems
   3. Section 27 05 28 – Pathways for Communications Systems
   4. Section 27 05 43 – Underground Ducts and Raceways for Communications Systems
   5. Section 27 11 00 – Communications Equipment Room Fittings
   6. Section 27 15 00 – Communications Horizontal Cabling

1.4 REFERENCES

A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

C. Conflicts
   1. Refer to Section 27 00 00.

D. Codes and Standards:
   1. ANSI/TIA-568-B, Commercial Building Telecommunications Wiring Standards.
   2. ANSI/TIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces.
   3. ANSI/TIA/EIA-606-A Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
   4. ANSI/TIA-758, Customer-Owned Outside Plant Telecommunications Cabling Standard.
   5. Underwriters Laboratories (UL) Cable Certification and Follow Up Program.
   6. National Electrical Manufacturers Association (NEMA).
   7. American Society for Testing Materials (ASTM); current edition.
   8. National Electrical Code (NEC); current edition.
   9. National Electrical Safety Code (NESC); current edition.
   10. Institute of Electrical and Electronic Engineers (IEEE).
   11. UL Testing Bulletin.
   12. Building Industry Consulting Services International (BICSI).

13. Telecommunications Distribution Methods Manual (TDMM).
14. Customer Owned Outside Plant Design Manual (CO-OSP).
15. Local, county, state and federal regulations and codes in effect as of date of purchase.
16. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.5 SUBMITTALS

A. Refer to Section 27 00 00.
B. Cable Pulling Plan: The contractor shall submit a cable pulling plan, as follows:
   1. Indicate the installed backbone conduit layout in schematic format, including junction boxes and distances between junction boxes.
   2. Indicate contents of each conduit.
   3. Indicate the cable pulling calculations, conduit fill ratios and actual cable runs and tensions.
   4. Include detail and schedule showing the construction sequence of communications rooms.
   5. Installation of cabling shall not commence prior to approval of the pulling plan and calculations by the engineer.
C. Splice Plan: The contractor shall submit shop drawings indicating the intended cable splice points, mounting method and equipment list.
D. Cable Testing Plan: The contractor shall provide a test plan for media testing as described in the article “Field Quality Control” prior to beginning cable testing. The following minimal items shall be submitted for review:
E. Cable Testing Reports: The contractor shall submit cable test reports as follows
F. Submit certified test reports of contractor-performed tests in accordance with the “Field Quality Control” article of this document.

1.6 QUALITY ASSURANCE

A. Refer to Section 27 00 00.
B. Cable splicing personnel shall have a minimum of five years splicing experience and shall have completed a minimum of five major splicing projects.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Refer to section 270000
B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)
C. The fiber optic cable shall be shipped on reels:
   1. The cable shall be wound on the reel so that unwinding can be done without kinking the cable.
   2. Two meters of cable at both ends of the cable shall be accessible for testing. All optical fiber shall be tested on the reel for continuity and distance compliance before installation.
   3. Marking: Each reel shall have a permanent label attached showing length, cable identification number, cable size, cable type, attenuation, bandwidth, and date of manufacture. Labels shall be water resistant and the writing on the labels shall be indelible.

1.8 PROJECT/SITE CONDITIONS

A. Refer to Section 27 00 00.

1.9 WARRANTY

A. Refer to Section 27 00 00.

1.10 MAINTENANCE AND SUPPORT

A. Refer to Section 27 00 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Horizontal Outside Plant Cable –Duct-rated:
   1. CommScope
   2. Berktek
   3. Owner approved alternate.
B. Horizontal Outside Plant Cable – Wet conditions-rated:

1. Superior Essex
2. Corning
3. Owner approved alternate.

C. Horizontal Outside Plant Cable - Armored:
1. CommScope
2. Berktek
3. Superior Essex
4. Owner approved alternate.

D. Copper Backbone Cable (plenum rated):
1. Superior Essex
2. Mohawk
3. General Cable
4. Owner approved alternate.

E. Fiber Backbone Cable (plenum rated, must be in innerduct):
1. CommScope
2. Corning
3. Superior Essex
4. Berktek
5. Owner approved alternate.

F. Fiber Riser Cable Plenum-Rated, Armored:
1. CommScope
2. Corning
3. Superior Essex
4. Berktek
5. Owner approved alternate.

G. Fiber Termination Cabinet (Rack-Mountable):
1. Leviton
2. Owner approved alternate.

H. Building Entrance Terminals –110in/110out – complete with 5 pin fast acting solid state protection modules for all terminated cable pairs.
1. Circa
2. Portasystems
3. Emerson

I. Labeling:
1. Refer to section 27 00 00.

J. Firestopping:
1. Refer to section 27 00 00.

2.2 BACKBONE CABLING

A. Optical Fiber General Requirements
1. Optical Fiber shall be certified to meet all parts of ANSI/ TIA-455 and comply with TIA/EIA-492, ANSI/ICEA S-83-596 and ANSI/ICEA S-83-640 and the NEC.
2. Fibers shall have D-LUX coating or approved equivalent to ensure color retention, minimize micro bending losses and improve handling. The coating shall be mechanically strippable.
3. Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked OFNP (optical fiber non-conductive plenum) in accordance with the NEC.
   a. Plenum Fiber rated cable consisting of multiple fibers shall have a Plenum PVC outer jacket. Each group of fibers shall have a color-coded Low Smoke PVC buffer. The buffered fibers are organized in subunits of fibers, reinforced with aramid yarn for extra strength and surrounded with a color-coded low smoke tube.
   b. Within the premises, all optical fiber shall be placed in plenum rated innerduct the entire length of the cable for protection. Use manufacturer plenum rated couplings for all connections.
4. Riser cable shall meet UL 1666 and be marked OFNR (optical fiber nonconductive riser) in accordance with the NEC. Non-plenum, riser rated cable consisting of multiple fibers, shall have an orange, Polyvinyl Chloride (PVC) outer jacket.
5. Outside Plant Optical Fiber:
   a. Stranded loose tube dielectric fiber optic cable shall be utilized for underground conduit, direct

buried, or aerial applications.
   b. Underground cable, including cable installed in conduits or duct banks, shall contain an additional moisture barrier in the form of a flooding compound.
   c. Outside plant optical fiber strength members shall be all dielectric without any metallic elements.
6. Optical fibers conductors shall follow standard color code schemes. Fiber numbers and binders shall correspond to the color codes as follows:
   a. Fiber/Binder No. 1 – blue
   b. Fiber/Binder No. 2 – orange
   c. Fiber/Binder No. 3 – green
   d. Fiber/Binder No. 4 – brown
   e. Fiber/Binder No. 5 – slate
   f. Fiber/Binder No. 6 – white
   g. Fiber/Binder No. 7 – red
   h. Fiber/Binder No. 8 – black
   i. Fiber/Binder No. 9 – yellow
   j. Fiber/Binder No. 10 – violet
   k. Fiber/Binder No. 11 – rose
   l. Fiber/Binder No. 12 – aqua
7. Cable Minimum Bending Radius:
   a. During Installation: 20 times cable diameter
   b. After Installation: 10 times cable diameter
8. Operating temperature range: -76°F to 185°F (-60°C to 85°C)
9. All optical fiber cables shall be installed in innerduct.

B. Multi-mode Optical Fiber
1. Fibers shall have dual wavelength capability; transmitting at 850 and 1300 nm ranges.
2. 50 µm ± 2.5 µm core
3. Core non-circularity: = 5%
4. 125 µm ± 1 µm cladding diameter
5. Cladding non-circularity: =1%
6. Colored fiber diameter: 254 µm ± 7 µm
7. Buffering diameter: 890 mm ± 50 mm
8. Minimum tensile strength: 100,000 psi
9. Maximum Attenuation: multimode 3.5 dB/km at 850 nm and 1.0 dB/km at 1300 nm (inside premises) and single mode 1.0 dB/km at 1310 and 1550 nm (inside premises) and 0.5 dB/km at 1310 and 1550 nm (outside plant).
10. Minimum Bandwidth: 2000 MHz per km with laser launch at850 nm ensured by differential mode delay at 850 nm" in TIA/EIA-492AAAC and 500 MHz at 1300 nm.
11. Additional component and transmission requirements for a 50/125 µm optical fiber cable capable of supporting 10 Gb/s serial transmission up to 300 m (984 ft) using 850 nm nominal wavelength lasers. These cables are suitable for use in accordance with ANSI/TIA/EIA-568-B.1.

C. Single Mode Optical Fiber
1. Fibers shall have dual wavelength capability, transmitting at 1310 and 1550 nm ranges.
2. 8.3 µm core
3. 125 µm ± 1 µm cladding diameter
4. Cladding non-circularity: =1%
5. Core/cladding concentricity error: = .5 µm
6. Colored fiber diameter: 254 µm ± 7 µm
7. Maximum Attenuation: .40 dB/km at 1310 nm and .30 dB/km at 1550 nm
8. Minimum Bandwidth: 20 GHz
9. The mechanical and environmental specifications for outside plant optical fiber cable shall be in accordance with ANSI/ICEA S-87-640. Outside plant optical fiber cables shall be of a water-block construction and meet the requirements for compound flow and water penetration as established by ANSI/ICEA S-87-640. Outdoor cable shall have a minimum pull strength of 2670 N (600 lbf).

D. Copper Cable Requirements
1. 100-ohm balanced twisted-pair.
2. Plenum-rated cabling: Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked CMP (communications multipurpose plenum) in accordance with the NEC. Plenum cable shall

consist of #24-AWG solid copper conductors insulated with color-coded FEP
3. Non-plenum riser-rated cabling shall meet UL 1666 and be marked CMR (communications multipurpose riser) in accordance with the NEC. And shall consist of 24 AWG copper conductors insulated with color-coded PVC copper cables.
4. ASP-filled multi-pair copper cables shall be utilized for underground conduit or direct buried applications. All outside plant (OSP) cable shall be transitioned to inside cable within 50 feet of building entry. The metallic portion of the cables, if present, must be bonded to the building ground upon entry.
5. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.

E. Coaxial Cable Requirements
1. All Backbone cable must be plenum-rated .500 hard line or RG-11
2. Shielded, with a copper clad aluminum center conductor; expandable polyethylene dielectric; continuous aluminum outer conductor, and a flame retardant jacket.
3. Tested and marked to comply with the NEC requirements for (CATVR) riser rating.

2.3 TERMINATION AND SPLICING FOR BACKBONE CABLE

A. Optical Fiber
1. Interconnect Units and Distribution Shelves.
a. Modular in design and used in fiber optic interconnection, cross-connection, and splicing applications.
b. 19-inch rack-mountable
c. Accept 12-strand, 24-strand, 48-strand or 72-strand terminations
d. Owner approved industry standard connector.
2. Splicing and closures: The fiber splice module shall be utilized for all outside plant terminations. The link shall consist of the fiber cable, the splice, the splice tray holder/closure, the fiber panel/coupler, a pre-manufactured fiber pigtail with pre-polished fiber connector, and a fiber jumper to connect the pigtail-coupled link to the appropriate electronic switch. The fiber splice module shall meet the following specifications:
a. Fusion: Optical fiber splices shall not exceed a maximum optical attenuation of 0.3 dB when measured in accordance with ANSI/EIA/TIA-455-34, Method A (factory testing) or ANSI/EIA/TIA-455-59 (field testing). Optical fiber splices shall have a minimum return loss of 20 dB for multimode, 26 dB for single mode, when measured in accordance with ANSI/EIA/TIA-455-107. The minimum single mode return loss for broadband analog video (CATV) applications is 55 dB.
b. All fusion splices shall be mounted in protective trays within the closure.
c. Joins single mode or multi-mode fibers
d. Establishes a permanent fusion splice
e. May be used in OSP and/or premises applications
f. Accept 250 and 900 micron fibers
g. Re-enterable, portable and reusable
h. Require no polishing
i. Require no adhesives
j. No loose parts
k. One-part index matching gel
l. Unlimited shelf life

B. Copper
1. 110-type Wiring Blocks using C5 clips, Insulation Displacement Connector Systems, with proper patch cord
a. Compatible with all voice and data circuits
b. Underwriter's Laboratories (UL) listed
2. Protector Panels shall be provided for all outside plant installed copper circuits. The protectors shall provide pair-for-pair protection and be mounted on a ¾” fire-rated wallboard.

2.4 PATCH CABLES

A. Copper
1. 24 AWG Cat 6 stranded UTP,
2. Standard modular non-keyed, 8-position 8-conductor plug,
3. 94V-0 rated

4. UL listed
5. Complies with TIA/EIA-568-B requirements
6. Meets FCC Part 68

B. Optical Fiber Patch Cables
1. Buffered, graded-index fiber with a 50 µm or 62.5 µm core and a 125 micron cladding for multi-mode and a stepped-index 8.3 µm core with a 125 µm cladding for single mode.
2. Aramid yarn and a jacket of flame-retardant PVC shall cover the fiber cladding.
3. Owner approved connectors
4. ISO 9001 Certified Manufacturers
5. Operating temperature: -4° to 158° F (-20 to 70° C)
6. Cable Retention: 50 lb. (220 N) minimum
7. Multi-mode patch cables shall meet or exceed the following additional requirements:
   a. Mated Connector Loss: µ = 0.3 dB, a = 0.2 dB
   b. Connection Repeatability: 0.20 dB maximum changes per 100 reconnects.
8. Single mode patch cables shall meet or exceed the following additional requirements:
   a. Return Loss: -50 dB maximum
   b. Mated Connector Loss: µ = 0.35 dB, a = 0.2 dB
   c. Connection Repeatability: 0.20 dB maximum changes per 200 reconnects.
9. The multi-mode connector or a visible portion of it shall be beige in color. The multi-mode adapter or outlet shall be identified by the color beige. The single-mode connector or a visible portion of it shall be blue in color. The single-mode adapter or outlet shall be identified by the color blue.
10. Fiber connectors shall be LC type unless otherwise approved.

2.5 IDENTIFICATION (LABELING) SYSTEM

A. Labeling system shall consist of a hand-held portable printer and labels appropriate to the application. Handwritten labels are not acceptable.
B. Fiber termination hardware (designation strip): Thermal transfer printable label with a permanent acrylic adhesive, preferably .75 inch by .25 inch
C. 110-type copper termination hardware: Laser printable, non-adhesive label designed for 110 terminal block marking.
D. Outside plant copper cable: Permanent acrylic adhesive, self-laminating vinyl wire and cable identification 1.5 inch by 6- inch by 1.5 inch.
E. Outside plant fiber cables: Permanent acrylic adhesive, self-laminating vinyl wire and cable identification 1. - inch by 4 inch by 1inch.
F. All labels shall be permanent, i.e. will not fade, peel, or deteriorate due to environment or time.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Refer to section 27 00 00.

3.2 PREPARATION

A. Refer to section 27 00 00.
B. Verify the following before proceeding:
1. Conduits, cable trays and pull boxes are properly installed following section 270528
2. Backboards in communications rooms are properly installed following section 271100
3. Grounding system is properly installed and tested following section 270526
4. All high-pair count copper cables are routed properly and attached.
5. All optical fiber links are terminated and tested.
6. All backbone cabling service loops are installed and protected.
7. Liquid-carrying pipes are not installed in or above voice and data system communications rooms. Do not proceed with installation in affected areas until removed.

3.3 PREPARATION

A. Refer to section 27 00 00.

3.4 INSTALLATION

A. Copper and Fiber Backbone Cables
   1. Contractor shall:
      a. Terminate onto wall-mounted 110-type Cat 5e blocks complete with cable management troughs in TR, and rack-mounted 24-port patch panels for copper terminations.
      b. Install riser cables according to manufacturer's instructions for compliance to warranty requirements.
B. OSP Cable
   1. The Contractor shall verify pulling material (pull rope, mule tape, etc.) average breaking strength based on cable type and size, pulling distance and pathway, and other pertinent factors.
C. Copper and Fiber Cable and Connectors
   1. Contractor shall
      a. Install connectors according to manufacturer's instructions for compliance to warranty requirements.
      b. Provide 10Gig capable MM fiber connectors
D. Fiber Distribution Center
   1. Contractor shall provide sufficient spare adapter plates to fill the appropriate-sized FDC.
E. All installation shall be done in conformance with ANSI/TIA/EIA-568-B standards, BICSI methods, industry standards and installation guidelines. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.
F. The contractor shall provide service loops for cables terminating in the communications rooms. A ten-foot service loop shall be provided and secured in a neat and standards- compliant manner above the equipment racks or cable trays unless specified otherwise. This allows for future changes or expansion without installing new cables.
G. Documentation:
   1. All cable inventory data documentation shall be submitted in format coordinated with and approved by owner so that data can be incorporated into existing databases.
   2. Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.
   3. Complete cross connect documentation is required. It shall include detailed documentation of each pair of all copper backbone cable and strand of fiber.

3.5 FIELD QUALITY CONTROL

A. Refer to section 27 00 00.

3.6 POST-INSTALLATION TESTING

A. Contractor shall test each pair or strand of every cable prior to acceptance. (100% PASS)
B. Contractor shall supply all of the required test equipment used to conduct acceptance tests.
C. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.
D. Standards Compliance and Test Requirements:
   1. Copper backbone shall exceed ANSI/TIA/EIA-568-B.2 Backbone Cabling requirements and meet the manufacturer's specifications for the installed product.
   2. Optical fiber shall exceed ANSI/TIA/EIA-568-B.3 Optical Fiber Cabling Components Standard requirements and meet the manufacturer's specifications for the installed product.
   3. Contractor shall certify to TIA/TSB-140 Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
E. Cable Test Documentation:
   1. Cable test documentation shall be submitted in hard copy and electronic (diskette or CD- ROM) formats. If proprietary software is used, disk or CD shall contain any necessary software application required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., software to read these files is not required. Electronic reports shall be accompanied by a certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate shall reference traceable circuit numbers that match the electronic record.
   2. Each test record shall contain the cable ID as follows: "MEDIA TYPE – SOURCE ROOM – DESTINATION ROOM – STRAND/PAIR #", e.g. MM-MC-HC23-001.

3. Copper: Test reports shall include the following information for each cabling element tested:
   a. Wire map results that indicate that 100 percent of the cabling has been tested for shorts, opens, mis-wires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.
   b. Copper cabling: Attenuation and NEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 to 250 MHz. Information shall be provided for all pairs or pair combinations. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
   c. Outside plant cabling: The test equipment shall be capable of making frequency sweeps at an impedance of 135 Ohms at the following frequencies (kHz): 20, 30, 50, 69, 90, 110, 138, 276, 400, 600, 800, 1000, and 1100. A far-end device shall be used for all frequency measurements. The loss at 138 kHz shall not exceed 46 dB. The test set shall have the ability to store 100 tests and be able to upload to a PC. The test set shall be able to measure resistance between the following conductors: tip to ring, tip to ground, and ring to ground. All measurements shall be greater than 999 Ohms.
   d. Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
   e. Cable manufacturer, cable model number/type, and NVP
   f. Tester manufacturer, model, serial number, hardware version, and software version.
   g. Cable ID and project name
   h. Auto-test specification used
   i. Overall pass/fail indication
   j. Date of test
4. Optical Fiber: Testing shall be performed on all fibers in the completed end-to-end system.
   a. Optical Time Domain Reflectometer (OTDR) Reports: Testing shall consist of a bi- directional end to end OTDR trace performed per TIA/EIA 455-61. The system loss measurements shall be provided at 850 and 1300 nanometers for multi-mode fibers and 1310 and 1550 for single mode fibers.
   b. Reflective events (connections) shall not exceed 0.75 dB.
   c. Non-reflective events (splices) shall not exceed 0.3 dB.
   d. Fibers shall be inspected at 250X or 400X magnification. 250X magnification is suitable for inspecting multimode and single mode fibers. 400X magnification may be used for detailed examination of single mode fibers.
   e. Testing shall be performed on each cabling segment (connector to connector).
   f. Testing of the cabling shall be performed using high-quality test cords of the same fiber type as the cabling under test. The test cords for optical loss test set (OLTS) testing shall be between one meter and five meters in length. The test cords for OTDR testing shall be approximately 100 meters for the launch cable and at least 25 meters for the receive cable.
   g. Testing shall be performed on each cabling channel (equipment to equipment) that is planned for use per the owner's instructions.
5. Test results saved within the field-test instrument shall be transferred into a Windows™ based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e., "as saved in the field-test instrument". The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.
6. The detailed test results documentation data is to be provided in an electronic database for each tested optical fiber and shall contain the following information:
   a. The identification of the customer site as specified by the end-user.
   b. The name of the test limit selected to execute the stored test results.
   c. The name of the personnel performing the test.
   d. The date and time the test results were saved.
   e. The manufacturer, model and serial number of the test instrument.
   f. The version of the test software and the version of the test limit database held within the test instrument.
   g. The fiber identification number.
   h. The length for each optical fiber.
   i. The index of refraction used for length calculation when using a length capable OLTS.
   j. Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).

k. Test results to include OTDR link and channel traces and event tables at the appropriate wavelength(s).
l. The length for each optical fiber as calculated by the OTDR
m. Overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.
n. Circuit IDs reported by the test instrument should match the specified label ID.

F. Cable Test Equipment:
1. Test equipment used under this contract shall be from a manufacturer that has a minimum of 5 years' experience in producing field test equipment. Manufacturer shall be ISO 9001 certified.
a. Copper: Fluke DTX CableAnalyzer or submitted and owner-approved equivalent.
b. Outside plant: 3M Dynatel 965 DSP Subscriber Loop Analyzer with Far End Device or submitted and owner-approved equivalent.
c. Fiber Optic: Fluke DTX CableAnalyzer or submitted and owner-approved equivalent.
2. Test equipment for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA- 526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455- 50B, Method A. Test equipment for single mode fiber cabling shall meet the requirements of ANSI/EIA/TIA-526-7. The cable installers shall have a copy of these references in their possession and be familiar with the contents.
3. The test instrument shall be within the calibration period recommended by the manufacturer.
4. Test instruments shall have the latest software and firmware installed.
5. All test tools of a given type shall be from the same manufacturer, and have compatible electronic results output.
6. The manufacturer of the test equipment shall approve test adapter cables. Adapters from other sources are not acceptable.

3.7 CLEANING

A. Refer to section 27 00 00.

3.8 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted and approved, and the owner is satisfied that all work has been completed in accordance with contract documents, the owner will notify Contractor in writing of formal acceptance of the system.
B. Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein.
C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100 percent PASS rating, and submittal and approval of full documentation as described above. Tests with the "* PASS" (asterisk) will not be acceptable. These circuits must be repaired to meet "PASS".

END OF SECTION