PART 1: GENERAL

1.01 SCOPE OF WORK
A. The extent of the Interbuilding Fiber Optic Cabling Installation (The Project) will include the following as shown on the Drawings or as Specified.

B. Related Sections: The Contractor is held responsible to be familiar with the Provisions contained herein and with other Sections of this Specification as applicable to the completion of the installation. The approved vendor, designated agent or employee is held responsible to be familiar with the provisions contained herein and is assumed to possess the knowledge, manpower, and materials applicable to the completion of the installation.

1. Division 27, Section 270526 Grounding and Bonding for Communication Systems.
2. Division 27, Section 270528 Pathways for Communication Systems.
3. Division 27, Section 270553 Identification for Communication Systems.
4. Division 27, Section 271116 Communications Cabinets, Racks, Frames, and Enclosures.
5. Division 27, Section 271119 Communications Termination Blocks and Patch Panels.
6. Division 27, Section 271123 Communications Cable Management and Ladder Rack.
7. Division 27, Section 271313 Communications Copper Backbone Cabling.
8. Division 27, Section 271323 Communications Optical Fiber Backbone Cabling.
9. Division 27, Section 271333 Communications Coaxial Backbone Cabling.
10.Division 27, Section 271513 Communications Copper Horizontal Cabling.
11.Division 27, Section 270800 Communications Commissioning, Testing and Acceptance.

C. Installation, splicing, termination, testing, labeling and documentation of new interbuilding fiber optic communication cable between buildings as specified and on the drawings.

D. The installation environment will include existing Building Distribution Frames (BDF), underground ductbanks, direct-buried conduit, utility tunnel pathways, as well Some areas of the University of New Mexico property will require directional boring, and/or trenching to facilitate direct burial of cable and conduit provided by the Contractor.

Optical Fiber Backbone Cabling 27 1323
E. The Contractor shall be responsible for: placement of cable, attachment cable to support devices within the utility tunnel system, underground structures, and pole lines, the placement of conduit, the installation of metallic pull-boxes (NEMA Type 3R), the furnishings of fiber optic splice closures, and installation of termination hardware.

F. The Contractor shall be responsible for the provision of grounding and bonding materials, duct plugs, and firestopping materials as appropriate. Other incidental hardware and appliances, necessary for the proper performance and operation of the communication cable system, which are consistent with the practices of underground cable installation are to be provided by the Contractor at no additional charge to the Owner.

1.02 QUALITY ASSURANCE

A. Verification: The Owner will maintain inspection personnel on the job site. It is incumbent upon the Contractor to verify that the installation and material used has been inspected before it is enclosed within building features, buried, or otherwise hidden from view. The Contractor shall bear costs associated with uncovering or exposing installations or features that have not been inspected.

B. The Contractor will provide test results and a 20 year manufacturer’s warranty at the completion of work.

1.03 SUBSTITUTIONS / INTENT OF SPECIFICATIONS

A. Product substitutions shall be managed according to the following guidelines:
   1. Where specified only by reference standards, select any product meeting standards by any manufacturer.
   2. Where specified by naming several products or manufacturers, select any product and manufacturer named that meets the specified requirements. Other products and manufacturers will not be considered.
   3. Where specified by naming one or more products or manufacturers, but indicating "or equivalent" after specified listing, the specified product is the preferred quality standard. The Contractor may submit a request for another product for acceptance.
   4. Where specified by naming only one product and manufacturer: “There is no option and no substitution” will be allowed.
   5. Submit requests for substitutions within 10 days of contract award, or sooner if required to maintain the construction schedule.
   6. The Contractor must submit sufficient information to show that a proposed substitute is equivalent to the item specified.
7. Acceptance of substitutions is at Owner’s discretion: the Owner reserves the right to determine suitability of the substitute product and reject any and all materials submitted for substitution.
8. All substitute products and the Owner in writing prior to installation must approve materials for substitution.
9. Products rejected or otherwise judged unsatisfactory by the Owner will not be authorized for use in completing the Work. Any unapproved products discovered as part of the installation will be removed and replaced with Owner-specified and approved products at the Contractor’s expense.
10. Project Drawings may be based on equipment configuration of a particular manufacturer. If a substitution is approved, the Contractor shall make changes needed to accommodate the substitution at no expense to the University of New Mexico, including work under other divisions.

PART 2: PRODUCTS

2.01 General

A. The materials and products specified herein reflect the minimum acceptable standards of fabrication and manufacture.

B. All materials and products supplied by the Contractor and specified herein are to be new, unused, of first quality and in original packaging or shipping containers.

C. All unused cables purchased for this project longer than 100ft will be surrendered to the Owner or disposed at the direction of the owner.

D. Provide materials as specified or as approved equivalent by Owner.
   The following manufacturer’s warranted systems are approved unless otherwise specified: Orthronics, Siemons, Bertek, Mohawk, Corning, ADC, Alcoa, Comscope

2.02 Outside Plant Fiber Optic Cable.

A. General: - The Project will require the installation of outside plant single-mode (SM) and/or multimode (MM) fiber optic cable in various outside plant environments. The cable types listed herein have been selected based on these environments and applications.

B. Single Mode Optical Fiber Specification
   1. Optical Characteristics – Single-mode fiber optic cable 8.3µm/125µm single-mode low water peak optical fibers
2. Attenuation: 0.35dB/km @ 1310 nm; 0.25dB/km @ 1550 nm

C. Multi Mode Optical Fiber
1. Optical Characteristics – 50µm/125µm laser optimized fibers for high-end 10 GHz applications for new installations. 62.5µm/125µm multimode optical fibers as specified for additions and modifications to existing of the same.
2. Attenuation: 3.5 dB/km @ 850 nm; dB/km @ 1300 nm
3. Bandwidth: 160 MHz/km @ 850 nm;500 MHz/km @ 1300 nm

D. Mechanical Specifications
1. Maximum tensile loading: Installation: 2700 N (600lb/ft); Long term installed: 890 N (200lb/ft)
   a) Operating Temperature: Storage: -40° to +70° C (-40° to +158° F) Long Term: -40° to +70° C (-40° to +158° F)
   b) Minimum bend radius (12 and 48 strand armored fiber optic cable): Loaded:
      a. 8.9 inches; Installed: 6.0 inches Minimum bend radius (12 and 48 strand all-dielectric fiber optic cable): Loaded: 7.0 inches; Installed: 4.6 inches
   c) Mechanical Construction – armored fiber optic cable for direct-buried and conduit installation. Construction shall include: locatable central strength member, water swell-able yarn, buffer tubes/fibers, water swell-able tape, ripcord, Polyethylene inner jacket, (9)High Tensile Strength, corrugated steel tape armor (for direct buried applications), Polyethylene outer jacket, UV-stabilized jacket or equivalent

E. Color Codes for Optical Fiber Cables
   a. Buffer tubes and individual strands shall be color coded as:

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blue</td>
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<tr>
<td>2</td>
<td>Orange</td>
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<td>3</td>
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<tr>
<td>11</td>
<td>Rose</td>
</tr>
<tr>
<td>12</td>
<td>Aqua</td>
</tr>
</tbody>
</table>

   b. Cable shall be assembled to ensure that no more than 12 fiber strands occupy each buffer tube.
Fiber Optic Connectors

A. Provide for all new fiber optic installations with Type LC terminated connectors. When adding to or modifying existing work coordinate connector type with Owner.

B. Single-mode connectors provide: Corning Part Number 95-200-42 Ultra-polished Unicam LC connectors

C. Multimode connector provide: 3M Part Number 6300 Hot Melt LC connector or Corning Part Number 95-000-41 Unicam LC connector

D. Fiber Optic Loose Tube Cable Furcation Kit provide: Corning Buffer Tube Fan-Out Kit – 12 fiber, indoor and outdoor cable. Corning Part Number FAN-BT25-12 for installation into CCH connector modules and WIC enclosures.

E. Fiber Optic Termination Enclosures and Associated Hardware provide or approved equal:

1. Wall mounted enclosures at each end point (i.e., BDF and IDF) shall be: Two (2) side-by-side Corning Cable Systems #WIC-012 per 12-strand multimode or single-mode fiber optic cable. Enclosures for multimode fiber to be complete with multimode connector panels with LC adapters, Corning Cable Systems #WIC-CP1-039.
2. Enclosures for single-mode fiber to be complete with single-mode connector panels with LC adapters, Corning Cable Systems #WIC-CP1-038.
3. Rack mounted enclosures at the BDF shall be: One (1) Corning Cable Systems #CCH-02U housing at the top of the equipment frame for OSP fiber Optic termination.
4. One (1) Corning Cable Systems #CJP-02U fiber wire management shall be installed directly below the CCH-02U panel.
5. Owner shall provide location for mounting enclosures if not shown on drawings.

F. Fiber Optic Splice Enclosures

1. Fiber optic fusion splices shall be performed in underground facilities, therefore splice enclosures designed for use in an outside plant environment shall be used.
2. Splice closures are to be configured for through splices only when distribution from splice is not required.
3. Where distribution is required from a splice closure, utilize splice closures with entrance from one end only.
4. Provide the 9.5”x28.0” Coyote #800010884 splice enclosure or from both ends when installing the 8.5”x22.0” Coyote #80805514 splice enclosure
with (2) 6 port end plates.
5. No encapsulate shall be injected into closures after splices are completed.
6. Provide Preformed Coyote Fiber Optic Splice Closures Kits, sized as required for the maximum fiber count within the splice case including distribution fibers.
7. Preformed Splice Trays shall be used with Preformed Fiber Optic Splice Closures. Splice only 24 fibers per splice tray (no exceptions, unless with written approval prior to installation).
8. Preformed splice trays are to be labeled with a permanent black (Sharpie) marker on the front face of each splice tray indicating fiber count.
9. Support bracket kits for a Coyote Splice Case, sized as required for fiber count. Preformed part #8003279 will support the splice case in maintenance holes, handholes and vaults.

G. Innerduct
1. Innerduct will be installed in specified ducts as indicated herein. Innerduct shall be molded in orange polyethylene and be of solid wall configuration.
2. Each innerduct placed by the Contractor shall have a one-quarter inch polyethylene pull rope placed within the innerduct secured at each end.

H. Innerduct Couplers
1. Aluminum threaded innerduct couplers to be used to join two segments of corrugated innerduct together. Non-metallic couplers are not acceptable.
2. Provide: Pyramid Innerduct Adapter 1-1/4 inches - Pyramid Part Number F09008 or equivalent. Carlon Threaded Aluminum Couplings 1-1/4 inches – Carlon Part #BS1.660 or equivalent

I. Duct Plugs
1. Split Triplex Duct Sealing Plugs to be installed in 4-inch ducts containing Contractor-installed 1-1/4 inch innerducts.
2. Jackmoon Triplex duct plugs - Jackmoon Part Number 40B167S or equivalent.
3. Carlon Triplex duct plugs – Carlon Part Number MATPG3 or equivalent.
4. Innerduct Sealing Plugs to be used to seal used and unused innerducts. Use in conjunction with triplex duct sealing plugs.
5. Provide Jackmoon Blank Duct Plug 1-1/4 inches – Jackmoon Part Number 12D148U or equivalent
6. Provide Jackmoon Fiber Optic Simplex Duct Plug 1-1/4 inches – Jackmoon
Part Number 12S0XXSB or equivalent. Exact part number should be specified by Contractor upon materials order placement once exact cable diameters are known.

J. Fiber Optic Cable Labels
1. Stainless steel or plastic cable labels will be attached to all fiber optic cables using stainless steel straps or approved zip ties.
2. Provide Panduit MMP Stainless Steel Marker Plates - 0.75 inch x 3.50 inches manufactured in 316 stainless steel. Panduit Part Number MMP350-C316.
3. Provide Panduit Pan-Steel Stainless Steel Clamps – MLT1S-CP Cable Support – J-Type Pipe Hangers; B-Line Products Pipe Hanger, B-Line Products Part Number 3690-X, or equivalent, sized appropriately.

PART 3: EXECUTION

3.01 TELECOMMUNICATIONS INSTALLATION

A. General
1. This Section describes the installation locations for the products and materials, as well as methods and Owner’s Standards associated with the telecommunications installation portions of the Project.
2. These Specifications, along with the Drawings and other Owner-supplied specifications shall be followed during the course of the installation.
3. The Contractor is instructed to coordinate his efforts with other tradesmen who may be working within the same vicinity to avoid conflict, lost time and potential injury. The Owner will assist in coordination as requested or as required.
4. The Contractor is to install all materials plumb, square and in a workman-like manner.
5. The Contractor is required to supply all necessary tools, equipment, accessories safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation
6. The Contractor shall comply with all National, State of New Mexico, Local and University of New Mexico Codes and Standards during the course of installation.
7. Should any portion of these Specifications conflict with said Codes, the Contractor is to cease work on that particular aspect of the Project and notify the Owner immediately.

B. Field Conditions
1. Fixed facility locations shown on the Drawings are based upon the latest design information available at the time this Specification was prepared. The Contractor shall conduct field inspections to determine the actual as-built
locations of conduits, manholes, handholes and all other special facilities that affect the installation, prior to commencing the installation in any area.

C. Cleaning
   1. Cleanliness. All BDFs, Underground structures to include utility tunnels, conduit and manhole systems, handholes and related fixtures shall be kept as clean as possible during installation. Labor required for any cleaning work shall be provided by the Contractor.

D. Completion.
   1. BDFs and Underground structures to include utility tunnels, conduit and manhole systems, handholes and related fixtures, shall be thoroughly cleaned, flushed out, or blown out before the installation is offered to the Owner for acceptance.

E. Temporary Work.
   1. Remove temporary labels, temporary protection and related items and leave the entire installation in a clean, usable condition.

3.02 FIBER OPTIC INNERDUCT INSTALLATION

A. Refer to the Project Drawings as applicable for routing.
B. Duct/Conduit Preparation.
   1. All ducts and conduits intended for use as a pathway will be blown out with compressed air or brushed out to remove dirt, water, and other residue prior to cable and innerduct installation.

C. Innerduct Installation
   1. Mount innerduct in utility tunnel on dedicated 6M strand-messenger.

D. The Contractor shall install 3 innerducts within any of the 4-inch conduits used for communication cable installed during this Project. Innerduct will be provided by the Contractor as required, under the following conditions:
   1. There is no existing innerduct installed in the conduit.
   2. There is no existing cable installed in the conduit.
   3. Multi-cell duct is not available as a pathway.

E. Three innerducts will be installed in any duct that is to hold any combination of: 1, 2 or 3 cables.

F. Do not install any duct that does not carry cable associated with this project.
G. Do not install innerduct within empty conduits slated for future use or expansion.

F. Innerducts will be cut to allow approximately 6 inches of excess material to extend beyond the end of the duct.

H. Innerducts are to be contiguous sections end to end. If it is absolutely necessary to splice innerduct together, use aluminum couplers as specified herein.

I. Secure innerduct pull-ropes by cutting a slit into the excess duct and wedging the pull-rope. Tie off excess slack around the duct.

J. Install a triplex duct plug into each end of the duct

K. Install a simplex duct plug over the cable and secure the plug.

J. Install a blank plug in unused innerducts.

3.03 FIBER OPTIC CABLE INSTALLATION

A. General
   1. For cable installation within ductbanks: Cable is to be installed in Owner-designated conduits. If field conditions prohibit the use of the Owner-designated duct, the Contractor is to select a duct for use and coordinate his selection prior to cable installation.
      2. If Multi-cell duct is available, install one cable in each sub-duct. If no multi-cell duct is available, the Contractor is to install Multi-cell innerduct into a single conduit upon approval by Owner.
      3. Three cables are to be installed within each innerduct.
   4. If cable is already installed within a duct without innerduct, new cable is to be pulled into the duct (also without innerduct) along with existing cables, provided that the new cable can be pulled without damage to itself or to other cables already in place.

B. Description – Primary Fiber Optic Cable Backbone Route
   1. As described herein and/or as shown on the Drawings.

C. Fusion Splicing of Fiber Optic Cable
   1. All backbone fibers will be fusion spliced to pigtails. No direct terminations will be allowed.
      2. Prior to sealing spliced cables into a fiber optic splice enclosure, the Contractor shall perform a power meter test on each individual fiber as described in Paragraph 3.04 G.1 herein. The attenuation measurement is to be compared to the link loss calculation for the segment in question.
3. Measured attenuation through the splice is not to exceed 0.2 dB. Splices that exceed this level will be broken, re-spliced and retested by the Contractor until the minimum reading is attained.

4. After performing the fusion splice, the splice technician shall examine each splice. Splices with a “neck-down” (narrowing) effect, or an oversized bulge at the splice location, or which contain gas bubbles, dirt, or other aberrations shall not be acceptable.

5. The spliced fibers are to be installed within a fiber optic splice tray according to the manufacturer’s specifications.

6. The fiber optic splice closure will be sealed (if OSP) to be air-tight as specified by the manufacturer. Installation would be only after testing and acceptance.

7. Sealed closures are to be secured to the wall of the manhole using appropriate hardware.

C. Installation of Fiber Optic Cable Within the BDF

1. Routing of cable and cable slack. Upon entering the BDF, the fiber optic cable shall be routed to the termination location as shown on the drawings.

2. At least 50 feet of slack cable shall be coiled maintaining a minimum of 2 times the minimum bend radius.

3. The cable shall be secured to the BDF wall or other specified location using Velcro cable wrap brackets. The end of the cable, exclusive of the coil of slack, shall be routed to the WIC or CCH mounted within the equipment frame for furcation and termination. Leave 6ft of buffer tube in the fiber optic enclosures. Secure the cable to the wall or equipment frame using Velcro cable wraps.

D. Furcation of Fiber Optic Cable

1. Prior to termination, fiber optic cable strands will be furcated (fanned out) using the specified furcation kits and using the procedure specified by the manufacturer.

E. Termination of Fiber Optic Cable

1. Where specified, the Contractor shall terminate the individual fiber strands with LC-type connectors according to the manufacturer’s specifications.

2. Upon final testing, mated-pair connector attenuation shall not exceed 0.5 dB.

3. Connectors which exceed this level of attenuation shall be cut off and fibers re-terminated by the Contractor.

4. Terminated fibers shall be installed within either a WIC or a CCH panel mounted within an equipment frame, as specified on the Drawings.

F. Installation of fiber in Maintenance Holes and Handholes

1. Loop the fiber once around the manhole or handhole in addition to a coil if one is required.
3.04 FIBER OPTIC CABLE TESTING

A. Scope of Work
1. Work covered by this Paragraph shall consist of furnishing labor, equipment and supplies unless otherwise specified, and in performing the following operations recognized as necessary for the successful testing and verification of the installation of the Fiber Optic cable plant described on the Drawings and required by these specifications.

B. Testing
1. Verify through Optical Time Dimension Reflectometer (OTDR) testing as well as visual inspection of manufacturers testing results, the quality of the fiber optic cable being installed.
2. Verify through power meter testing the attenuation of all point to point fiber optic strands.
3. Verify through OTDR testing the integrity of the point-to-point connections, the final installed connector-to-connector length of the fiber optic strands.
4. Verify through visual inspection of all fiber optic cable termination locations on Drawings, the integrity of the workmanship and the operability of the fiber optic media.

C. Contractor Responsibility - The Contractor shall:
1. Coordinate a meeting with ITT personnel to discuss testing procedures, equipment, documentation, etc. to verify to the owner a complete understanding of requirements and schedule.
2. Complete quality control inspection and testing per this Specification. Provide technicians qualified to operate the test equipment.
3. Maintain test equipment in current calibration during testing operations.
4. Notify the Owner 48 hours in advance when work, technicians and equipment are prepared for Acceptance tests and inspections.
5. Coordinate testing with the Owner beforehand to avoid delays in the Project Schedule
6. Maintain written record of tests pertinent for each fiber run and upon completion of testing, assemble and certify a final test report.
7. Maintain safety procedures and discipline when test equipment is emitting optical energy.

D. Test Equipment
1. Contractor will submit specification sheets for the test equipment utilized for Owner approval prior to commencement of testing.
E. Calibration

1. The Contractor is to ensure all test instruments are calibrated to provide measurements within stated accuracy.
2. Visible, dated calibration labels will be affixed to test instrumentation. Calibration performed within 12 months of current testing operation.
3. The Contractor shall be prepared to present accurate records that indicate the calibration history of the equipment. The records should include the date and results of instruments calibrated or tested.
4. Test equipment is to be calibrated using a standard of higher accuracy than that of the instrument tested. Accuracy is to be directly traceable to the National Institute of Standards and Technology.

F. Acceptance Procedures:

1. Purpose: The following acceptance practices are required to ensure that should the incorrect products be received, should damage to the cable have occurred during shipping and handling; the Contractor can reorder replacement materials as soon after determination of the product’s unsuitability as possible to minimize the impact to the installation schedule.
2. The Contractor shall visually inspect fiber optic cable reels for damage upon receipt from the shipper.
3. Part numbers on cable reel shipping labels, bills of lading, invoices, etc., shall be compared to the original order.
4. All cable lengths shall be verified.
5. The manufacturer’s OTDR measurement records received with the shipment shall be examined to ensure compliance with stated attenuation performance. The Contractor will either accept and guarantee the OTDR and loss measurements provided with the cable or will make their own test before acceptance. The OTDR readings will be provided for all the fibers in each spool of fiber optic cable. Readings are required at the 850 nm, 1300 nm windows for multi mode fiber and 1310 nm, 1550 nm windows for single-mode fiber.
6. The Contractor will retain the manufacturer’s test data and provide it, along with all other specified test documentation to the Owner at the completion of the Project.

G. Field Testing Procedures

1. The following test procedures shall be performed for all fiber optics cable installations. No variance can be obtained without written request to the Owner. Verbal approvals will not be accepted or provided.
2. All readings will be taken end to end (LC to LC) in both directions on every
fiber terminated at both ends, without exception.
3. Fiber optic cable that is left un-terminated at both ends shall be tested using a launch cable and bare fiber adapter.
4. Fiber optic cable that is left un-terminated at one end shall be tested at the connector end using an OTDR.
5. The Owner is to be notified at least 48 hours prior to testing to allow 100% observation at the Owner’s discretion. If the Owner confirms his intention to observe, a reasonable starting time will be agreed upon. Should the Owner not be present at the scheduled commencement time, the Contractor may begin testing as scheduled.

H. Table 2: Maximum Acceptable Attenuation Values

<table>
<thead>
<tr>
<th>Fiber Type</th>
<th>Test Wavelength</th>
<th>Mated Pair Connector Loss (each)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50/125 Multimode</td>
<td>850nm</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>50/125 Multimode</td>
<td>1300nm</td>
<td>0.5 dB</td>
</tr>
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<td>62.5/125 Multimode</td>
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<td>0.5 dB</td>
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<td>62.5/125 Multimode</td>
<td>1300nm</td>
<td>0.5 dB</td>
</tr>
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<td>Single-mode</td>
<td>1310nm</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>Single-mode</td>
<td>1550nm</td>
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<table>
<thead>
<tr>
<th>Fiber Type</th>
<th>Test Wavelength</th>
<th>Fusion Splice Loss (each)</th>
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</thead>
<tbody>
<tr>
<td>50/125 Multimode</td>
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</tr>
<tr>
<td>Single-mode</td>
<td>1550nm</td>
<td>0.25 dB</td>
</tr>
</tbody>
</table>

I. Optical Time Domain Reflectometer (OTDR) Testing
1. After all terminations have been completed, tests will be conducted using an OTDR prior to testing with a power meter set (optical light source and optical meter). Contractor will test insertion loss of 850 nm and 1300 nm for Multimode cable; and at 1310 nm and 1550 nm wavelengths for Single-mode cable, for both directions through each connector pair using the OTDR. Use of an OTDR determines overall length and pinpoints loss locations along the segment being tested by indicating their distances from the source. The
2. Contractor will use the OTDR traces to assess the span attenuation that is necessary to evaluate the final acceptance tests utilizing the power meter test set(s). The power meter test measures overall attenuation of each span; this
test also determines whether terminations are not within specified quality limits.

J. OTDR Testing and the Span Loss Benchmark Calculation

1. Span Loss Benchmark Calculation. The estimated attenuation (loss) must be calculated for each fiber segment to determine a comparison value for the actual readings during the power meter test. This calculation is derived from the original reel tests performed at the time of cable acceptance.

2. In general, the OTDR traces must be interpreted to determine the length of each cable segment. Both ends of the span are terminated with an LC connector. In the following example the test is performed on multi mode fiber at 850nm. At the conclusion of the test, the trace for the span (end-to-end) is interpreted as follows:

3. Span Loss Calculation Factors
   a. Segment 1 is a fiber segment measured from termination-to-termination.
   b. Distance of Segment 1 (per OTDR trace)
   c. Span Loss Benchmark Calculation. The estimated attenuation (loss) must be calculated for each fiber segment to determine a comparison value for the actual readings during the power meter test. This calculation is derived from the original reel tests performed at the time of cable acceptance.
   d. In general, the OTDR traces must be interpreted to determine the length of each cable segment. Both ends of the span are terminated with an LC connector. In the following example the test is performed on multi mode fiber at 850nm. At the conclusion of the test, the trace for the span (end-to-end) is interpreted as follows:

Table 3 – Calculation Example

Segment 1 is a fiber segment measured from termination-to-termination.

Distance of Segment 1 (per OTDR trace) = 125 meters

Pre-Installation Attenuation Acceptance Test = 2.90 dB/km

Calculation: 125 meters X 0.0029 dB/meter = 0.36 dB

Calculated loss value for Segment 1: = 0.36 dB

Mated pair connector loss:
0.5 dB (per pair) * X 2 = + 1. dB

The Span Loss Benchmark Calculation for this span: 1.36 dB

The benchmark calculation for the span is to be compared with the reading taken on the span with the power meter in final acceptance testing.

K. Power Meter Testing

1. The Span Loss Benchmark Calculation for this span: 1.36 dB
   The benchmark calculation for the span is to be compared with the reading taken on the span with the power meter in final acceptance testing.

2. Power Meter Testing:
   After termination of all the individual fibers, power meter readings will be taken. The attenuation of readings must not be higher than the optimal attenuation loss. The optimal attenuation loss will be calculated using the manufacturer's factory certified fiber test reports (dB/km) converted to the actual installed lengths plus the attenuation losses for the LC connector of 0.75 dB per mated connector pair.

3. The optimal attenuation losses shall be used for comparison with the end-to-end power loss test results prior to acceptance by the Owner.
   If any reading is higher than 0.10 dB over the optimal attenuation loss, the Owner must be contacted for acceptance.

4. If the loss is not acceptable, then the contractor must re-terminated the fiber to obtain acceptable loss levels. This will be done at the Contractor's expense.

5. Records of fiber loss must be maintained and provided for system acceptance by the Owner.

   The Owner is to be notified at least 48 hours prior to testing to allow 100% observation at the Owner’s discretion. If the Owner confirms his intention to observe, a reasonable starting time will be agreed upon. Should the Owner not be present at the scheduled commencement time, the Contractor may begin testing as scheduled.

L. Test Report Submittals

1. The Contractor shall submit a completed hard copy Fiber Optic Cable Test Report to the Owner as well as test results on CD and in written Excel Format for review before the Owner’s acceptance of the Work. Provide 3 copies of each.

2. The Fiber Optic Cable Test Report shall be completed using the format shown in Exhibit I.
3. Fiber optic cable test reports shall be delivered to Owner for loss @ 1310nm and 1550nm for all single-mode fiber strands and 850nm and 1300nm for all multimode fiber strands.
4. Loss budget calculation shall be shown on the Fiber Optic Cable Test Report. Substantial Completion will not be given without the final test results submitted and approved by the Owner.

3.05 LABELING

A. Each Fiber Optic Cable installed by the Contractor shall be labeled as follows: Contractors Company’s name, address and phone number, Technicians initials and date.

B. Fibers must be labeled as they are in the buffer tube. The first fiber of the cable be terminated in position one and consecutive as they are terminated.

C. In the case of hybrid cables, fibers must be labeled as MM for multimode and SM for singlemode.

D. The identification of the other end of termination including building number, room number, rack number, FDU position number and FDU termination position number.

E. Documentation shall be provided as a part of the as-built package. A copy of this documentation shall be left at each FDU location.

3.06 AS-BUILT INFORMATION

A. Contractor shall provide as-built information to Owner to accompany all test result information.

B. As-built information shall be in red-lined format on a copy of construction drawings.

C. Indicate location of all OSP routes, if different than original drawing, conduit configuration, cable type, cable labeling, and all additions and deletions pertaining to telecommunications.

D. If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled site plan.

3.07 SYSTEM WARRANTY

A. General
1. Contractor shall perform all labeling requirements and provide testing documentation for verification as described herein.
2. Contractor shall submit cable records to reflect all moves, adds, and changes.
3. Contractor shall provide site plans showing locations of all telecommunication routes. See Item 3.06.
4. Contractor shall submit final paperwork for warranty to manufacturer and a copy to the Owner one week prior to the substantial completion date.
5. Contractor must be a certified as required by the University of New Mexico by a University approved supplier such as Mohawk, Bertek, Ortronics, Siemons or approved supplier by the Owner.
6. Contractor must offer a 25-year extended manufacturers warranty for the premises fiber cabling solution comprised of approved manufacturer products and must follow all warranty registration procedures set forth by the manufacturer, including submitting all required documentation to the manufacturer for warranty certification.
7. All installed equipment must conform to the manufacturer's official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of 25 years from that date. The contractor shall agree to repair, adjust, and/or replace, as determined by the University of New Mexico, to be in its best interest of the owner and to replace defective equipment, materials, or other parts of the system at the contractor's sole cost. University of New Mexico will incur no costs for service or replacement of parts during the warranty period of 25 years. All third party warranties shall be passed through from the contractor to the University of New Mexico.
8. Contractor shall warrant that the system will function as specified in the approved manufacturer's Technical Description Guide.
9. Contractor shall warrant that the system shall accommodate the specifications in all appropriate sections of this Request for Proposal and all applicable sections of the University of New Mexico’s Guide Specifications.

End of Section