

SECTION 16080P - ELECTRICAL TESTING

PART 1 - GENERAL

1.1 TESTING AND INSPECTION

- A. Major electrical equipment requiring factory testing shall be indicated in electrical construction documents, including notification requirements where witnessing by Owner or Commissioning Agent is required.
- B. Labor, installation, supervision, test equipment, material, power supplies, devices, etc. required to meet the requirements of this Section shall be provided.
- C. Test and inspect all parts of the work provided under this Section. Conduct all tests and inspections to the satisfaction of the Architect or Engineer. Tests shall be completed and electrical work 100 percent operational including any interfaces with other systems prior to performing acceptance demonstrations. Notify the Architect, Engineer, Owner and General Contractor at least one week (seven days) prior to testing or inspection. Do not cover work prior to testing or inspection. Testing shall be completed prior to substantial completion.
- D. Prior to the date of substantial completion and acceptance demonstrations, furnish the Architect or Engineer with certificates of testing and inspection for all systems furnished or installed under this Section indicating the approval of all authorities having jurisdiction, manufacturers and a letter from the installer stating conformance with all requirements of the Contract Documents.
- E. All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than the values recommended by the manufacturers.
- F. Test all circuits and receptacles for proper neutral and grounding connections.
- G. Lighting fixtures shall be tested with specified lamps in place for not less than ten hours; the fixtures may be checked in sections.
- H. Testing recommended by manufacturers shall be required; this requirement may be waived with permission in writing from the Owner's Project Manager.
- I. Perform a high potential D.C. test on all equipment and cable rated for use over 600V. Testing on incoming services shall be in accordance with Local Power Company requirements. Tests shall be performed by an approved independent testing Company in the presence of the Architect or Engineer, Owner, and the local Power Company.

- J. Failure or defects in workmanship or materials revealed by tests or inspection shall be corrected promptly and retested. Defective material shall be replaced at no additional expense to the Owner.
- K. Provide all temporary connections, necessary testing equipment, labor and materials, required for the testing of the systems and equipment. All systems shall be prepared for testing and protected from damage. The cost of all tests shall be included in the contract price.
- L. Verify and correct as necessary the following: voltages, tap settings, trip settings, and phasing on all equipment and devices furnished or installed. Secondary voltages shall be tested at the bus in the main switchboard, at panelboards, and at such other locations on the distribution systems as necessary. Secondary voltages shall be tested under no-load and full-load conditions.
- M. Set GFI trip settings as required by the short circuit and protective device coordination study or as directed by the Architect. Initially, prior to final trip settings, set up as follows upon installation:
 - N. Main GFI (no downstream GFI CB): Time at minimum and maximum amp.
 - O. Main GFI (with downstream GFI CB): Time at maximum and maximum amp.
 - P. Downstream GFI: Time at twenty five percent of maximum
 Amp at twenty five percent of minimum
- Q. Electronic solid state trip units shall be set by a manufacturer's trained technician as follows:
 - 1. All circuit breakers with solid state trip units shall be initially pre-set to the equivalent LT, LTD, ST, STD setting of the thermal magnetic version of the same ampere rated circuit breaker. Instantaneous setting shall be not less than 4X.
- R. Measure minimum and maximum voltages, and voltage between phase wires and neutral, and immediately deliver to the Architect a report on all voltage measurements.
- S. Fire Alarm System shall be tested in accordance with the requirements on NFPA 72. Fill out forms provided in NFPA 72.
- T. Test systems installed for proper operation and adherence to specifications including sound, security, cable TV, etc.
- U. The equipment grounding shall be checked to insure continuity of the ground return path.

- V. The ground grid systems shall be tested using the three terminal fall in potential method. A minimum of eight test points for each ground grid system shall be submitted for review by the Engineer. The test points shall be made along a straight line from the grid system to the reference terminal. The distance between the grid system and the reference terminal shall be consistent with normal practices for ground testing.
- W. Grounding tests shall be performed during the dry season. Tests shall be performed before loaming and seeding or paving work has been performed.
- X. Emergency generator testing shall include load testing.
- Y. Provide a written report on all testing and device settings. Include a copy in the Operation and Maintenance Manual.
- Z. Adjust occupancy sensors for proper operation including time delay, field of view (masking), typed sensing and parallel operation.

1.2 MEDIUM VOLTAGE TESTS

- A. Test and inspect all primary electric service wiring and equipment required by codes, standards or authorities having jurisdiction. Conduct all tests and inspections to be complete satisfaction of the Architect and all authorities. Notify the Architect and all involved authorities at least one week (seven days) prior to testing or inspection. Do not cover work prior to testing or inspection.
- B. All tests shall be performed by an approved independent testing and inspection agency.
- C. Prior to the date of acceptance, furnish the Architect or Engineer with certificates of testing and inspection for all systems indicating the approval of all authorities having jurisdiction and conformance with all requirements of the Contract Documents.
- D. All medium volt feeder cables shall be hypotential tested individually prior to final connection to the primary electric service and new medium voltage equipment.
- E. The insulation resistance of the cable system shall be tested in accordance with the requirements of the National Electrical Testing Association and as herein indicated.
- F. Cables:
 - 1. Visual and Mechanical Inspections:
 - a. Inspect exposed section for physical damage.

- b. Verify cable is supplied and connected in accordance with single line diagram.
 - c. Inspect for shield grounding, cable support and termination.
 - d. Visible cable bends shall be checked against ICEA or manufacturer's minimum allowable bending radius.
 - e. Inspect for proper fire proofing in common cable areas.
2. Electrical Tests:
- a. D.C. Hypotential Test (Where approved and required):
 - 1) Each conductor shall be individually tested with all other conductors grounded. All shields shall be grounded.
 - 2) Terminations shall be properly corona suppressed by guard ring, field reduction sphere or other suitable methods.
 - 3) A D.C. hypotential shall be applied in at least eight equal increments until maximum test voltage is reached. D.C. leakage current shall be recorded at each step after a constant stabilization time consistent with system charging current decay.
 - 4) A graphic plot shall be made of leakage current (X axis) versus voltage (Y axis) at each increment.
 - 5) The test conductor shall be raised to a maximum test voltage and held for a total of ten minutes. Readings of leakage current (Y axis) versus time (X axis) shall be recorded and plotted on thirty second intervals for the first two minutes and every minute thereafter.
 - 6) The applied conductor test potential shall be reduced to zero (0) and grounds applied for a period adequate to drain all insulation stored potential.
 - b. Maximum test voltages shall be as follows:
 - 1) 5 kV - 25,000 volts for 100 or 133 percent insulation level.
 - 2) 15 kV - 55,000 volts for 100 percent insulation level.
 - 3) 65,000 volts for 133 percent insulation level.

- 4) Submit a written report of all tests to Architect in quadruplicate.
 - 5) Perform a shield continuity test by ohmmeter method. Ohmic value shall be recorded.
- c. Test Values:
- 1) D.C. Hypotential Test Results:
 - a) Step voltage slope should be reasonably linear.
 - b) Absorption slope should be flat or negative. In no case should slope exhibit positive characteristic.
 - c) Maximum leakage current should not exceed I_L corrected to 15 degree C where
$$I_L = \frac{E}{K \log D/d}.$$

K = Insulation Specific Resistance Mego hm/MFT at 15 degree C.
D = Diameter Over Insulation
d = Diameter Under Insulation
E = Maximum Test Voltage
- G. Test all circuits for proper neutral connections.
- H. Failure or defects in workmanship or materials revealed by tests or inspection shall be corrected promptly and retested. Defective material shall be replaced.
- I. Provide all temporary connections, necessary testing equipment, labor and materials, required for the testing of the systems and equipment. All systems shall be prepared for testing and protected from damage. The cost of all tests shall be included in the contract price.

1.3 ACCEPTANCE DEMONSTRATIONS

- A. Systems installed under this section shall be demonstrated to the Owner, Architect and Engineer. Demonstrations are in addition to necessary testing and training sessions. Notify all parties at least 7 days prior to the scheduled demonstration. Schedule demonstrations in cooperation with and at times convenient to all parties and so as to not disturb ongoing activities.
- B. Systems shall be tested prior to the demonstrations and each system shall be fully operational and tested prior to arranging the Acceptance Demonstration. Final

payments shall be withheld until a satisfactory demonstration is provided for all systems indicated or requested.

- C. If the demonstration is not totally complete, performing all functions, features and connections or interfaces with other systems, or if there is a failure during the demonstration, additional demonstrations shall be performed.
- D. Demonstrations shall be scheduled in ample time to complete all activities prior to final acceptance and Owner occupancy. Demonstrations shall take place at least 30 days prior to the scheduled project completion date and 30 days prior to owner's use and occupancy.
- E. As a minimum, provide demonstrations for systems indicated under "Work Included" under Part One of the Specifications. Provide demonstrations of additional systems as requested by the Owner, Architect or Engineer.

END OF SECTION