

SECTION 27 08 00
COMMISSIONING OF COMMUNICATIONS SYSTEMS

PAET 1 - GENERAL

1.1 DESCRIPTION NOTE: COMMISSIONING OF BACKBONE CABLING ~~IS~~ SHALL BE DELETED AS PART OF ALTERNATE 4.

COMMISSIONING OF MASS NOTIFICATION AND PA CABLING ~~IS~~ SHALL BE DELETED AS PART OF ALTERNATE 4.

THE COMMISSIONING OF HORIZONTAL VOICE AND DATA CABLING IS NOT IN CONTRACT-N.I.C.

- A. The requirements of this Section apply to all sections of Division 27.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs will manage the commissioning process.
- C. At a minimum, the horizontal Category 6 cabling system, backbone fiber optic cabling system, backbone copper cabling system and paging system shall be tested and commissioned.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.3 SUMMARY

- A. This Section includes requirements for commissioning the communications systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.
- C. The commissioning activities have been developed to support the United States Green Building Council (USGBC) LEED™ rating program and to support delivery of project performance in accordance with the Contract Documents developed with the approval of the VA.
 - 1. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" prerequisite of "Fundamental Building Systems Commissioning".
 - 2. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" requirements for the "Enhanced Building System Commissioning" credit.
- D. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.
- B. The following Communications systems will be commissioned:
 - 1. Facility Telecommunications and Data Distribution Systems.
 - 3. Public Address and Mass Notification Systems (Amplifiers and head-end hardware, speaker volume, and background noise - i.e. hiss or similar interference).

1.6 SUBMITTALS

- A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the Resident Engineer prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS

2.1 HORIZONTAL CATEGORY 6 UNSHIELDED TWISTED-PAIR CABLE TESTER

- A. Shall perform all tests necessary to certify the horizontal Category 6 UTP cabling in accordance with ANSI/TIA/EIA 568 B.2-1.
- B. Shall be a UL certified Level III test set calibrated by a manufacturer certified calibration facility. The calibration shall be dated no more than 60 days prior to the start of testing.
- C. Acceptable Manufacturers
 - 1. Fluke Networks
 - 2. Ideal Industries
 - 3. Agilent Technologies
 - 4. Or equal.

2.2 OPTICAL FIBER CABLE TESTERS

- A. The Contractor shall test all strands of optical fiber cable with an approved power meter and light source. OTDR Trace results to be provided on all fiber strands.
- B. The tester shall be capable of performing the tests required by ANSI/TIA/EIA - 568-B.1, ANSI/TIA/EIA-526-14A, and ANSI/TIA/EIA-526-7.
- C. The tester shall have been calibrated by a manufacturer certified calibration facility. The calibration shall be dated no more than 60 days prior to the start of testing.
- D. Acceptable Manufacturers
 - 1. Fluke Networks
 - 2. Ideal Industries
 - 3. Agilent Technologies
 - 4. Or equal.

2.3 LABELS

- A. Labels shall be laser printed and shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Acceptable manufacturers
 - 1. Brother

2. Ideal
3. Panduit
4. W.H. Brady
5. Or equal

2.4 WORK AREA OUTLET FACEPLATE LABELS

- A. Label each port in each faceplate in accordance with Labeling Scheme identified on the Drawings. Label must be machine printed and inserted in the faceplate label window. Labels shall be provided by the faceplate manufacturer (Belden/CDT, CommScope Systimax, or equal).

2.5 HORIZONTAL CABLE SHEATH LABELS

- A. Label horizontal cable sheaths at work area outlets and at patch panels with laser printed self laminating wrap around vinyl labels. Labels shall be in accordance with the Labeling Scheme identified on the drawings.
- B. Labels shall be white with black type. Label size shall be 1.0" wide by 1.5" high.
- C. At the Telecom Room, cable labels will be affixed to cable a minimum of 1 inch from the termination on the patch panel, and placed in such a way as to be clearly visible.
- D. At the work area outlet, cable labels shall be affixed to the cable 2 inches from the termination on the jack.
 1. Acceptable Manufacturers:
 - a. Brady.
 - b. Belden.
 - c. Hellermann Tyton.
 - d. Or equal.

2.6 COPPER PATCH PANEL LABELS.

- A. Label each patch panel with a single panel ID label in accordance with the labeling scheme identified on the drawings.
- B. Labels shall be compatible with the patch panels provided for the Project.
- C. Label material shall be permanent polyester. Labels shall be white with black type. Label size shall be 0.5" wide by 0.5" high.
 1. Acceptable Manufacturers:
 - a. Brady.
 - b. Belden.
 - c. Hellermann Tyton.
 - d. Or equal.
- D. Label each patch panel port with a laser printed label. Label each port with the room number of the room housing the work area outlet.
- E. Labels shall be compatible with the patch panels provided for the Project.
- F. Label material shall be permanent polyester. Labels shall be white with black type. Label size shall be 0.375" high.
 1. Acceptable Manufacturers:
 - a. Brady.
 - b. Belden.
 - c. Hellermann Tyton.
 - d. Or equal.

2.7 TELECOM ROOM FIBER OPTIC TERMINATION CABINET LABELS

- A. Label each fiber optic patch panel with a single panel ID label in accordance with the labeling scheme identified on the drawings.

- B. Label material shall be permanent polyester. Labels shall be white with black type. Label size shall be 0.5" wide by 0.5" high.
 - 1. Acceptable Manufacturers:
 - a. Brady.
 - b. Belden.
 - c. Hellermann Tyton.
 - d. Or equal.
- C. A label will be affixed to the FiberExpress chassis for each Optical Fiber Adapter Strip as shown using the Backbone Cable Labeling Scheme.
- D. Label material shall be permanent polyester. Labels shall be white with black type. Label size shall be 0.5" high.
 - 1. Acceptable Manufacturers:
 - a. Brady.
 - b. Belden.
 - c. Hellermann Tyton.
 - d. Or equal.

2.8 EQUIPMENT ROOM FIBER OPTIC TERMINATION CABINET LABELS

- A. Label each FiberExpress chassis in accordance with the labeling scheme identified on the drawings. Label with a single panel ID label.
- B. Label material shall be permanent polyester. Labels shall be white with black type. Label size shall be 0.5" wide by 0.5" high.
 - 1. Acceptable Manufacturers:
 - a. Brady.
 - b. Belden.
 - c. Hellermann Tyton.
 - d. Or equal.
- C. Label fiber modules in accordance with the labeling scheme identified on the drawings. Labels shall be affixed to the FiberExpress Manager chassis directly on the Plexiglas front cover so labels will be visible when the cover is closed. Place labels below each set of two Connector Modules. Each label will be representative of one Connector Module and will indicate the exact location and position of the cable's far end according to the Backbone Cable Labeling Scheme.
- D. Label material shall be permanent polyester. Labels shall be white with black type. Label size shall be 0.5" high.
 - 1. Acceptable Manufacturers:
 - a. Brady.
 - b. Belden.
 - c. Hellermann Tyton.
 - d. Or equal.
- E. Label each Connector Module with its Slot in accordance with the labeling scheme identified on the drawings.
- F. Label material shall be permanent polyester. Labels shall be white with black type. Label size shall be 0.5" wide by 0.5" high.
 - 1. Acceptable Manufacturers:
 - a. Brady.
 - b. Belden.
 - c. Hellermann Tyton.
 - d. Or equal.

2.9 EQUIPMENT RACK LABELS

- A. Provide labels on the top angle of all equipment racks. Labels shall in accordance with the labeling scheme identified on the drawings.
- B. Racks shall be labeled with Space ID and Rack ID.

- C. Label material shall be permanent polyester. Labels shall be white with black type. Label size shall be 1.0" high.
 - 1. Acceptable Manufacturers:
 - a. Brady.
 - b. Belden.
 - c. Hellermann Tyton.
 - d. Or equal.

2.10 COPPER BACKBONE CABLE SHEATH LABELS

- A. The backbone cable sheaths in the Telecom rooms and at pull boxes shall be labeled. Labels shall be in accordance with the labeling scheme identified on the drawings.
- B. Labels must be clearly visible at the rear of the rack.
- C. Labels shall be self-laminating vinyl labels and must be compatible with the diameter of the backbone cable. Labels shall be 2.5" high by 1.5" wide.
 - 1. Acceptable Manufacturers:
 - a. Brady.
 - b. Belden.
 - c. Hellermann Tyton.
 - d. Or equal.

PART 3 - EXECUTION

3.1 CABLE TESTING - GENERAL

- A. Visually inspect all cables, cable reels, and shipping cartons to detect cable damage incurred during shipping and transport. Return visibly damaged items to the manufacturer.
- B. Where post-manufacture test data has been provided by the manufacturer on the reel or shipping carton, submit copies to the Owner's Representative as part of the cable test results.
- C. The Owner's Representative reserves the right to observe any or all portions of the cable testing process.
- D. The Owner's Representative further reserves the right to conduct, using contractors equipment and labor, a random re-test of up to thirty percent (30%) of the cable plant to confirm documented test results.
- E. Test results and corrective procedures are to be documented and submitted to the Owner's Representative within five (5) working days of test completion.

3.2 CATEGORY 6 UTP CABLE TESTING

- A. A representative of the end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase 5 business days before testing commences.
- B. Field test measurements shall be made in accordance with Annex I of ANSI/TIA/EIA-568-B.2 unless otherwise noted.
- C. Field test measurements shall be conducted from 1 MHz to 250 MHz.
- D. Field testing shall be conducted using a level III tester. The accuracy of the level III tester shall meet or exceed the requirements of Annex B of ANSI/TIA/EIA-568-B.2-1. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
- E. Every cabling link shall be tested in accordance with the ANSI/TIA/EIA-568-B.1 Section 11.2: "100-Ohm twisted-pair transmission performance and field test requirements".
- F. The installed twisted-pair horizontal links shall be tested from the patch panel in the telecommunications room to the work area outlet. The

cable must pass the "Permanent Link" performance limits specification as defined in ANSI/TIA/EIA-568-B.1.

- G. 100% of the installed cabling links must be tested and must pass the requirements of the standards mentioned above. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.
- H. Trained technicians who have successfully attended an appropriate training program shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).
- I. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks. (Reference TIA-568-B; Annex I: Section I.2.2).
- J. The Contractor shall provide Category 6, 250 MHz channel test results on all pairs of cable. The following minimum field test parameters are required:
 - 1. Wire map (including cable shield if present).
 - 2. Length.
 - 3. Insertion loss.
 - 4. Near-end crosstalk (NEXT) loss.
 - 5. Power sum near-end crosstalk (PSNEXT) loss.
 - 6. Equal-level far-end crosstalk (ELFEXT).
 - 7. Power-sum equal-level far-end crosstalk (PSELFEXT).
 - 8. Return loss.
 - 9. Propagation delay.
 - 10. Delay skew.
- K. Test results shall be provided in electronic format and printed 8.5" x 11" format signed by the technician performing the testing. The electronic format should be a Microsoft Word .doc file. Along with the above test parameters, the following information must be included for each cable tested:
 - 1. Name of Owner and name of project (building name).
 - 2. Date and time of test.
 - 3. Name of technician performing the field testing.
 - 4. Manufacturer, model number, serial number and software revision of field tester.
 - 5. Cable ID (Telecom Room # - Patch Panel # - Port # / Work Area Room # - Telecom Outlet - Jack #).
 - 6. Overall Pass/Fail result.
 - 7. Manufacturer, category and model number of cable.
 - 8. NVP used to determine cable length.

3.3 BACKBONE UTP COPPER CABLE TESTING

- A. 100% of the backbone copper cable pairs shall be tested for opens, short, polarity reversals, transpositions, and the presence of AC voltage.

- B. The Contractor shall examine open and shorted pairs to determine if the termination has been done properly. If so, the Contractor shall tag bad pairs at both ends, and make note on the as-built documentation.
- C. If copper backbone cable contains more than one percent (1%) bad pairs, the Contractor shall remove and replace the cable at the Contractor's expense.
- D. The Contractor shall test all backbone copper cables and submit test result information in an electronic format and a printed 8.5" x 11" format signed by the technician performing the testing. The electronic format should be a Microsoft Word .doc file.

3.4 OPTICAL FIBER CABLE TESTING

- A. A representative of the end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase 5 business days before testing commences.
- B. 100% of the installed cabling links must be tested and must pass the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-B.1, ANSI/TIA/EIA-568-B.3 and ANSI/TIE/EIA-568-C.0. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.
- C. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - 1. The manufacturer of the fiber optic cable and/or the fiber optic connectors.
 - 2. The manufacturer of the test equipment used for the field certification tests.
 - 3. Training organizations authorized by BICSI or by the ACP (Association of Cabling Professionals™) Cabling Business Institute.
- D. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-B.1) with a Category 1 light source. Field test instruments for singlemode fiber cabling shall meet the requirements of ANSI/EIA/TIA-526-7.
- E. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
- F. The fiber optic launch cables and adapters must be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
- G. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.
- H. Performance Test Parameters:
 - 1. The multimode backbone links shall be tested in one direction at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A.
 - 2. Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper or equivalent method.

3. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-C.

$$\text{Link Attenuation} = \text{Cable Attenuation} + \text{Connector Insertion Loss} + \text{Splice Insertion Loss}$$

Where:

$$\text{Cable Attenuation(dB)} = \text{Attenuation Coefficient(dB/Km)} \times \text{Length(km)}$$

$$\text{Connector Insertion Loss(dB)} = \# \text{ of connector pairs} \times \text{connector loss(dB)}$$

$$\text{Splice Insertion loss(dB)} = \# \text{ of splices(S)} \times \text{splice loss(dB)}$$

The values for the Attenuation Coefficient are listed in the following table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation Coefficient (dB/km)
Multimode 50/125 um	850	3.5
Multimode 50/125 um	1300	1.5
Single Mode	1310	0.5
Single Mode	1550	0.5

4. The maximum allowable connector insertion loss = 0.75 dB. The maximum allowable splice loss = 0.3 dB.
- I. The Contractor shall test all fiber optic cables and provide test results in electronic format and printed 8.5" x 11" format signed by the technician performing the testing. The electronic format should be a Microsoft Word .doc file. The following field test documentation shall be provided for each fiber optic strand:
1. Wavelength of test (850 nm or 1300 nm for Multimode and 1310 nm or 1550 nm for Singlemode)
 2. Length of segment.
 3. Number of splices.
 4. Link attenuation (for each wavelength).
 5. Overall Pass/Fail result.
 6. Margin by which the strand passed the test (difference between the allowable link attenuation and the measured link attenuation).
 7. Name of Owner and name of project (building name).
 8. Date and time of test.
 9. Name of technician performing the field testing.
 10. Manufacturer, model number, serial number and software revision of field tester.
 11. Cable ID (Telecom Room # - Patch Panel # - Port # / Telecom Room # - Patch Panel # - Port #. Telecom Outlet - Jack #).
 12. Manufacturer, model number of cable, type of cable and strand count.

3.5 CABLE TESTING VALIDATION

- A. To validate the testing and associated results, the Contractor shall participate in cable testing validation.

- B. After the Contractor has completed all cable testing and submitted test results, the Contractor shall, in the presence of the Owner's Representative, test up to 5% of the installed and tested cables (random sample to be selected by the Owner's Representative).

3.6 IDENTIFICATION AND LABELING

- A. The Contractor shall confirm the telecom room and work area room numbers with the Owner or Owner's Representative prior to labeling.
- B. The following items shall be labeled. The contractor shall determine and shall follow the Owner's labeling scheme for all items:
1. Work Area Outlet Face Plates.
 2. Work Area Data and Voice Jacks.
 3. Work Area Horizontal Data, Voice and Video Cable.
 4. Telecom Room Horizontal Data, Voice and Video Cable.
 5. Patch Panels.
 6. Patch Panel Ports.
 7. Fiber Termination Cabinets.
 8. 110 Blocks.
 9. Backbone Cables.
 10. Telecom Grounding Bars: Grounding bars shall be labeled in each telecom room. The label should identify the telecom room and the type of telecom grounding bar (TGB or TMGB). For example, MDF ground bar = "MDF-TMGB".
 11. Telecom Grounding Conductors.
 12. Paging system components including speakers, PAM's, DSS "bus" cabling, speaker cabling, pull boxes, power supplies, etc. Contractor shall label the paging system to match the existing paging system throughout the building.

3.7 ADMINISTRATION

- A. As-Built Drawings.
1. The Contractor shall provide As-Built drawings at the end of the project. One (1) reproducible and (1) blue line shall be provided. Electronic versions of the drawings in AutoCAD version 2000/2002 shall also be provided. The following information shall be provided on the As-Built Drawings:
 - a. Plan location of all telecom outlets.
 - b. Quantity and type of drops at each telecom outlet.
 - c. Telecom room where the drops are terminated.
 - d. Cable tray layout. Provide dimensions from building grid lines to locate cable tray.
 - e. J-hook layout. Provide dimensions from building grid lines to locate J-hook runs.
 - f. Conduits and pull box layout. Provide dimensions from building grid lines to locate conduits and pull boxes.
 - g. Backbone cable runs and pair/strand counts.
 - h. Horizontal and vertical sleeve layout.
 - i. Outside plant vaults and pull boxes. Provide dimensions from curbs to locate vaults and pull boxes.
 - j. Outside plant conduits. Provide dimensions from curbs to locate conduit.
 - k. Paging system components including speakers, power supplies, PAM's and cable routing.

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