1.0 Purpose

A. These guidelines provide requirements for designers to incorporate into bid documents. They are part of the University Wiring Standard (UWS), version 3.0.

2.0 General Requirements

A. Certification. Certification of cabling is the process of testing the transmission performance of an installed cabling system to a specified standard. All communications cabling installed on the NC State campus is required to be certified prior to its acceptance. This certification shall be completed by qualified personnel using test equipment designed to perform these specified tests. It shall be performed according to current industry and manufacturer performance standards for each type of cable installed. Testing will be completed using industry standard equipment and testing practices. It shall be performed by the contractor with test results provided to NC State ComTech and to Leviton Network Solutions, Inc.

B. Commissioning. In addition to the above, personnel from ComTech and from Leviton may perform inspections during and following completion of cabling installation. Also, either ComTech and/or Leviton may, at their discretion, directly observe the cable testing process and perform secondary testing of any installed cables after test results are submitted.

3.0 Cabling Certification Requirements and Standards

A. Standards. All work shall be performed in accordance with these guidelines, current industry testing standards, and with the test equipment manufacturer recommendations.

Category 6A UTP cables shall be tested and proved to conform to TIA-568-C.2 standards.

UTP cable testing equipment will be NRTL certified for EIA/TIA TSB95 and to the manufacturer’s specifications.

Fiber optic cables shall be tested and proved to conform to TIA-568-C.3 standards. Testing procedures shall be in compliance with TIA TSB-140, TIA-526-7, TIA-526-14A, and OFSTP-14A.

Fiber Optic Cable Test Equipment: Cable tester will be NRTL certified for TIA/EIA TSB95 and to the manufacturer’s specifications.

B. Horizontal cabling testing – CAT6A. All Category 6A UTP horizontal cables installed shall be tested. The following parameters will be tested: wire map, length, attenuation, propagation delay, delay skew, insertion loss, NEXT, PSNEXT, FEXT, PSFEXT, ELFEXT (ACRF), PSELFEXT (PSACRF), and return loss. Testing will be for full channel only. Permanent link tests will not be acceptable. Testing will be conducted to prove compliance with TIA Category 6A standards and with the Leviton NextLAN 10Gc AXi Channel Margin Guarantee parameters as denoted below:

<table>
<thead>
<tr>
<th>TIA parameter</th>
<th>Margin vs. TIA 568-C.2-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion loss</td>
<td>3%</td>
</tr>
<tr>
<td>NEXT</td>
<td>1dB</td>
</tr>
<tr>
<td>ACR*</td>
<td>3dB</td>
</tr>
</tbody>
</table>
PSNEXT 2dB
PS-ACR* 4dB
ACR-F 5dB
PSACR-F 6dB
Return Loss 3dB

*ACR and PSACR margin guarantee is minimum performance margin vs. calculated minimum defined by TIA 568-C.2 for 1 to 500 MHz.

All values will be tested 1-500 MHz. Field testing for alien cross talk (AXT) parameters is not required.

Cables shall be tested after all jacks are securely inserted into the outlet faceplate and into the patch panel in the BDF/IDF. Cables shall be tested after the outlet faceplate is securely fastened in its final, permanent position onto the outlet box. Only test results completed after jacks and faceplates are secured will be accepted by NCSU.

Cables shall be tested from both ends of the cable. Tests shall be based on each pair of conductors and not the aggregate multiple pair results.

Testing shall be accomplished using a UL Level IV compliant field tester capable of testing to 500 MHz. The cable tester shall be preprogrammed with the latest software to test the Leviton/Superior Essex Category 6A system employed at NCSU. The contractor shall ensure that the tester has any necessary hardware or software upgrades. The contractor shall provide proof that the tester has been properly calibrated by the tester manufacturer within the previous 12 months. The cable testers currently approved for use at NCSU are: Fluke Networks, Agilent Technologies, and Ideal Industries. Use of any other tester is prohibited unless specifically approved by Leviton.

Any cable failing the certification test (Fail, Fail* or, Pass*) must have remedial work done to provide a full pass test result. Remediation may include retermination or replacement of the cable. No cables passing within tolerance only (Conditional Pass*) will be accepted.

C. Horizontal cabling testing – fiber. All horizontal fiber optic cables installed shall be tested. Following is a summary of horizontal cable testing requirements:

1. One direction.
2. Test multi-mode strands at either 850 nm or 1300 nm.
3. Test single-mode strands at either 1310 nm or 1550 nm.
4. Tier 1 testing – with Light Source and Power Meter (LSMP) or Optical Loss Test Set (OLTS).
5. Record attenuation, length, and polarity.
6. Maximum allowable attenuation is as follows:

<table>
<thead>
<tr>
<th>Strand type</th>
<th>Wavelength (nm)</th>
<th>Maximum attenuation (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-mode</td>
<td>850</td>
<td>1.82 dB</td>
</tr>
<tr>
<td>Multi-mode</td>
<td>1300</td>
<td>1.65 dB</td>
</tr>
<tr>
<td>Single-mode</td>
<td>1310 or 1550</td>
<td>1.59 dB</td>
</tr>
</tbody>
</table>
Cables shall be tested after all connectors are securely inserted into the outlet faceplate and into the patch panel in the BDF/IDF. Cables shall be tested after the outlet faceplate is securely fastened in its final, permanent position onto the outlet box. Only test results completed after connectors and faceplates are secured will be accepted by NCSU.

The contractor shall ensure that the tester has any necessary hardware or software upgrades. The contractor shall provide proof that the tester has been properly calibrated by the tester manufacturer within the previous 12 months.

D. Horizontal cable testing – RG6 coax. All horizontal RG6 cables shall be tested using a time domain reflectometer (TDR) tester designed for CATV RG6 cable testing. Tester shall operate at 75 Ohm output impedance with ½ sine test signal output. Continuity testing alone will not be sufficient.

E. Horizontal cable testing – CAT3. Provision of test results is not required unless requested by NCSU ComTech. If required, the contractor will provide certification of continuity and polarity.

F. Intra-building riser cable testing – fiber. All fiber optic riser cables installed shall be tested. Following is a summary of horizontal cable testing requirements:

1. One direction.
2. Test multi-mode strands at 850 nm and 1300 nm.
3. Test single-mode strands at 1310 nm and 1550 nm.
4. Tier 1 testing – with Light Source and Power Meter (LSMP) or Optical Loss Test Set (OLTS).
5. Record attenuation, length, and polarity.
6. Maximum allowable attenuation is as follows:

<table>
<thead>
<tr>
<th>Strand type</th>
<th>Wavelength (nm)</th>
<th>Maximum attenuation (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-mode</td>
<td>850</td>
<td>2.20 dB</td>
</tr>
<tr>
<td>Multi-mode</td>
<td>1300</td>
<td>1.80 dB</td>
</tr>
<tr>
<td>Single-mode</td>
<td>1310</td>
<td>1.70 dB</td>
</tr>
<tr>
<td>Single-mode</td>
<td>1550</td>
<td>1.70 dB</td>
</tr>
</tbody>
</table>

The contractor shall ensure that the tester has any necessary hardware or software upgrades. The contractor shall provide proof that the tester has been properly calibrated by the tester manufacturer within the previous 12 months.

G. Intra-building riser cable testing – voice. Each cable pair within all UTP riser cables shall be tested for continuity to ensure conductors are terminated in proper sequence and with correct polarity. Provision of test results is not required unless requested by NCSU ComTech. If required, the contractor will provide certification of continuity and polarity.

H. Inter-building cabling testing – fiber. Fiber optic cables installed between buildings will typically be tested by ComTech technicians. Following is a summary of interbuilding cable testing requirements:
1. One direction.
2. Test multi-mode strands at 850 nm and 1300 nm.
3. Test single-mode strands at 1310 nm and 1550 nm.
4. Tier 2 testing - with Optical Time Domain Reflectometer (OTDR) for tests.
5. Record signature trace, length, and attenuation.
6. Maximum allowable attenuation is as follows:

<table>
<thead>
<tr>
<th>Strand type</th>
<th>Wavelength (nm)</th>
<th>Maximum attenuation (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-mode</td>
<td>850</td>
<td>2.10 dB + (3.5 X length*)</td>
</tr>
<tr>
<td>Multi-mode</td>
<td>1300</td>
<td>2.10 dB + (1.5 X length*)</td>
</tr>
<tr>
<td>Single-mode</td>
<td>1310</td>
<td>2.10 dB + (0.5 X length*)</td>
</tr>
<tr>
<td>Single-mode</td>
<td>1550</td>
<td>2.10 dB + (0.5 X length*)</td>
</tr>
</tbody>
</table>

(* length measured in km)

4.0 Documentation/submissions

A. As-built drawings. The contractor shall provide ComTech as-buils consisting of building floor plan drawings showing final outlet locations and outlet numbers for all outlets installed. These may be provided in basic form (with legible handwritten outlet numbers on paper copies of the floor plans), or in electronic format (AutoCAD or PDF format).

B. UTP cabling test results. Prior to acceptance of construction, the contractor shall submit a copy of all applicable test results (as described above) to Leviton via the Leviton website. The data for each individual cable shall include: data/time stamp info, technician name, building name, and specific termination location information (room number, outlet number, etc. as appropriate to allow Leviton and the Owner to easily determine specific cable origination and termination points). Results shall be in electronic format as follows: in the original tester format and with full plot data to enable detailed analysis. Acceptable file formats for data are: .FLW (for Fluke), .SDF or .MDB (for Agilent), and .DBF (for Ideal). All other formats will require approval from Leviton prior to the commencement of testing.

C. Fiber cabling test results. Prior to acceptance of construction, the contractor shall submit a copy of all applicable test results (as described above) to ComTech. The data for each individual cable shall include: data/time stamp info, technician name, building name, and specific termination location information (room number, outlet number, etc. as appropriate to allow ComTech to easily determine specific cable origination and termination points). Results shall be provided in electronic format that allows for the inspection and archiving of individual records.

5.0 Commissioning process

A. Project registration. The contractor shall register each project prior to the commencement of the installation of the building communications cabling system. This registration will be performed via the Leviton website.
B. Initiation meeting. Upon completion of the above registration, Leviton engineering personnel and ComTech representatives will meet with the communications cabling contractor. The purpose of this meeting will be to complete and review bills of materials, address any questions from the contractor regarding NCSU requirements, and review installation best practices. In addition, the contractor may elect to view mock-ups of all major system components at the ComTech physical layer lab at the Avent Ferry Technology Center.

C. Project execution. Leviton will make available an on-call support engineer and on-site specification engineer as required for the duration of the project. These engineers will address any contractor installation questions, communicate with Leviton sales staff for assistance with issues related to materials distribution channels, etc. This support will be provided in coordination with Leviton’s manufacturer representative and with ComTech staff. In addition, Leviton may conduct installation audits as work is completed.

D. Post installation. Personnel from Leviton and from ComTech will conduct post installation inspections in addition to those conducted by the overall project architectural and engineering design team. These inspections will be to ensure that installation meets published Leviton and NCSU specifications.

Leviton may, at the discretion of ComTech, conduct spot testing of AXT performance of the installed system. This will be conducted to prove compliance with Leviton’s guaranteed 4dB headroom above TIA requirements for AXT.

The contractor shall complete all submissions as required by Leviton in order for Leviton to issue a Lifetime Product and Performance Warranty for the installed system, including compliance with the Leviton NextLAN 10Gc AXi Channel Margin Guarantee.

End of Section