

SECTION 28 05 00
COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 – General Requirements" form a part of the Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. The contractor shall provide a completely functional integrated physical electronic security solution as detailed here and within the project documentation.
- B. Provide labor, materials, coordination, and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Access Control System (ACS)
 - 2. Video Surveillance System (VSS)
 - 3. Intercommunications and Program Systems
- C. It is the intent of these specifications to provide a complete workable integrated security system ready for the Client's use as described within the project documentation. Any items not specifically detailed on the drawings or described in the Specifications, but normally required to conform to the intent, are to be considered as part of the Contract.
- D. These specifications are equipment and performance specifications. Actual installation shall be as indicated on drawings, specifications and/or contained within the manufacturers written installation instructions. Any discrepancies found between the specification, drawings and manufacturers' installation instructions shall be immediately brought to the attention of engineer/Client in writing at once. Installation and details indicated on the drawings shall govern if they differ from the specifications.

1.3 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- B. Related Documents and Sections:
 - 1. Division 01 – General Requirements
 - 2. Division 26 – Electrical
 - 3. Division 27 – Communications

C. The following codes, associations, acts and agencies, as required by law

1. American National Standards Institute/Electronic Industries Association/Telecommunication Industries Association (ANSI/EIA/TIA)
2. Federal Communications Commission (FCC)
3. National Fire Protection Association (NFPA)
4. NFPA-70, 2011 (National Electric Code)
5. National Electrical Safety Code (NESC)
6. National Electrical Manufacturers Association (NEMA)
7. Occupational Safety and Health Administration (OSHA)
8. UL Standard for Safety
9. International Building Code
10. International Fire Code
11. Any additional applicable local codes or amendments

D. When a discrepancy arises between the above-mentioned codes, standards or guidelines and the standards contained in this document, it shall be brought to the attention of the Owner immediately for resolution. The more stringent of the two guidelines shall be implemented.

1.4 SYSTEM DESCRIPTION

A. The physical electronic security system will be the center point for the receiving of security signals from various security sub-systems. The Security Operations Center and various Security monitoring locations will receive signals from the Video Surveillance System (VSS), Access Control System (ACS), and Resident Intercom Systems (RIS). Authorized personnel, based on level of authority, will have access to this information and provide control of these systems.

B. Requirements

1. Determine hardware, software, and operation requirements to implement a fully functional security system. Owner shall have final approval of all equipment and locations of system.
2. Install and program all software packages.
3. Install and configure all hardware and related equipment.
4. Setup and configure communications between host server and local workstation.
5. LAN related information shall be provided by owner.
6. Configure cameras on NVR application and database.
7. Test systems operation based on a point-by-point inspection.
8. Shall perform end-user training.
9. Shall participate in system commissioning.

1.5 WORK INCLUDED

- A. Surveillance cameras to be integrated into existing video surveillance platform including all required licensing and modifications to existing platform required to accept cameras added under this scope.
- B. Resident intercom system with required access control integration. Resident intercom system to be local to the Zimmerman-Bingaman (ZB) Cottage.
- C. Shall make final power and data connections to all cameras, power supplies, door hardware, etc.
- D. Shall install all low voltage cabling where required.
- E. Conduit or raceway shall be provided by the Electrical Contractor and is required from devices back to the control and/or network point.
- F. Shall supply all racks and rack hardware that is required for security equipment.
- G. Shall coordinate all requirements with owner to ensure equipment being supplied will function with existing security devices.
- H. Shall coordinate system requirements with computer hardware being supplied will function as intended.
- I. Shall coordinate all locations and layouts of security system with owner. All cabling from network switches to each network security device will be provided by contractor.
- J. LAN/WAN network transmission lines shall be provided by owner. Contractor shall be responsible for interfacing network transmission lines with security system.
- K. Shall follow ANSI/TIA standards for all cabling requirements. Coordinate cable type and hardware with owner.

1.6 DEFINITIONS

- A. Cable Tray: A support mechanism used to route and support telecommunications and other optical fiber cable. Cable trays may be equipped with side walls or barriers to constrain a cable's horizontal placement or movement.
- B. Category 6: The balanced twisted-pair specifications characterized by, among other requirements, a frequency range from 1 to 250 megahertz (MHz).
- C. Communications Pathways: Conduits, cable trays or other supports with the sole purpose of carrying communications cabling. Communications pathways shall not be used by other low-voltage systems, including but not limited to fire alarm, security systems, and or building automation wiring or air/vacuum tubes.
- D. Horizontal Cabling: The cabling between the Telecommunications Room and the Work Area that carries voice, data and/or video signals.

- E. Intermediate Distribution Frame (IDF): An enclosed space designed for housing telecommunications equipment, cable terminations, and cross-connects. The room is the recognized cross-connect between the Backbone and Horizontal Systems. Also frequently referred to as TR.
- F. Plenum-rated: Listed by the Underwriters Laboratory as being suitable for installation into a plenum space. Communications cabling routed through plenum-rated space shall be plenum-rated and identified as Type CMP.
- G. Telecommunications Room (TR): An enclosed space designed for housing telecommunications equipment, cable terminations, and cross connects. The room is the recognized cross-connect between the Backbone and Horizontal Systems. Also frequently referred to as IDF (legacy term).

1.7 ABBREVIATIONS AND ACRONYMS

- A. A/E: Architect/Engineer (designer)
- B. ADA: Americans with Disabilities Act
- C. AHJ: Authority Having Jurisdiction
- D. ANSI: American National Standards Institute
- E. AWG: American Wire Gauge
- F. BISCI: Building Industry Consulting Service International
- G. BPS: Bits Per Second
- H. CATV: Community Antenna Television (Cable Television)
- I. CCTV: Closed Circuit Television
- J. CMP: Communications Plenum Cable
- K. CPU: Central Processing Unit
- L. EIA: Electronic Industries Association
- M. FCC: Federal Communications Commission
- N. IEEE: Institute of Electrical and Electronics Engineers
- O. IT: Information Technology
- P. LAN: Local Area Network
- Q. NEC: National Electrical Code, NFPA 70
- R. NESC: National Electric Safety Code

S. PoE:	Power-over-Ethernet
T. RAID:	Redundant Array of Independent Disks
U. REX:	Request to Exit
V. SCS:	Security Control System
W. SDRAM:	Synchronized Dynamic Random-Access Memory
X. UL:	Underwriters Laboratory
Y. UTP:	Unshielded Twisted Pair
Z. VLAN:	Virtual LAN
AA. WAN:	Wide Area Network

1.8 SUBMITTALS

- A. Refer to Division 1 and the General Provisions of the Contract for exact submittal procedures.
- B. Bid Submittals shall be provided as part of the bid package and shall include a detailed equipment list by system showing each piece of equipment's make and model, quantity, and proposed unit price and total price in spreadsheet format. Provide separate line item pricing for installation labor, programming labor, documentation costs, taxes, shipping/delivery costs, and travel expenses.
- C. Provide a resume of qualifications consisting of a list of three recently completed projects of similar type and size with contact names, telephone numbers and email address for each. Jobs must be representative of the work your proposed team has completed.
- D. Provide resumes of experience for the Project Manager, Lead Engineer, Lead Field Technician, who will be assigned to this project. Provide electronic copies of required certifications for proposed project team.
- E. Work shall not proceed without the Owner and Technology Consultant approval of all submitted items.
- F. Shop drawings shall be submitted in advance of construction to cause no delay in other Contractors' work. Shop drawings shall be submitted at such time to allow the Engineer reasonable time to review shop drawings to make necessary corrections.
- G. It will be assumed that the Contractor has examined the shop drawings and equipment brochures prior to submission and that materials and equipment depicted will readily fit into the construction. Contractor shall also review all completed work related to materials or equipment depicted to ensure that it has been properly installed.
- H. No materials or equipment subject to prior review by the Engineer shall be fabricated or installed by the Contractor, without such review and approval. The Engineer's review of such drawings and brochures shall not relieve the Contractor of responsibility for deviations from the requirements of the drawings and specifications unless they have notified the Engineer in writing.

- I. The Division 28 Contractor shall provide for review, without exception prior to material acquisition and installation, multiple copies of the following items, quantity as required by the General Contractor or Construction Manager, as applicable. Specific requirements shall be listed and described within each Division 28 section. Failure to submit required items shall disqualify the bidder.
 - 1. Product Data Sheets (Catalog Cuts)
 - 2. Cabling Diagrams
 - 3. System Schematics
 - 4. Specification Sheets for Test Equipment
 - 5. Bill of Materials
 - 6. Contracting Firm Qualifications and Certifications
 - 7. Installation Team Qualifications by Individual
 - 8. Current Manufacturer Certifications
- J. The Division 28 Contractor shall provide Coordination Drawings for review, without exception prior to material acquisition and installation for approval to proceed. Coordination Drawings shall consist of floor plans and building sections, drawn to scale. Include Security System Wiring Diagrams and relationships between components.
- K. Provide throughout installation:
 - 1. Product samples, if requested by the Architect, Technology Consultant, General Contractor, or Construction Manager.
 - 2. Periodic field quality control reports.
 - 3. Periodic cable test reports.
- L. Provide prior to completion:
 - 1. Actual samples of the component labeling scheme to be applied to cabling components, to be approved by the Architect, Technology Consultant, General Contractor, or Construction Manager.
 - 2. Draft cable administration drawings, as requested to assist the Owner in the planning process. Drawings will be requested prior to final documentation and as Xerox reproductions of handwritten field copies.
- M. Provide at completion of each construction/testing phase or area, as defined by the General Contractor or Construction Manager:
 - 1. Cable test and certification reports; summary hard copy or full test results on compact disc when requested by the General Contractor or Construction Manager, the Owner's Networking & Telecommunications, or the Technology Consultant. Reports shall be submitted to the requesting party within thirty (30) working days of completion for each phase.
 - 2. One (1) full size set of final drawings of the actual installation for the Division 28 systems. Drawings shall be given as E size originals and on disc in AutoCAD format.

N. Provide after the installation is complete

1. One (1) full size set of record drawings of the actual installation for the Division 28 systems. Drawings shall be given as E size originals and on disc in AutoCAD format.

O. Provide after the installation is complete and two (2) weeks before final acceptance, three (3) bound sets of O&M (Operating and Maintenance) Manuals formatted as defined by Division 1 and within Section 28 00 00. In addition, each copy of the O&M Manual shall include, at minimum, items listed as follows:

1. One (1) copy of each approved submittal.
2. Cable test and certification reports; summary hard copy and full test results on disc.
 - a. All test data, including documentation of failed tests, the corrective procedures performed, and the results of re-tests are to be documented and submitted in both hard copy and ASCII format on CD-ROM disc.
 - b. Handwritten test reports shall not be accepted.
 - c. All actions required to correct failed tests shall be documented to include the cable identifier, tests that were failed, and actions performed to correct the problem.
3. Instruction manuals including equipment and cable schedules, operating instructions, and manufacturer's instructions.
4. Manufacturer Warranty Certificate.
5. Warranty contacts including but not limited to names, telephone numbers (office and mobile).

1.9 QUALITY ASSURANCE

- A. Comply with all local, state, and federal codes.
- B. All materials furnished shall be new, unused, clean, and free from damage, defects, or corrosion.
- C. Equipment and materials of the same type shall be a product of the same manufacturer throughout unless specifically exempted in advance.
- D. The Contractor shall accept complete responsibility for installation, certification, and support of cabling system. Contractor must show proof the vendor has the certifying manufacturer's support on all these issues with shop drawing submittals.
- E. Only installers trained and certified by the proposed manufacturer shall be allowed to install products. Installers must possess the highest level of certification available by the manufacturer for the specific copper cabling solution being installed.
- F. The Contractor may provide proof of registration/certification of planned installers in bid documents. If not included in the bid documents, the Contractor shall provide a narrative on the levels of registration/certification of their installers within the bid documents. The Contractor shall provide proof of registration/certification for the final list of installers prior to the start of work.
- G. The Owner's Facilities Management and Networking & Telecommunications reserve the right to reject any unregistered or uncertified installers performing work for which they are not registered/certified. The Contractor shall be responsible for any loss of work, delays in schedules,

or extra cost because of the use of unregistered/uncertified workers. Additional effort on the part of the Contractor to maintain the installation schedule because of the above-mentioned loss time shall be the Contractor's responsibility and at the Contractor's additional expense.

- H. The Contractor shall provide to the Owner's Campus Facilities Management and Networking & Telecommunications the above required documentation for any worker on this project brought in after the submittal of initial documentation on installers. Owner may periodically check installer identification and registrations/certifications during the installation.

1.10 WARRANTY

- A. Warrant work against faulty material or workmanship in accordance with Division 1 requirements. If the Project is occupied or the systems placed into operation in several phases, then the warranty of each system or piece of equipment shall begin on the date each system or piece of equipment was placed into satisfactory operation and accepted as such, in writing, by the Owner. The use of building equipment for temporary service, and/or through testing and commissioning of such equipment, does not constitute the beginning of the warranty.
- B. Shall submit, in the bid documents, any additional contractor-specific warranties or guarantees to be offered on the project.
- C. Shall supply all necessary documentation needed to process and record the warranty(s) and to verify the installation solution.
- D. Manufacturer's Warranty
 - 1. Equipment and materials required for installation under these standards shall be the current model and new (less than one (1) year from date of manufacture), unused and without blemish or defect, and are to be guaranteed to be free from defect for a minimum of one (1) year from the date of project's substantial completion.
 - 2. When a defect or problem is observed within the first year after substantial completion, the Owner will notify the governing subcontractor through the proper channels. The appropriate subcontractor then will have 48 hours to fix the defect or furnish and install a replacement part/system, all at no cost to the project or the Owner.
- E. Manufacturer's Extended Warranty
 - 1. All manufacturer extended product warranties shall be afforded to The Owner. A copy of certification by the manufacturer for all products listed in this specification is to be provided.
 - 2. Prior to commencement of the work, the successful bidder shall contact an authorized manufacturer's representative to inform them that this job is being registered under the warranty program.
 - 3. Upon completion of the work, coordinate with the manufacturer the issuance of a full warranty on the entire security system. The cabling contractor at his sole expense will correct any deficiencies determined by the manufacturer.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. Provide Operations and Maintenance Manuals in accordance with Division 1 requirements.

- B. Provide copies of all required test reports.
- C. Provide complete warranty certificates for system and equipment.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Insofar as possible, deliver items in the manufacturer's original unopened packaging. Where this is not practical, cover items with protective materials to keep them from being damaged. Use care in loading, transporting, unloading, and storage to keep items from being damaged.
- B. Store items in a clean dry place and protect from damage. Evidence of damage from water or other contaminants will be cause for rejection.

1.13 RECORD DRAWINGS

- A. Comply with Division 1 requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Equipment and materials furnished shall be listed by UL or other nationally accredited testing laboratory where available. When listing is not available for a piece of equipment, it shall be submitted in accordance with Drawings and Specifications and shall be approved by the authorities having jurisdiction
- B. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.
- C. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer and part number.
- D. All products and materials shall be new and unused prior to their installation as part of this project. Refurbished items are not allowed.
- E. Alternates may be proposed but shall meet or exceed specifications for the items listed. Acceptance shall be at the sole discretion of the owner.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall coordinate with all other trades prior to installation. Meeting with the Electrical and General Contractors to identify pathways and infrastructure space requirements.
- B. Contractor shall provide conversion and integration of existing in-service communications infrastructure into new and existing spaces in close coordination with the Owner's Networking &

Telecommunications. Accommodate all Owner requirements for after-hours scheduling and planned service outages.

- C. The Owner shall not be responsible for delays in work because of shutdowns due to unsafe working practices by Contractors. Delays enforced by the Safety Office caused by unforeseen environmental conditions in the work area may be out of Contractor's control. Contractors shall contact the Owner's primary project manager immediately if delays are incurred for safety reasons.
- D. It shall be the responsibility of the Contractor to secure any parking permits prior to the first day of work on-site.
- E. Work outside of normal operating hours and days shall be coordinated with the Owner's Facilities Management.

3.2 FEES AND PERMITS

- A. Obtain and pay for all necessary permits and inspection fees required for this installation.

3.3 DIMENSIONS AND DEFINITE LOCATIONS

- A. The Project Drawings depicting work show approximate locations. The exact location of equipment and devices shall be established in the field in accordance with instructions from the owner. Consideration shall be given to construction features, equipment of other trades, and requirements of the equipment proper
- B. The Contractor shall refer to shop drawings and submittal drawings for equipment requiring electrical connections to verify rough-in and connection locations.
- C. Unless specifically stated to the contrary, no drawings by scale shall be used as a dimension to work by. Dimensions noted on the drawings are subject, in each case, to measurements of adjacent or previously completed work and all such measurements necessary shall be taken before undertaking any work dependent upon them.

3.4 PROJECT SITE

- A. During construction, and prior to the Owners acceptance of the building, remove from the premises and dispose of packing material and debris cause by communications work.
- B. Remove dust and debris from interior and exterior of telecommunications equipment. Clean accessible current carrying equipment prior to being energized.
- C. Contractor shall clean work areas each day and remove debris properly and legally from the Owner's property. Where communications equipment and related materials are installed or stored for use in the project shall be neatly stacked and remain free of debris, cable scraps and accumulated dust from the floor and surfaces of installed communication equipment, and materials. All exits and paths shall be cleaned to prevent dirt from being tracked throughout the facility.

- D. Upon completion of the work, remove excess debris, materials, equipment, tools, and similar items. Leave the premises clean, neat, and orderly.

3.5 INSTALLATION

A. General

B. Cabling Installation

1. Where cables are supported from building structure, they shall be adequately supported such that the cable will not be damaged by normal building use.
2. Cables shall not be installed or routed in any manner that violates the manufacturer's specifications. Manufacturer's minimum bend radius for static (post installation) cables is 10 times the cable diameter. Manufacturer's minimum bend radius for cables under strain (pulling tension) is 20 times the cable diameter.
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Install a 5-foot-long service loop on each end of cable. Coil service loop at work area end, maintaining appropriate bend radii. Secure service loop to conduit stub or j-hook above ceiling with Velcro.
5. Unless otherwise specified, terminate cables in accordance with ANSI/TIA/EIA-568-A, Commercial Building Telecommunications Cabling Standard, observing the industry standards for terminating color-coded cables for premises and campus environments.
6. Do not install damaged or defective cable. Installation of damaged cable will not be accepted. Unless otherwise allowed by the Owner, damaged cable shall be removed, and new cable installed at the expense of the Contractor. Damage includes physical damage to the cable and damage that may affect performance. THE OWNER WILL NOT ACCEPT CABLE OF ANY TYPE UNTIL AFTER IT IS INSTALLED AND PASSES A PHYSICAL INSPECTION AND ALL PERFORMANCE TESTS.
7. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
8. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports ideally 48 inches but not more than 60 inches apart.
9. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
10. Cables shall not be tied or supported by pipes, ducts, ceiling support wires or other building components which are not part of the communications pathway system.
11. Separation guidelines for routing pathways from power lines and equipment:

Separation of Telecommunications Pathways from Power Lines			
Minimum Separation Distance			
Condition	<2KV	2-5KV	>5KV
Unshielded power lines or electrical equipment in proximity to open or non-metal raceways.	5 inches	12 inches	24 inches

Unshielded power lines in proximity to a grounded metal raceway.	2.5 inches	6 inches	12 inches
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal raceway.	N/A	3 inches	6 inches

3.6 CUTTING AND PATCHING

- A. Comply with Division 1 requirements.
- B. Repair or replace routine damage caused by cutting in performance of Work under this Division.
- C. Correct unnecessary damage caused due to installation of electrical Work, brought about through carelessness or lack of coordination.
- D. Holes cut through floor slabs shall be core drilled with drill designed for this purpose. All openings, sleeves, and holes in slabs between floors shall be properly sealed, fire proofed and waterproofed.
- E. Holes cut through walls shall be drilled or cut with tools designed for the purpose. All openings, sleeves and holes in walls that extend to underside of floor above shall be properly sealed and fire proofed.
- F. Repairs shall be performed with materials which match existing materials and be installed in accordance with appropriate sections of these Specifications.
- G. Contractor shall not be permitted to cut or modify any structural members without the written permission of the Architect.

3.7 FIRESTOPPING

- A. Comply with ANSI/TIA-569-C, Annex A, "Fire-stopping."
- B. Comply with BICSI TDMM, Chapter 8 "Fire-stopping."

3.8 TRAINING

- A. General
 - 1. Coordinate operation and maintenance training activates with owner. Provide a master training schedule with specific task line items of training activities. Schedule shall start each activity with a pre-training coordination meeting then proceed from simple training session to the complex systems.
 - 2. Training shall start prior to final acceptance testing of each system. Training shall be

conducted during normal business hours (9:00 am to 4:00 pm, Monday through Friday) unless directed otherwise.

3. Provide training material to the owner's maintenance and operation staff that meets the owner's learning objectives.

B. Pre-training Process

1. Coordinate with owner a pre-training meeting at least two (2) weeks, then a final review meeting at least one (1) week prior to the start of individual training sessions to review owner requirements and training material. These reviews shall include:
 - a. Inspection of locations intended for classroom and field training/demonstration.
 - b. Finalization of owner approved training material, schedule, and expected trainees attending sessions.
 - c. Equipment and systems to be covered.
 - d. Proposed agenda of specific training subjects to be covered and their respective durations.
 - e. Coordinate the final training session schedule with the owner. The owner has the right to waive a training session specified if they determine the session topic to be one their operation and maintenance personnel are familiar with. The owner can exercise this waiver right without affecting contractor obligations to provide the remaining training.
 - f. Develop training session agendas with subjects that specifically address recommended practices for the following applicable topics:
 - 1) Material, equipment, and process description.
 - 2) Installation requirements and O&M manuals
 - 3) Operational requirements, features and functions, diagnostics, troubleshooting and testing.
 - 4) Automatic and manual control
 - 5) Safety precautions
 - 6) Interaction and interface with other equipment and systems
 - 7) Common failure modes, power loss, error codes, warning instructions, emergency responses, and typical trouble shooting.
 - 8) Adjustments, alignments, and calibration.
 - 9) Preventive and predictive maintenance.
 - 10) Specialty tools and test equipment.
 - 11) Contractor-furnished spare parts and extra materials.
 - 12) Recommended stock inventory items to be furnished by owner.
 - 13) Recommended spare parts to be furnished by owner.
 - 14) Procurement information for replacement parts, repair kits, and materials.
 - 15) Cleaning needs, surface care, and accompanying procedures.
 - 16) Warranty terms and conditions point of contact, RMA process, expiration dates.
 - 17) Maintenance agreements and other similar commitments provided by contractor.

C. Training Process

1. The Contractor shall provide a minimum of 8 hours of on-site training session(s) for, but not limited to, the Owner's staff at a time that is mutually agreeable for the Owner and Contractor.
2. The Owner may choose to have the sessions spread out over a period of time and vary the staff being trained and the level of training. The Final acceptance and/or final payment for the system(s) shall not be delayed due to scheduling delays beyond the control of the Contractor. The Contractor should also be available for additional training session(s) should the Owner request it.
3. The Contractor shall provide a System(s) Operational Manual (not equipment O&M manuals) that explains how to fully operate the system(s) from start-up to shut-down and all operational steps in-between, in a step by step description, with pictures and other visual aides to help convey information.
4. The Contractor shall coordinate with the Owner if they would like the training session(s) recorded for the Owners reference, and to help limit minor follow up phone calls.
5. The Contractor shall document the success of each training session by completing the last two sections on the maintenance and operation training plan form.
6. Maintenance and operation training plan form shall contain
 - a. Date of training
 - b. Training acceptance sign-off by owner's maintenance and operation staff.
 - c. Any follow-up training should the original training be evaluated as unsuccessful.
7. The Contractor shall document the performance of the follow-up training session by completing the maintenance and operation training plan form.
8. Follow-up maintenance and operation training plan form shall contain
 - a. Date of training
 - b. Training acceptance sign-off by owner's maintenance and operation staff.

3.9 TESTING

A. Cable Testing

1. New cable pairs shall be end-to-end tested as follows.
 - a. DC loop resistance
 - b. Wire map
 - c. Continuity to remote end
 - d. Shorts between two or more conductors
 - e. Crossed pairs
 - f. Reversed pairs
 - g. Split pairs
2. All balanced twisted-pair field testers shall be factory calibrated each calendar year by the field test equipment manufacturer as stipulated in the manuals provided with the field test unit. The calibration certificate shall be provided for review prior to the start of testing.

Autotest settings, provided in the field tester for testing the installed cabling, shall be set to the manufacturer default parameters for the type and characteristics of the cable to be tested.

3. Tests shall be performed with connectors and termination completed and in-place.
4. Any cable or component not satisfactorily passing the tests as described or failing to meet quality installation standards as described in this specification, shall be repaired, and/or replaced at the Contractor's expense.
5. The Contractor shall prepare complete cable test reports for all installed cables for review and approval by the Owner prior to acceptance of the cabling system.

B. Final Acceptance Testing

- C. After testing reports, as-built drawings, and required manuals have been submitted for review, the Contractor shall coordinate a date for Final Acceptance Testing.
- D. Testing and acceptance of this system will take place in the presence of the owner.
- E. Acceptance of the system shall require a demonstration of all system components to evaluate their performance and reliability. Prior to this test the system must have been online for a period of sixty (60) days, with an uptime of no less than 99%. Should a major equipment failure occur, the Contractor shall replace the defective component and continue the testing period. Any items discovered during final inspection which require the contractor's attention, shall be promptly addressed. These items will then be re-inspected by the owner for approval.
- F. Upon the completion of acceptable Final Acceptance Testing the Contractor shall submit all finalized project documentation and associated electronic media. Upon approval from the owner, the owner will issue a Letter of Completion to the Contractor indicating the date of such completion. This notice will serve as Client acceptance of this system.

END OF SECTION