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January 6, 2000

EXECUTIVE SUMMARY

The <school/district> will be implementing a new wiring infrastructure system campus wide. The System consisting of, but not limited to: horizontal, riser, and backbone cables, connecting hardware and accessories, raceways, conduit and pathways required for on-site transport of telephone and data signals between equipment rooms in outlying buildings and outside utilities/service providers. Work includes all labor, materials, equipment and services required to provide an integrated and complete installation of the wiring infrastructure system.

GOALS

The following are the major objectives of the new communications wiring system:

- Obtain a high quality job that meets TIA/EIA 568A, 569 Telecommunication Standards, NFPA and NEC code compliant.
- Obtain the best price for a quality job
- Provide a wiring infrastructure that will support the needs of the clients for at least the next seven years without a major upgrade.
- Provide a termination system that is uniform in labeling, arrangement, designation, and appearance, with a common method of terminating voice and data wiring
- Complete documentation of the wiring system to include as-built drawings with each pathway and connect itemized on the prints
- Provide Category 5E common manufacturers warranty

SECTION 1

1.00 TELEPHONE AND DATA WIRING & SYSTEMS

1.01 SUMMARY

A. Section Includes:

The infrastructure wiring systems consisting of, but not limited to: horizontal, riser, and backbone cables, connecting hardware, equipment and accessories, raceways, conduit and pathways required for on site transport of telephone and data signals between equipment items in a building and connection with external telephone utilities. Work includes all labor, materials, equipment and services required to provide an integrated and complete installation of the systems.

Among the items required are:

1. Horizontal cabling and connecting hardware between Distribution Frames and outlets (nodes) throughout the site. Cabling in a star topology from Termination Points to each node with Category 5E cable.
2. Backbone cabling with fiber optic cable from the MDF (main distribution frame/Administration Building) to the HDF's (horizontal distribution frames) in each campus building.
3. Provision of adequate communications pathways and spaces using EIA/TIA 569 as a minimum requirement.
4. Hardware, labeling, and identification required to provide a complete and operable facility meeting the performance standards listed in this specification.

1.02 REFERENCES:

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Unless otherwise noted use the most recent edition. Where the contract documents differ from the standards and codes, the stricter shall govern.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)/TELECOMMUNICATIONS
INDUSTRY ASSOCIATION (TIA)

EIA/TIA 568	(July 9, 1991) Commercial Building Telecommunications Wiring Standard
EIA/TIA 569	(Oct. 15, 1990) Commercial Building Standard for Telecommunications Pathways and Spaces
EIA/TIA 607	Grounding and Bonding Requirements for the Telecommunications Infrastructure of Commercial Buildings
EIA/TIA TSB 36	(Nov. 1991) Additional Cable Specifications for Unshielded Twisted Pair Cables

EIA/TIA TSB 40	(Aug. 1992) Additional Transmission Specifications for Unshielded Twisted-Pair Connecting Hardware
EIA/TIA TSB 67	Transmission Performance Specifications for Field Testing of UTP Cabling Systems
EIA/TIA TSB 72	Centralized Optical Fiber Cabling Guidelines

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70/72	National Electrical Code
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BUILDING INDUSTRY CONSULTING SERVICE INTERNATIONAL

BICSI	Telecommunications Distribution Methods Manual
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UNDERWRITERS LABORATORY (UL)

UL 50	Enclosures for Electrical Equipment
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1.03 PROJECT/SITE CONDITIONS:

A. Environmental Requirements:

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing. Follow requirements of EIA 569 where active electronic equipment is located in telecommunications closets and equipment rooms.

B. Asbestos Contaminated Material:

Do not disturb Asbestos Contaminated Material (ACM). Do not route cabling through ACM. Previously unknown ACM may be found during installation of cabling. If asbestos, or suspected asbestos, is encountered in any form, the contractor shall immediately notify the <school/district> Representative.

C. Field Measurements:

Prior to start of work Contractor shall conduct field measurements as required to perform the work, including the determination of necessary cabling lengths required for the cable routes. Notify the <school/district> Representative of any conflict with the contract documents.

1.04 QUALIFICATIONS:

A. Minimum Installer Qualifications:

All work under this section shall be performed by, and all equipment shall be furnished and installed by, a certified telecommunications installer. With the exception of furnishing and installing conduit, electrical boxes, and pull wires, this

work shall not be performed by an electrical subcontractor. The installer shall have the following qualifications in Telecommunications Systems installation:

1. The installing firm shall have a minimum of 3 years experience (if applicable) in the application, installation and testing of the specified systems and equipment.
2. All supervisors and installers assigned to the installation of this system or any of its components shall have factory certification from each equipment manufacturer that they are qualified to install and test the provided products. General electrical trade staff (electricians) shall not be used for the installation of the LAN system cables and associated hardware.
3. All installers assigned to the installation of this system or any of its components shall have a minimum of 3 years licensed experience in the installation of the specified copper and fiber optic cable and components. All installers shall have a current Journeyman Limited Energy license. Non-licensed personnel may be accepted on a case-by-case basis with written approval by the <school/district> representative.

B. Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract shall be from manufacturers with a minimum of 3 years experience in producing the types of systems and equipment specified.

1.05 WARRANTY:

Submit a written warranty covering materials and workmanship for a period of fifteen (15) years from the date of final acceptance. Warranty shall be as provided by Lucent "Systemmax SCS High-5 Products 15 Year Assurance Program Coverage", Siemon/CommScope 15 year warranty program, MOD-TAP's "System 100 15 year System Guarantee and Lifetime Product Warranty" or Ortronics "25 Year Extended Product Warranty". All installers must be certified by either Lucent, Siemon/CommScope, MOD-TAP or Ortronics certified installer plus programs.

Upon notification of a problem, the warranty provider shall furnish within 48 hours of verbal notification, within 4 hours of written notification, and at no cost to the owner, such labor and materials as needed to return the system to proper operation and functionality per <school/district> acceptance.

Warranty shall include provision that <school/district> may make emergency repairs without voiding the warranty.

Warranty shall be submitted prior to substantial completion for approval.

1.06 SUBMITTALS:

A. Material and Equipment Lists:

Submit material and equipment lists covering all LAN materials as follows:

1. Before commencing work, furnish two copies of complete Material Lists. Assemble submittal data in a loose-leaf, 3-ring binder. Include only information on exact material installed; not complete "line" of manufacturer. Where catalog sheets show proposed material as well as other materials or equipment, identify proposed material with rubber stamp arrow or similar concise method.

B. LAN Documentation:

Provide two completed copies of cabling documentation to include:

1. A building block diagram showing distribution frame location and cabling routes. Modify existing drawings as required to show any approved changes and or deviations.

C. Maintenance Data:

Submit the following prior to final acceptance and request for final payment:

1. Maintenance Data Binder (to be submitted before substantial completion)

a. Format:

Commercial quality, 8-1/2" x 11" x2", blue 3-ring hardback binders.

b. Content:

One copy of all wiring documents for each equipment room, in it's own labeled section. All documents shall be signed and dated.

A product list that includes all products used listed by manufacturer, name and part number.

One floor plan, per floor, size 8 1/2"x11" for each equipment room, showing just the area covered by that equipment room. Each floor plan shall include all as built jacks, pull boxes, pathways and raceways.

One copy of the cooper test results for each cable installed, by cable number.

One copy of the OTDR test result for each fiber installed, by number/color code.

One copy of warranty certification.

c. Amount:

Following approval of the Maintenance Data Binder, provide one binder for each equipment room and two additional copies (in binders) to the <school/district> Representative.

2. As-built drawings.

One copy of full size, reproducible, as built drawings, shall be submitted to the <school/district> representative.

3. Equipment rooms:

- a. Each equipment room shall have one binder placed in the equipment rack.
- b. Each binder shall contain all documentation for that equipment room.
- c. Binders shall be prepared as indicated above.

4. Keys:

- a. Two sets of all keys for all enclosures shall be supplied to the <school/district> representative.
- b. No keys shall be left in the equipment rooms.

D. Shop Drawings - LAN:

All shop drawings shall be submitted and approved before work begins. Shop drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and shall function properly as an integrated system. Drawings shall include vertical riser diagrams (if any), equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, raceways, conduits, cable trays and pathway devices. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Indicate routing of all raceway segments. Provide finish system and color for all raceways, conduit and accessories. System drawings and records showing final configuration, including location, type, block, panel and terminal assignment of cabling as specified, and floor plan layout of the equipment room. A copy of the shop drawing(s) shall be included in each maintenance manual binder.

E. Manufacturer's Recommendations:

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, shall be submitted prior to installation. Installation of the item shall not proceed until the recommendations are received and approved.

F. Test Plan:

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, must be submitted **14** days prior to the proposed test date. The test plan must be approved in writing before the start of any testing. The test plan shall identify the capabilities and functions to be

tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

G. Qualifications:

Provide a summary of qualifications of the Manufacturer(s), Contractor(s), and the Installer(s) performing the work specified herein. This summary shall include proof that all parties meet the minimum qualifications specified herein.

H. Test Reports:

Test reports in booklet form with witness signatures verifying execution of tests. Test results shall also be provided on 3-1/2 inch diskettes "Comma Separated Variable" (CSV) format. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test results for each cooper cable and OTDR test results for each Fiber shall be submitted and approved within 14 days after the cable has been tested. See paragraph 3.12 Testing for detailed requirements.

I. System Certification

Written certification that the LAN system fully complies with the requirements of EIA/TIA 568, EIA/TIA 569, EIA/TIA TSB 36, and EIA/TIA TSB 40 standards.

J. Materials and Equipment Certification:

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

K. Installer Certification:

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products and licensed.

L. Operation and Maintenance Manuals:

Commercial off the shelf manuals for operation, installation, configuration, and maintenance for all products provided as a part of the LAN system. Specification sheets for all cable, connectors, and other equipment.

1.07 SUBSTITUTIONS:

During bidding, the <school/district> representative will consider written requests for substitutions. No request will be considered unless received at least five calendar (10) days prior to the final Bid date.

In making request for substitution, Bidder/Subcontractor represents:

1. It has personally investigated proposed product or method, and determined that it is equal or superior in all respects to that specified.
2. It will provide the same guarantee for substitution as for product or method specified.
3. It will coordinate installation of accepted substitution into Work, making such changes as may be required for Work to be complete in all respects at no additional cost to the <school/district>.
4. It waives all claims for additional costs or time extensions related to substitution which consequently becomes apparent.

1.08 DELIVERY AND STORAGE:

Equipment and materials delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

1.09 QUALITY ASSURANCE:

- A. Contractor shall hold a pre-construction meeting to discuss and clarify all aspects of the work under this section with the <school/district> representative.
- B. Throughout the construction period the contractor shall maintain inspection of the work to assure installation quality and conformance with the specifications. All non-conforming products and work shall be corrected at no cost to the <school/district>.
- C. Deviations from the Contract Documents are only permitted with the prior written approval of the <school/district> representative.
- D. Site inspections shall be at 25%, 50%, 90%, substantial and final completion.

1.10 SCHEDULING:

- A. Coordinate all modifications to site electrical service required to occur prior to or concurrent with the work of this section.
- B. Coordinate the installation of cabling with the installation of raceways and outlet box systems.
- C. Coordinate the installation of equipment racks and associated systems in MDF and HDF rooms with the <school/district> representative.
- D. Maintain a field copy of all project documentation incorporating up to date modifications and changes. Documentation shall be available for review on site at all times. During prefinal and final inspection of the work, the Contractor shall make available for review at the site a copy of all project documentation.

2.00 PRODUCTS

2.01 MATERIALS AND EQUIPMENT:

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's current standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70. All products or manufacturers used shall be as specified below or as approved in writing by the <school/district> representative.

2.02 APPROVED MANUFACTURERS:

- A. Cable:
Lucent, Comscope or Berk-Tek LAN 350 or approved equal.
- B. Fiber Optic Cable:
Specified: Lucent, Berk-Tek, Belden, chromatic or approved equal.
- C. Jacks:
Lucent, MOD-TAP, Siemon, or approved equal.
- D. Fiber Optic Terminations:
Lucent, Automatic Tool Company, MOD-TAP or approved equal.
- E. Enclosures:
Lucent, AMP , MOD-TAP, B-JED, Ortronics, Radiant, or approved equal.
- F. Equipment Racks and Wall Closets:
Southwest Enclosures Inc.

2.03 CABLING:

- A. Horizontal Cable:
 - 1. Non-plenum cable:
 - a. Gauge: #24 AWG
 - b. Pair Size: 4
 - c. Weight: 23 lb/1000 ft.
 - d. Outside Diameter: 0.21in
 - e. Mutual capacitance: 14nf/1000FT.
 - f. Attenuation (dB/1000ft.):
 - @ 1.0 MHZ: 6.3
 - @ 4.0 MHZ: 13
 - @ 10.0 MHZ: 20
 - @ 16.0 MHZ: 25
 - @ 20.0 MHZ: 28
 - @ 100.0 MHZ: 67
 - g. Characteristic Impedance at 1.0 - 25.0 MHZ: 100 +/-15%
 - h. Near-end crosstalk (max.dB)
 - @ 1.0 MHZ: 68
 - @ 4.0 MHZ: 59

- @ 10.0 MHZ: 53
- @ 16.0 MHZ: 50
- @ 100.0 MHZ: 38

- i. Cable is solid copper conductor, insulated with fire retardant polyethylene. Insulated conductors and twisted pair and jacket with gray fire-retardant polyethylene (Computer Connection). Cable must meet enhanced Category 5 and EIA/TIA TSB-36 requirements. Reference product: Lucent 1061.
- j. Cable is solid copper conductor, insulated with fire retardant polyethylene. Insulated conductors and twisted pair and jacket with blue fire-retardant polyethylene (Telephone Connection). Cable must meet enhanced Category 5 and EIA/TIA TSB-36 requirements. Reference product: Lucent.
- k. Cable is solid copper conductor, insulated with fire retardant polyethylene. Insulated conductors and twisted pair and jacket with yellow fire-retardant polyethylene (server/service Connection). Cable must meet enhanced Category 5 and EIA/TIA TSB-36 requirements. Reference product: Lucent

2. Plenum Cable:

- a. Gauge: #24 AWG
- b. Pair Size: 4
- c. Weight: 19.2 lb/1000 ft.
- d. Outside Diameter: 0.20 in.
- e. Mutual Capacitance, Characteristic Impedance, Attenuation and Near-end CrossTalk: Same as non-plenum areas.
- f. Cable is solid copper conductor, insulated with FEP. Insulated conductors are twisted pair and jacket with Fluoropolymer. Must meet enhanced Category 5 and EIA/TIA TSB-36 requirements. Reference product: Lucent 2061.

3. Outdoor and Underground Cable:

- a. Gauge: #24 AWG
- b. Pair Size: 4 (minimum)
- c. Outside Diameter: 0.21in (minimum)
- d. Mutual capacitance: 4.6nf/330FT.
- e. Attenuation (max. dB/330ft.):
 - @ 1.0 MHZ: 2.0
 - @ 4.0 MHZ: 4.1
 - @ 10.0 MHZ: 6.5
 - @ 16.0 MHZ: 8.2
 - @ 20.0 MHZ: 9.2
 - @ 100.0 MHZ: 21.0
- f. Characteristic Impedance at 1.0 - 25 MHZ: 100 +/- 15%
- g. Near-end crosstalk (max.dB)
 - @ 1.0 MHZ: 69
 - @ 4.0 MHZ: 60
 - @ 10.0 MHZ: 54
 - @ 16.0 MHZ: 51

@ 100.0 MHZ: 39

- h. Cable is solid copper conductor, insulated with polyethylene. Insulated conductors are twisted pair and jacketed with polyethylene. Designed for direct burial, underground or aerial applications. Must meet enhanced Category 5 and EIA/TIA TSB-36 requirements. Reference products: CommScope 568Ultra II - part number 5NF4; Essex Broadband OSP - BB or Megapic

B. Riser and Backbone Cable:

1. Optical Fiber

- a. Type 62.5/125 microns.
- b. Number of Fibers: 12
- c. Attenuation: Typical 2.9/0.9 dB/KM
- d. Bandwidth MHz-KM 160/500
- e. Outside Diameter: 0.47 in.
- f. Fiber must meet or exceed (FDDI/ANSI) X39.5 PMD for 62.5/125. Must be UL listed Non-conductive Optical Fiber Riser (OFNR) for non-plenum use or Non-conductive Optical Fiber Plenum (OFNP) for plenum application. Outdoor or underground fiber must be rated for that use.
- g. Must have high strength Aramid Fibers applied to each individual component.
- h. Cable must be breakout type cable.
Reference products:
Riser/Backbone: Bertek #HDRO12CA3515/15.
Plenum: Bertek #HDPO12CA3515/15.
Outdoor or underground: Optical Cable Corp. #BX012-125D-W3EB-1HC-900R

2. Fiber Patch Cord

- a. Number of Fibers: 2
- b. Coated fiber Diameter: 250 um
- c. Min. bend radius: 1.25 in. (3.18 cm)
- d. Operating Temperature: -4 to 158 degrees F (-20 - 70 C)
- e. Must be minimum 25' long.
- f. ST connectors
Reference products: Lucent FL2E-E-25, Siecor 02K5141

2.04 METAL ENCLOSURES: LIGHT INTERFACE UNIT (LIU)

A. Optical Fiber:

- 1. 12, 24, or 48 port rack mount all metal enclosures.
- 2. 2.5 mm ST bayonet coupling bushings and adapter plate.
- 3. Provide rubber grommets where cable enters an enclosure outside of a raceway or conduit.
- 4. LIU must be populated with ST couplings for maximum number of fibers installed.

2.05 TERMINATIONS:

A. Wall Jacks:

For locations without raceways where wall jacks are required:

1. Terminate on 8 pin 568B Cat 5E RJ-45 inserts. Insert shall be modular design to permit disconnection from plate without removing the UTP cable.
2. Must have bezel capable of holding 6 jacks.
3. Modules must be able to hold a maximum of 2 jacks and be capable of being removed from bezel. Modules must be interchangeable between different connector.
4. All unused openings shall be covered with a blank plate.

B. Raceway/Floor Jacks

Duplex 8 pin data jacks. Reference product: Mod tap 19-20-EE, Lucent.

C. Fiber Optic Connectors:

1. ST Connectors

- a. Low dB loss (.25 dB).
- b. Compatible with 900 micron buffer cable.
- c. Must be secured to jacket, strength member, and buffer.
- d. 62.5/125 micron multi mode type.
- e. Insertion loss .25 dB to .6 dB max.
Reference product: ATC STA-01-C-T

D. Fiber Optic Couplers:

1. ST coupling sleeves dual flange, threaded, floating, multi mode.

E. Modular RJ-45 Connectors:

1. Category 5E modular RJ-45 patch panels and associated parts shall be provided and installed in equipment racks.

2.06 BACKBOARDS:

A. Equipment Mounting Board:

1. 3/4 inch thick void free fire retardant treated plywood or void free ACX plywood with two coats of fire resistant paint shall be used in each equipment room in approved location for the mounting of the enclosures.

2.07 ACCESSORIES:

A. Distribution Rings:

1. Die cast aluminum designed for holding cables in orderly fashion

2.10 EQUIPMENT RACKS:

A. Floor Mounted Equipment Frame:

1. 24 inches wide x 24 inches deep x 84 inches high
2. 16 gauge carbon steel carbon steel tubing
3. All welded construction, color: black.
4. All racks shall be assembled with the following accessories listed below:
(4) shelves, (2) Side panels (2) 2 pair mounting rails and
1 Power strip: Reference product: Southwest Data
Products SWE110

B. Wall Mounted Equipment Rack:

1. 23 inches wide x 20 inches deep x 36 inches high
2. 16 gauge steel tubing
3. Hinge on right hand side
4. All racks shall include 2 pair mounting rails.
Reference product: Southwest Data Products SWE450

C. Accessories:

1. Shelves:
 - a. 100 lb. weight capacity
 - b. 20 inches wide x 18 inches deep
 - c. Carbon steel construction
 - d. Mounting hardware holes on standard EIA spacing.
Reference product: Southwest Data Products SWE703
2. Side Panels:
 - a. 24 inches wide for floor mount rack
 - b. Carbon steel construction
 - c. All welded construction
Reference product: Southwest Data Products SWE113
3. Mounting Rails:
 - a. 84 inches long for floor mount rack.
 - b. Carbon steel construction
Reference product: Southwest Data Products SWE730
 - c. All rails shall have threaded holes.
4. Power Strip (Floor Rack)
 - a. 10 grounded outlets
 - b. 48 inches long (Floor Rack)
 - c. six foot power cord
 - d. 15 amp rating with circuit breaker
Reference product: Southwest Data Products SWE705-10
5. Power Strip (Wall Rack)
 - a. 6 grounded outlets
 - b. six foot power cord
 - d. 15 amp rating with circuit breaker

6. Rack Wire Management
 - a. Associated Rack mount wire management panels are to be installed between each rack mount RJ-45 modular patch panel.
 - b. Each Rack installed shall contain a vertical wire management device.

3.00 EXECUTION

3.01 EXAMINATION:

Examine all surfaces, substrates, cable routes, adjacent construction and related systems affected by the Work installed under this section prior to starting work. Notify the <school/district> representative of any unsatisfactory conditions affecting or restrictions upon the installation of the Work as designed. Do not proceed with Work until unsatisfactory conditions have been resolved.

3.02 GENERAL INSTALLATION REQUIREMENTS:

A. Components:

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturers instructions, EIA/TIA 569, Section 4: CONDUITS, RACEWAYS, BOXES AND FITTINGS below, and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided by contractor.

B. Penetrations:

Penetrations in fire-rated construction shall be firestopped in accordance with the following:

1. 2-3 hour fire penetration test per ASTM E 814, UL 1479, or IEEE 634.
2. Flame spread: 0; smoke contribution: 0, per ASTM E 84.

Penetrations in corridor "smoke membranes" shall be sealed with fire stop sealant:

Putty Fire-Rated Sealants:

1. 3M Putty 303.
2. Nelson Electric "Flameseal" Putty.
3. Standard Oil "Pure Putty".

C. Electrical Consideration:

1. Conduits, outlets and raceways shall be installed in accordance with EIA/TIA 569 and Section 4: CONDUITS, RACEWAYS, BOXES AND FITTINGS. Wiring shall be installed in accordance with EIA/TIA 568 and as specified in Section 5: BASIC ELECTRICAL MATERIALS AND METHODS. Wiring, and

outlets shall be marked in accordance with article 3.06 of this specification.

2. Cables shall not be installed in the same cable tray, conduit, utility pole compartment, or floor trench compartment with ac power cables.
3. No interruption of service to any part of the existing facilities will be permitted without express permission in each instance from the Owner. Obtain written permission from the Owner for any interruption of power, lighting or signal circuits and systems.
4. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work, due to maintaining continuity of service herein required.
5. Organize work to minimize duration of power interruption.

3.03. CABLE ROUTING:

A. General Routing Requirements:

1. Provide a common cable route in an accessible area, for as many cables as is possible for as long as is possible.
2. Routes for cabling shall be reviewed and approved at a pre-construction meeting attended by the contractor, LAN system designer and <school/district> representative.
6. All data cable, raceway or conduit shall be installed at a minimum of 16 inches from all parallel runs of fire alarm raceway, conduit or cable.
4. Cables shall not be installed in the same cable tray, conduit, utility pole compartment, or floor trench compartment with ac power cables.
5. All routes shall be installed in crawl spaces or soffit areas whenever possible, with access hatches installed as required for easy access.
6. All data raceway, conduit or cable shall be installed with a minimum separation of 12 inches from parallel runs of power raceway, conduit or conductors.
7. Routes indicated within metal conduit or raceways shall be continuous from each node to its appropriate equipment room.
8. All routes shall be sized for future capacity. Nominal (future) cable cross sectional area of a route shall be 4 times the combined cross section area of all cables installed under this contract. Route components (raceways, conduits or pathway devices) shall be sized not to exceed a 50% fill ratio for the nominal (future) cable area. The maximum number of cables allowable for a 40% fill for the following common component trade sizes shall be as follows:

EMT: 1/2"-3, 3/4"-5, 1"-8, 1-1/4"-15, 1-1/2"-21, 2"-34, 2-1/2"-50, 3"-76, 3-1/2"-103, 4"-132

WIREMOLD: series 700 -3, series 2100 -9, series 3000 -39, series 4000 with divider -39, series 4000 without divider -80

9. Access to any pull boxes, raceways, pathways or equipment rooms shall not be made from or through any restroom, locker room or similar space.
10. No cables, raceway, conduit or pathway shall be installed on the exterior of any building, or otherwise exposed to the environment, without the prior written consent of the <school/district> representative.
11. No cables, raceway, conduit or pathway shall be installed closer than 16 inches to a fluorescent light fixture
12. No raceway, conduit or pathway shall terminate above an equipment room ceiling. All raceways, conduits or pathways shall be continuous from the equipment rack/equipment board to an accessible area outside the equipment room.
13. When raceways, conduits or pathways are routed through crawl spaces, locate the route to one side of the crawl space.
14. Pull boxes shall not be used in place of a raceway bend. Creating a 90 turn exiting from a pull box is not acceptable.

B. Routes Through Exposed Areas:

1. Where exposed routes are required, install all surface mounted cabling in two piece metal raceways. Vertical raceways shall be Wiremold V4000 or approved equal. Horizontal raceways shall be Wiremold V4000.
2. All raceways shall be securely anchored at a maximum of every 4 feet to a building structural member (wall stud, rafter, floor joist, etc.). Tie wraps shall not be used to anchor any raceway or cable. Secure raceways to masonry or concrete with pan head phillips screws into lead sleeve anchors. Secure raceways to gypsum wallboard with pan head toggle bolts. Power driven fasteners, molly bolts and tappets are prohibited.
3. Provide boxes in walls with a minimum depth of 3 inches, and a minimum of six (6) 3/4 inch diameter knockouts; no cable clamps. At gypsum wallboard only, secure surface boxes with "zip it" anchors.
4. Install boxes in walls with grip-locs as required.
5. Any horizontal raceway with an outlet installed in it shall have entrance end fittings where power or data cables enter the raceway or where raceway enters rooms.
6. All raceways shall be installed with all miscellaneous hardware fittings and accessories standard to that raceway system. All of these components will be the standard product of the raceway manufacturer produced for use with that particular model raceway. Field fabricated corners, elbows, boxes fittings or accessories are not acceptable.

8. Two piece surface metal raceway shall not penetrate any wall, floor or hard surface ceiling. Raceways may penetrate suspended acoustic tile ceilings provided that an appropriate flashing, grommet or entrance fitting is used. Where raceways penetrate suspended acoustic tile ceilings the dimension of the opening shall not exceed the dimension of the raceway by more than 1/8 inch on any side.
10. Flex conduit is prohibited without prior written approval by the <school/district> representative.
11. Chase nipples shall be used at all locations where wire enters metal raceways without conduit interface.
12. Conduit shall not be visible in any exposed area.
13. Two piece raceway shall not be mounted to the floor for any reason.
14. Floor penetrations into two piece raceway shall be tight to the wall or structure that the raceway is mounted on, such that the raceway completely covers the penetration. Location of the floor penetration shall not create a tripping hazard.

C. Routes Through Non-Exposed Areas:

1. Non exposed areas are defined as those areas not accessible to the public (such as areas above suspended ceilings, attic spaces, utility tunnels, Boiler Rooms, Equipment Rooms, and crawl spaces). Verify locations of non-exposed areas with <school/district> representative as necessary for clarification.
2. Cable routed through non-exposed areas shall be run in electrical metallic tubing (EMT) or run exposed, retained and supported by pathway accessories (Cat 5E compliant support devices).
3. General Installation Requirements:
 - a. Anchor all conduit and pathways in non-exposed areas a minimum of 18 inches above the walking surface, where possible the pathway or raceway shall be anchored above 72 inches and below 80 inches above finished floor.
 - b. Install all cables and conduits in a manner not to pose a trip hazard, or to block access to and from any portion of the area.
 - c. Install all cable hooks a minimum 18" above walking surface with horizontal spacing not to exceed five (5) feet apart.
 - d. Cables installed vertically in existing walls shall enter through a minimum 1 inch diameter hole drilled through the center line of the top plate and any blocking in the wall. Provide a pull string in each wall accessed from above with a minimum. 3 foot long pigtail secured at the box and above the wall.
 - e. The use of Tie wraps will not be allowed for any reason.

- f. When EMT is not used, pathways shall be constructed using Category 5 J-Hooks as the first device option.
 - g. Cables running down through walls shall enter raceway system through chase nipples and an entrance fitting in the raceway system.
4. All Raceways and Conduit:
- a. Anchor all raceways and boxes securely and permanently to the building structure. Tie wraps will not be used to anchor any raceway or boxes. Secure raceways to masonry or concrete with pan head phillips screws into lead sleeve anchors. Secure raceways to gypsum wallboard with pan head toggle bolts. Power driven fasteners, molly bolts and tappets are prohibited.
 - b. Install an insulated connector on the end of all raceways or conduit that terminate in a non-exposed area.
 - c. Extend all conduit ending on an equipment mounting board 6 inches onto the board and anchor securely.
 - d. Terminate all conduit used for optical fiber cable inside a Light Interface Unit (LIU).
 - e. No cable shall traverse more than two 90 degree bends or a maximum of 180 degrees of curvature between pull boxes.
 - f. Provide pull boxes along conduit at a maximum spacing of 100 feet. Whenever possible pull boxes shall be located within reach of access hatches or accessible areas. Pull boxes shall not be used in place of a conduit bend. All conduit runs shall be straight through all pull boxes.
 - g. Pull boxes shall be 12" x 12" x 4" with screw type lids.
 - h. Provide a pull string for future use in all conduit. Pull string to remain in place after wire has been installed.
 - i. Provide 12" x 12" x 4" weather proof boxes in any areas of high moisture and where needed.
 - j. The use of conduit outlet bodies (condulets or LB's) is not allowed.
 - k. One hole metal strap, two hole metal strap or kindorf clamp will be the only approved method to anchor conduit.
 - l. When an existing conduit is used, that conduit shall be made consistent with current code and this specification.
 - m. Flex conduit shall not be used without prior written permission from the <school/district> representative.
 - n. Pull boxes shall not be used in place of a raceway bend. Creating a 90 turn exiting from a pull box is not acceptable.

5. Innerduct or Conduit Installation for Optical Fiber:
 - a. Routing shall not include more than two 90 degree bends or a maximum of 180 degrees of curvature between pull boxes.
 - b. Provide pull boxes at a maximum spacing of one per every 100 lineal feet of route. Whenever possible pull boxes shall be positioned within reach of access hatches or accessible areas.
 - c. Pull boxes shall be a minimum size of 12" x 12" x 4" with screw type lids. Weather proof boxes shall be provided in moist areas and where needed.
 - d. Innerduct or conduit shall be secured directly to building structure or supported by Kindorf anchored to the building structure with threaded metal rods with nuts above and below Kindorf.
 - e. Tie wraps shall not be used to support or anchor any innerduct or conduit.
 - f. Innerduct or conduit shall be supported at a maximum spacing of 10 feet.
 - g. A pull string for future use shall be left in all conduit after optical fiber is installed.
 - h. The only methods allowed to secure innerduct or conduit to the building structure shall be one hole metal clamps, two hole metal clamps or kindorf clamps.
 - i. When placed in another type of conduit the innerduct shall not occupy more than 25% of a 40% fill of the conduit's cross sectional area.
 - j. Innerduct and conduit shall be a continuous run from one equipment room to another. Breaks shall only occur in an approved pull box.
 - k. Raceway, conduit or innerduct shall be placed in pull boxes so that there is a straight feed through the box.
 - l. Pull boxes shall not be used in place of a raceway bend. Creating a 90 turn exiting from a pull box is not acceptable.
6. Installation of pathway devices:
 - a. D Rings:

D Rings shall only be used on equipment boards.
 - b. J hooks:

J hooks shall be anchored directly to the building structure. J hooks shall be placed at a maximum of 4 feet apart. J hooks

shall be placed at a minimum of 18 inches above any walking surface of any space they are installed in. Tie wraps may be used on j hooks only to close the top of the hook and then only if it is necessary to keep the wire from falling out. Where possible J hooks shall be installed so that tie wraps shall not be needed to keep the wire in. J-Hooks shall be allowed to be anchored to other electrical support devices specifically designed for the support of electrical raceway.

7. Installation of Backbone Cable Routes:

The installation practices listed below apply only to backbone cable routes and are in addition to the requirements listed above for raceway, conduit and innerduct:

- a. The backbone raceway, conduit and innerduct shall be continuous from the HDF to the MDF.
- b. Flex conduit or conduit bodies shall not be used for any backbone cable routing.
- c. Access to backbone cable pull boxes shall not be accessed from or through any restroom, locker room or similar area.
- d. Backbone cable from each HDF shall be routed independently to the MDF through a dedicated raceway, conduit or innerduct.
- e. All pull boxes shall be located in accessible areas or within reach of an access hatch. All pull boxes shall face the hatch or access area if possible.
- f. All raceways, conduits and innerducts shall be installed plumb, level, parallel and perpendicular to the building structure.

3.04 CABLE INSTALLATION:

A. General Requirements:

1. Install the cabling system to conform to the requirements of EIA/TIA-568 and 569, or as specified herein, whichever is stricter.
2. In conformance with the above referenced standards, install the cable system in a hierarchical star topology.
3. Horizontal cabling shall be home run from each station jack to the distribution frame on the same floor unless specifically approved by the <school/district> representative.
4. No intermediate termination or patching facilities shall be allowed.
5. Backbone cabling shall be home run from the horizontal distribution frame to the main distribution frame and include innerducting.
6. Cable length from HDF to station jack shall not exceed 200 feet without prior written approval by the <school/district> representative.

B. Installation Practices:

1. Attaching cable with staples, or nails is not acceptable. Use of tie wraps to secure cable to conduit, water pipes, steam pipes, building structure or any other material is not acceptable.
2. Install all cables in a manner that prevents the cable from rubbing or otherwise contacting sharp or rough edges during and after installation of the cable.
3. Install cables in the appropriate cable hooks, raceway or conduit as designed.
4. Where cables are installed in pathways composed of hooks, the maximum fill shall be 25% of a 40% fill of the cross sectional area of the hook.
5. During installation do not apply greater tension on cables than that recommended in print by the manufacturer.
6. Pull fiber optic cable through a dedicated conduit, utilizing a pull meter to insure that the maximum tension recommended in print by the manufacture has not been exceeded. No fiber cable shall be installed in a manner that causes curvature less than the listed minimum bend radius.
7. Pull all cables from box to box without bypassing any pull boxes. All pull boxes shall be utilized. All fiber optic cable runs in excess of 100 feet shall be center pulled.
8. Splices and/or repairs are not permitted on any cable . Remove all damaged cabling from the site and replace with new material.
9. Install all cables in a manner that does not damage their sheath or exceed the manufactured maximum pull tension.
10. Install all cables in a manner not to create a trip hazard, or to block access to and from any portion of the area.
11. When installed in a pathway instead of a raceway or conduit, cables shall be installed with a visible sag between supports.
12. All cables shall be installed plumb, level, parallel and perpendicular to the building structure.

C. Cabling Inside Classrooms and Offices:

1. Contractor shall provide cabling and patch cords required to connect individual PC's to the hub. The computer patch cord color must be consistent with equipment room/rack computer patch cord.

D. Plenum Areas:

Provide and install FEP cable in plenum areas.

E. Non-Plenum Areas:

Provide and install polyvinyl chloride (PVC) cable in non-plenum areas.

3.06. TERMINATIONS:

A. Station Jacks:

1. Terminate all station jacks as per TIA/EIA 568 8 position jack pin/pair assignments (designated T568B). Contractor to supply all patch cables.
2. Terminate all station cables to rack mount 110-type UPT to Category 5E RJ-45 patch panel per specs of application warranty for Category 5E EIA/TIA-568.
3. Install all cables on multiple jacks by cable number, left to right and from top to bottom.
4. All station cables shall have a minimum of 12 inches of free cable coiled inside the box.
5. Label all cables with cable number designation within 6 inches of the end of the cable.
6. Jacks shall be installed tab down or tab to right.
7. Terminate Fiber from LIU to equipment rack with approved contractor supplied fiber patch cable.

3.07 STATION CABLES and EQUIPMENT CABLES:

A. General termination practices:

1. Mark all cables with cable number per Section
2. Each cable sheath shall be stripped back no more than 1/2 inch from the termination point of its shortest pair.
3. When terminating the cable pairs, each pair shall be run by the shortest route to the termination point.
4. When terminating the cable pairs, if the colors are on the wrong side, then add a half twist to the pair to bring the colors to the right side. Do not untwist the pairs.

3.08 NETWORK LABELS:

A. Cables:

Label all cables at jack end within six (6) inches of termination using 3M Write-on tape (DCI No. 054007-11954) or equivalent and indelible ink. Cable end in distribution frame labeled accordingly.

1. Horizontal cables in distribution frame and telecommunication outlets:
 Format = HDF No./Cable No./ Room No. i.e. 2.1/001/124A
 HDF = HDF no. as per cabling diagram drawing.
 Cable = 3 character number as per cabling diagram drawing.
 Room No. = 4 or 5 character Room number as per cabling diagram drawing.
2. Backbone cables at each distribution frame:

 Format = MDF No./Cable No./HDF No. i.e. 1.1/001/2.1
 MDF = MDF No. as per cabling diagram drawing.
 Cable = 3 character number as per cabling diagram drawing.
 HDF = HDF no. as per cabling diagram drawing.

B. Data Jacks:

Label the top of all Bezels with the distribution frame number. Each data jack will be labeled with the Cable number on the front side of the face plate.

3.09 EQUIPMENT ROOMS:

A. Installation of equipment and accessories shall be made according to the following general direction.

B. Equipment mounting boards:

1. All boards shall be hung plum, level and secured to studs or solid concrete or masonry walls. Plastic anchors in concrete and masonry, or screws in gypsum wall board or plaster are not acceptable. Anchors for attaching equipment board shall be as follows:

<u>Material/Substrate</u>	<u>Anchor Type</u>
Concrete/Masonry	Expansion anchors - wedge type with a washer located on the back side of the board.
Gypsum Wallboard	Togglebolts - use pan head type.

Powder driven anchors, molly bolts and tappets are prohibited.

C. Accessories:

1. D-rings:

D-rings shall be placed around the perimeter of the equipment mounting board. Locate D-rings 1 inch inside, and perpendicular to, the outside edge of the equipment board. D-rings shall be spaced no more than 12 inches on center around the entire perimeter of the equipment board.

2. Light Interface Unit (LIU):

The fiber LIU shall be mounted inside locking wall racks.

3. Test Jacks:

Install two test jacks in each equipment room. The jacks shall be located within the equipment racks.

D. Equipment racks:

1. Floor mounted equipment racks:

Wherever possible floor racks shall be mounted directly to the right of the equipment board. Floor racks shall be mounted 4 inches from the wall with d-rings, spaced 12 inches apart, behind the rack, in line with the bottom row of equipment board d-rings. Seismic bracing shall be installed on each rack.

2. Wall mounted equipment racks:

Wall racks shall be mounted with the top of the rack at 72 inches. Wall racks shall be plumb, level and secured to building structure member. The door hinge shall be on the right side of the rack.

E. Power Outlets:

Provide a double duplex outlet labeled as "Data" and located along side the equipment rack. The double duplex outlet will be on 2 separate dedicated circuits.

3.10 FLOOR PENETRATIONS:

All floor penetrations required by LAN and associated electrical power systems installation shall be made tight to the wall. No floor penetration shall extend more than 4 inches from the wall. Floor slots shall not protrude more than 4 inches from the wall. Floor slots and penetrations shall not be installed in any location that may create a tripping hazard.

3.11 GROUNDING:

Grounding and Bonding shall comply with EIA/TIA-607 Standards for Grounding and Bonding.

3.12 TESTING:

A. Materials and documentation to be furnished under this specification shall be inspected and tested by the contractor. All components shall be terminated prior

to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the LAN system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

- B. Test and document each copper cable. Testing shall meet the standards set forth in these documents or those required to meet Lucent's, MOD-TAP'S, Siemens/ComScope or Ortronics warranty requirements, whichever is stricter. Each copper cable shall meet or exceed the following:
 - 1. DC Resistance:
The DC resistance shall not exceed 28.6 ohms/1000 FT.
 - 2. Impedance:
The total impedance shall be 100 ohms plus/minus 15% measured at 1-100 MHz.
 - 3. Attenuation:
The attenuation shall not be more than .067 dB/FT measured at 100 MHz.
 - 4. NEXT:
The near end crosstalk shall not be less than 38db/1000FT measured at 100 MHz.
 - 5. Noise:
Burst noise shall not measure more than 254 millivolts on any pair.

- C. Contractor shall test and document each fiber optic cable. Each fiber optic cable shall meet or exceed the following:
 - 1. Attenuation:
The attenuation for each fiber and connectors shall meet TIA/EIA Fiber Standards.
 - 2. All fiber runs must pass OTDR test. Test reports shall be submitted within **14** days after completion of testing

- D. Include a printout for each cable from the original cable test equipment with the original documentation forms. Provide CSV compatible database on 3.5 inch diskette with the test results downloaded from the original test equipment.

- E. Record the tester's name/company and the test date for each cable on the appropriate form as provided in this Specification.

- F. Testing By <school/district>
 - 1. The <school/district> reserves the right to perform inspections and tests of materials incorporated into the work as it deems necessary to assure compliance with Contract requirements. <school/district> testing will be in addition to specified contractor testing requirements.
 - 2. The <school/district> will test 10% of the completed cabling during the prefinal inspection.

3. During inspections performed by the <school/district> representative, the contractor shall provide someone to remove raceway covers, device cover plates and similar covers as required for observation.
4. The contractor shall employ and pay for the services of a separate, qualified independent testing laboratory, to perform additional inspections and testing required when the <school/district> initial tests indicate work does not comply with the Contract.

3.13 CONTRACTOR QUALITY CONTROL:

A. General:

The contractor shall establish and maintain quality control to assure compliance with contract requirements and to maintain records of all quality control for all construction operations including but not limited to:

1. Inspection of material delivered to project site against approved material data.
2. Storage and handling of materials.
3. Verification that all electrical and telecommunications equipment and materials are listed by Underwriters Laboratories, Inc. (UL).
4. Verification that all materials and equipment are installed consistent with this specification and manufacturer's printed instructions.
5. Testing of all components and systems to demonstrate that specified performance requirements are met.
6. Correction or replacement of all work that does not meet technical and/or design requirements.
7. Replacement of all damaged conduit and raceways, where damage shall include dents, dings, abrasions, crimping and marring of paint or anodized finishes.

B. Evaluation of Test Results:

1. If test results show that any part of the Work tested contains material that does not meet the requirements of these specifications, that portion of the Work shall be removed from the site and disposed of at no cost to the <school/district>.
2. Rejected materials shall be replaced with new materials meeting the requirements specified at the Contractor's expense, including <school/district>s extra supervision costs and costs for subsequent tests by the independent testing laboratory as may be required until such Work is approved.

3. The result of the laboratory and/or field control tests embodied in a written report by the testing laboratory shall be the principle basis upon which the satisfactory completion of the Work will be judged.

SECTIONS 2

1.00 CONDUITS, RACEWAYS, BOXES AND FITTINGS

1.01 WORK INCLUDED:

- A. Provide all raceways, wireways and associated fittings as herein specified.

1.02 APPLICATION:

- A. EMT, rigid galvanized, intermediate metal, and PVC conduit may be used. (Aluminum is not allowed.)
- B. Schedule 40 PVC conduit may only be used below grade and in slabs on grade provided it doesn't penetrate more than 15% of the thickness of the slab. PVC may not be used above grade.
- C. Galvanized rigid conduit (GRC) shall be used in locations subject to mechanical injury and for all service conduit.
- D. Electric metallic tubing may be used in all dry and protected locations.
- E. Electrical wiring shall be in U.L. listed raceways and enclosures throughout.

1.03 PRODUCTS

1.04 FITTINGS:

- A. Rigid and intermediate metal conduit shall be coupled and terminated with threaded fittings. Ends shall be bushed with insulating bushings equal to T&B 200 series.
- B. Connectors and couplings for EMT shall be concrete tight set screw type with insulated throats on connectors. Connectors larger than 1-1/4 inch shall be with T&B 200 series insulating bushing.
- C. Contractor shall provide all necessary backfill material for trenching required by conduits routed below grade. Backfill may be excavated from material on site, excluding any rocks over 1-1/2". The top 12" of backfill shall be topsoil.
- D. Reference additional specifications located in Section 3.03 and EIA/TIA, NFPA standards and use the stricter code.

1.05 EXECUTION

1.06 INSTALLATION:

- A. Provide pull boxes where required to limit the number of bends in any run to not more than two 90 degree bends. Use code gauge galvanized sheet steel boxes of code required size with removable covers, installed so that covers will be

accessible after work is completed. Verify with the <school/district> representative any locations in finished areas.

- B. Conceal all wiring in finished spaces. Exposed raceways shall be parallel to structural lines.
- C. Support suspended feeder conduits by metal ring or trapeze hangers with threaded steel rods.
- D. Conduit stubbed from a concrete slab or all to serve an outlet under a table or to supply a machine shall have a rigid conduit coupling flush with the surface of the slab. Provide plug where conduit is to be used in future.

SECTION 3

1.00 BASIC ELECTRICAL MATERIALS AND METHODS

1.01 WORK INCLUDED:

Provide all items, articles, materials, equipment, operations and/or methods listed, mentioned, shown and/or scheduled on the drawings and/or in these specifications, including all labor, services, permits, fees, utility charges, and incidentals necessary and required to perform and complete the electrical work described in this Division.

1.02 QUALITY ASSURANCE:

Do all work in accordance with regulations of serving electric utility, telephone utility, National Electrical Code, National Fire Codes, and all other applicable codes.

1.03 PROJECT CONDITIONS:

- A. The Contractor shall inspect the job site prior to bidding and familiarize himself with existing conditions which will affect his work.
- B. When required make all deviations from Drawings to make the work conform to the building as constructed, and to relate work of others. Minor relocations ordered prior to installation shall be made without added cost to the <school/district>.
- C. Call to the attention of the <school/district> representative any error, omission, conflict or discrepancy in Drawings and/or Specifications. Do not proceed with and questionable items of work until clarification of same has been made.
- D. Under no conditions are beams, girders, footings or columns to be cut for electrical items without written approval obtained from the <school/district> representative.
- E. Arrange work to reduce interruption of any existing services to minimum. When interruptions are unavoidable, consult the <school/district> representative and Utilities involved and agree in writing, with copy to the <school/district> upon mutually satisfactory time and duration.
- F. Verify the physical dimensions of each item of electrical equipment to fit the available space and promptly notify the Architect prior to roughing-in if conflicts appear. Coordination of equipment to the available space and to the access routes through the construction shall be the Contractor's responsibility.

1.04 PRODUCTS

1.05 MATERIALS:

- A. All materials shall be new and bear manufacturer's name, model number, electrical characteristics and other identification. All equipment to be U.L. listed if applicable.

- B. Material and equipment shall be standard product of manufacturer regularly engaged in production of similar material for at least five years (unless specifically exempted) and shall be manufacturer's latest design.

1.06 BOXES:

- A. Outlet and junction boxes shall be sized in accordance with code requirements.
- B. Unless otherwise specified, all outlet boxes for new work shall be galvanized steel knockout, outlet boxes. Gangable boxes are not acceptable. Outlet boxes shall not be smaller than 4" square and 1-1/2 inches in depth, unless otherwise noted. All outlet box covers, rings, or other fittings shall be galvanized.
- C. Outlet boxes shall be designed for the intended use, and shall be installed flush with finish surface lines or not more than 1/8 inch back and shall be level and plumb. Long screws with spacers or shims for mounting devices are not acceptable. No combustible materials shall be exposed to wiring at outlets.
- D. Outlet boxes on opposite sides of fire rated partitions shall have a minimum horizontal separation of 24". Back to back boxes are not permitted in any walls.

1.07 EXECUTION

1.08 GENERAL INSTALLATION METHODS:

- A. Cutting or notching shall be kept to an absolute minimum and done when, and in a method approved by the Christy School representative. Patch and correct finished surfaces damaged by electrical work.
- B. Relays, panels, cabinets and equipment shall be level and plumb and installed parallel with structural building lines. All equipment and enclosures shall fit neatly without gaps, openings, or distortions. Provide approved devices for closing all unused openings.
- C. Feeder runs shall not be recombined or altered.
- D. Where raceways penetrate floors, ceiling, and fire walls, provide fire stopping to maintain integrity of the fire assembly.
- E. It is the intent to require the Contractor to make all necessary adjustments to the existing electrical systems, required to meet code and to accommodate the installation of the new work.
- F. Clearly and properly label the complete electrical system.
- G. Precautions: Do not damage or attempt to remove any material suspected of containing asbestos. In the event insulated piping and/or sprayed or trowelled-on fireproofing, sprayed acoustical material and similar materials are uncovered during cutting and patching operation, notify the <school/district> representative immediately. Do not proceed with the Work in such areas until so instructed by the <school/district> representative.
- H. Contractor shall repair or replace any conduit, wiring and electrical equipment damaged by his personnel or his sub-Contractor's personnel in a timely fashion.

- I. Any relocation of existing electrical work, required to maintain circuit continuity, to avoid conflict with new mechanical, architectural, structural item locations or to accommodate demolition work must be included in bid.
- J. No interruption of service to any part of the existing facilities will be permitted without express permission in each instance from the Owner. Obtain written permission from the Owner for any interruption of power, lighting or signal circuits and systems.
- K. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work, due to maintaining continuity of service herein required.
- L. Organize work to minimize duration of power interruption.

1.09 LABELING:

- A. Clearly and properly label the complete electrical system to indicate the loads served or the function of each item of equipment provided under this work.
- B. Nameplates shall be 1/16 inch thick, laminated three-ply plastic, center-ply white, outer-ply black "Lamicoid" or approved. Letters shall be formed by engraving outer black ply, exposing white center-ply. Nameplates shall be secured with screws or pop rivets.
- C. Provide typewritten branch panel schedules with protective clear, transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on the Drawings.
- D. Identify branch panels with engraved nameplate corresponding with distribution panel labeling. Mount labels inside door for flush panels, and on the face of the door for surface panels. No brand labels or other marking shall be on the outside of the panels. Where changes are made in existing panels, distribution boards, etc., provide new labeling and schedules to accurately reflect the changes.

SECTION 4

1.00 EARTHWORK

1.01 SUBMITTALS:

- A. Test Reports: Submit test reports showing materials comply with Specification requirements.

1.02 QUALITY ASSURANCE:

- A. Regulatory Requirements:
 - 1. The following standards form a part of this Specification:
AASHTO Standards T-99, latest edition (ASTM D-698).
AASHTO Modified Standards T-180, latest edition (ASTM D-1557).

1.03 JOB CONDITIONS:

- A. Shoring and Bracing: Provide adequate shoring, sheeting and bracing in excavations to prevent cave-ins, erosion of steep cuts and embankments.

Protect existing structures, sidewalks, paving, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- B. Barricades: Barricade open excavations and provide warning lights from dusk to dawn each night.

1.04 PRODUCTS:

- A. ENGINEERED FILL: Well-graded, clean, granular, crushed rock, gravel and sand known as "all weather" fill. Limit 1/4" minus non-plastic fines to no more than 7% passing the No. 200 sieve (based on wet sieve analysis). Limit the maximum size of the aggregate to 1-1/2" in the top 12" of fill and to 2" below that depth.
- B. GRANULAR FILL: Well-graded granular pit or bank-run sand and/or gravel containing small cobbles up to 1-1/2" in maximum size, free-draining and with not more than 5 percent fines passing a No. 200 sieve. Obtain fill material from on-site excavations or off-site borrow as approved by the <school/district> representative.
- C. GRAVEL BASE COURSE: 1-1/2" to 1/2" evenly graded, clean, washed, crushed rock.
- D. GRAVEL CUSHION COURSE: 3/4" minus evenly graded crushed rock.
- E. Option: One inch material may be used for both the base course and cushion course throughout.

- F. TOPSOIL: Clean, sandy loam free from all foreign materials, debris, organic matter and gravel. All material shall pass a 1/4" mesh screen. Topsoil shall be material from the Site, properly screened per above and stockpiled on the Site, or from off-site borrows meeting above requirements, as approved.
- G. IMPERVIOUS SHEETING:
 - 1. Polyethylene Sheeting: Commercial Standard CS-238, 6 mil minimum thickness, black.
 - 2. Waterproof Paper: St. Regis Orange Label Sisal-Kraft, or approved equal complying with ASTM C-171.
- H. NON-WOVEN FILTER FABRIC: Celanese Fibers Marketing Company's "Mirafi" 140 Fabric, Phillips Fibers Corporation "Supac" Fabric, Crown Zellerback 150 "Fibretex", or approved, meeting the following minimum requirements:
 - 1. Grab Strength per ASTM D-1628: At least 100 lbs. per inch in either direction (warp/fill).
 - 2. Coefficient of Water Permeability: At least 0.05 cm/sec. when tested per CFMC Feet-2 or M 1110-2-1906 modified.
 - 3. Mildew and Rot Resistance: 100% when tested per AATCC 30 1974.
 - 4. Insect and Rodent Resistance: 100% when tested per AATCC 24 1974.
- I. COARSE SAND: 3/8 to 1/8-inch washed river-run granular material as approved.

1.05 EXECUTION

- A. LOCATE: Perform Locate and Survey existing utilities that may effect excavating.
- B. PREPARATION: Stake out and mark boundary of construction.
- C. CLEARING: Remove all logs, shrubs, brush, other vegetation, debris, existing foundations, pavements, structures, fences and other items, natural or artificial, that are in the way of construction operations, unless otherwise indicated to remain.
 - 1. Remove cleared items from the Site.
 - 2. Protect trees and shrubs indicated to remain.
 - 3. Do not store materials or run equipment near trees to remain.
- D. STRIPPING: Remove topsoil to an average depth of 6 inches. Remove sod, organic material, stone and debris larger than 1/2" in size from all topsoil.
- E. EXCAVATING: :Excavate to grades, elevations and dimensions as required for all footings, foundations, topsoil installation, and other improvements; allow for form clearance. Remove from he Site all unstable materials in excavations not suitable for firm bearing or for backfill.

1. Do not excavate more than 6" below existing grade or add more than 2" above existing grade in areas within 6-feet of existing trees.
- F. **PROOF ROLLING:** Prior to placement of engineered fill, proof roll. Any soft and/or wet areas that are detected by the proof rolling shall be over-excavated to firm ground and the excavation backfilled with compacted engineered fill as directed.
- G. **DRAINAGE:** Maintain excavations free of water at all times.
1. Provide ditches, pumps and other facilities necessary to keep water level at least one foot below bottom of excavations.

1.06 **BACKFILLING:**

- A. **General:** The work "filling" and "backfilling" shall be construed as synonymous.
- Do all backfilling required to complete the Work. Use only approved material for backfilling. Deposit fill materials on approved bearings of existing firm or compacted and undisturbed soil. Extend fill up to height required to accommodate gravel fills, base courses, concrete paving and other superimposed materials. Material used must be approved as suitable for proper handling and compaction under job and weather conditions prevailing at time of deposit and compaction operations
- B. **Preparation:** Before starting backfilling, remove formwork, debris, decayable matter and other foreign matter from excavations. Provide necessary means for sprinkling fill materials with water and drying fill material by spreading and aerating as necessary to obtain the required compaction.
- C. **Backfill Against Foundation Walls:** Backfill with granular fill material from top of drainage gravel up to 8" below finish grade elevation. Place and compact as specified below.
1. Do no backfilling until after drainage pipe and surrounding gravel fill, Drainage, has been installed around foundation footings.
- D. **Gravel Fill Under Ground Supported Concrete Slabs:** Gravel base course and cushion course with impervious sheeting in between. Extend from bottom of concrete slab down to original firm soil or to top of engineered fill. Compact to prevent subsequent settlement. Impervious sheeting not required under exterior slabs.
1. Base course shall be at least 4" thick and extend up to within 2" of concrete slab supported thereon. Level base course, compact, and cover with impervious sheeting, lapping side and end joints at least 6".
 2. Cover impervious sheeting with gravel cushion course at least 2" thick. Bring to level smooth surface or sloped grade as indicated.
- E. **Placement and Compaction:** Place fill material in layers not exceeding 6 inches in thickness. Compact to produce densities specified below. Compact each lift by rolling and/or tamping, applying water when necessary and as required to attain the desired compaction; ponding not permitted.

1. Compact granular fill to within 95% of maximum density at optimum moisture content as determined by AASHTO Standards T-99.
2. Compact engineered fill to 98% of maximum density at optimum moisture content as determined by AASHTO Modified Standards T-180.
3. Compact topsoil to within 90% of maximum density at optimum moisture content as determined by AASHTO Standards T-99.

1.07 GRADING:

- A. Subgrade areas under asphalt concrete paving 8" minimum below finish elevations. Provide firm bearing surfaces to receive subsequent Work.
- B. Proof-roll entire area to receive paving work. Fill depressed areas with granular fill material and compact to density specified above for backfill

1.08 EROSION CONTROL:

- A. Cover drainage gravel with continuous layer of Non-Woven Filter Fabric lapping all joints approximately 1 meter (39.37 inches).
- B. Cover filter fabric with not less than 4" of coarse sand or topsoil as indicated. Compact topsoil to 90% of maximum density at optimum moisture content as determined by ASSHTO Standard T-99. Grade surface to within 4" of finish grades.

1.09 CLEANING UP:

- A. Remove excess materials from site. Leave topsoil in stockpile. Clear construction area of all debris resulting from operations under this Contract.

SECTION 5

DETAILS

1.00 SCOPE OF WORK TO BE PERFORMED:

1.01 INTERNAL WIRING

- A. Install equipment racks and associated parts onto equipment boards
- B. Provide backbone cabling to other distribution rooms via fiber
- C. Install Category 5E cables to designated locations indicated on drawings
- D. Install interior conduit to specification in Sections 1 and 2 or EIA/TIA standards, whichever is stricter
- E. Extend existing PBX wiring infrastructure to new MDF in Administration building
- F. Obtain final design approval from <school/district> representative before construction begins.

1.02 EXTERNAL WIRING

A. CONDUIT:

- 1. Install 2 (minimum 4") conduits between building, 1 for fiber, 1 for cooper.
- 2. Install conduit between all campus building and ISP presence
- 3. Design conduit in consideration of future PBX distance limitations
- 4. Design conduit connection box into Administration Building in support of the future building next door
- 5. Conduit must have minimum depth of cover of not less that 24"
- 6. Fiber will be run in innerduct within 4" or better conduit.
- 7. Install exterior conduit to specification in Sections 1 and 2 or EIA/TIA standards, whichever is stricter
- 8. Obtain final Conduit design approval from <school/district> representative before construction begins

B. TRENCHING/EARTHWORK:

- 1. Backfill all trenchwork per specs Section 4 , AASHTO standards and AASHTO modified standards, whichever is stricter.
- 2. Backfill under asphalt requires 1" minus gravel fill only, compact to specification listed in Section 4.

3. When crossing roadway, Asphalt cutting must be done by sawing, no ripping or breaking

C. LANDSCAPING:

1. Redo landscape to pre-construction appearance

1.03 ELECTRICAL SYSTEM

- A. Install clean power to each equipment room per specifications in Section 3 or National Electric Code, whichever is stricter.

1.04 PHONE SYSTEM

- A. Extend existing PBX wiring infrastructure to new MDF in Administration building
- B. Design wiring infrastructure with new PBX in mind, ie distance limitations etc.
- C. Install/terminate new phone wiring between Administration building and Clark Cottage using new conduit.

1.05 ADMININISTRATION BUILDING:

- A. Use wire molding for external runs. Move/replace existing cables into wire molding not covered by new Category 5E infrastructure installation (all cables not accounted for in attachment 1 table).
- B. Extend existing PBX cabling into new MDF, make preparations for new PBX system with respect to expansion/relocation.
- C. Total number of new connections detailed on attachment 1, <school/district> Telephone and Computer Population Chart.
- D. Verify with <school/district> representative the exact network/telephone drop location within office, to be determined before construction begins. If modifications are required once work begins, obtain written permission from <school/district> authority. Associated charges for any changes will be the responsibility of the Contractor.
- E. Construction/Excavating can not affect exterior appearance of historic building.
- F. Wiring must be installed on the exterior of the lathe-and-plaster walls in specified wire molding throughout the administration building.

1.06 COTTAGES:

- A. Ensure cable runs cannot be tampered with by students. Install in ceilings where possible.
- B. Verify with <school/district> representative the exact network/telephone drop location within office, to be determined before construction begins. If

modifications are required once work begins, obtain written permission from <school/district> authority. Associated charges for any changes will be the responsibility of the Contractor.