



SECTION 26 05 71 - ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract apply to the Work specified in this Section.
- B. Refer to all Electrical Sections of the Specifications, as well as the Specifications for the other various trades and materials and be thoroughly familiar with all provisions regarding electrical work.

1.2 SUMMARY

- A. This section outlines the acceptance testing requirements and division of responsibility.

1.3 SCOPE

- A. Contractor shall engage the services of a recognized independent NETA Certified testing firm or professional electrical engineering firm for the purpose of performing inspections and tests as herein specified.
- B. The testing firm shall provide all materials, equipment, labor and technical supervision to perform such test and inspections.
- C. It is the intent of these tests to assure that all electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.
- D. The tests and inspections shall determine suitability for energization.

1.4 REFERENCES

- A. All inspections and tests shall be in accordance with the latest editions following applicable codes and standards except as provided otherwise herein.
 - 1. National Electrical Code – NEC
 - 2. National Electrical Manufacturer's Association - NEMA.
 - 3. American Society for Testing and Materials - ASTM
 - 4. Institute of Electrical and Electronic Engineers – IEEE
 - 5. National Electrical Testing Association – NETA
 - 6. American National Standards Institute – ANSI
 - 7. State Codes and Ordinances
 - 8. Insulation Cable Engineers Association – ICEA
 - 9. National Electrical Safety Code – NESC
- B. All inspections and tests shall utilize the following references:
 - 1. Project Design Specifications
 - 2. Project Design Drawings
 - 3. Manufacturer's Instruction Manuals applicable to each particular apparatus.

1.5 QUALIFICATIONS OF TESTING AGENCY

- A. The testing/engineering firm shall be a corporately independent testing organization that can function as an unbiased testing authority, professionally independent of the

manufacturers, suppliers and installers of equipment or systems evaluated by the testing firm.

- B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations and systems.
- C. The testing firm shall have been engaged in such practices for a similar size project.
- D. The testing firm shall utilize only full-time technicians who are regularly employed by the firm. Electrically unskilled employees are not permitted to perform testing or assistance of any kind. Electricians and/or linemen may assist but may not perform testing and/or inspection services.
- E. The testing firm shall submit the "on site" foreman's qualifications and experience through the Contractor at the pre-construction conference for review and approval by the Engineer.
- F. Contractor shall submit statement of qualifications of proposed testing firm at the pre-construction conference for approval and acceptance by the Engineer.

1.6 DIVISION OF RESPONSIBILITY

- A. Testing firm shall perform the following tests as outlined in these specifications:
 - 1. Equipment Tests
 - 2. Ground Resistance Tests
 - 3. Thermographic Survey
- B. Contractor shall perform the following tests as outlined in these specifications:
 - 1. Low Voltage Cable
 - 2. Phasing and Rotation Tests

1.7 TEST REPORT

- A. The test report shall include the following:
 - 1. Summary of project.
 - 2. Description of project.
 - 3. Description of test
 - 4. Test results.
 - 5. Conclusions and recommendations.
 - 6. Appendix, including appropriate test forms.
 - 7. Identification of test equipment used.
 - 8. Signature of responsible test organization authority.
- B. Furnish three printed (3) copies of the complete report to the Engineer prior to requesting substantial completion and no later than thirty (30) days after completion of testing procedures unless directed otherwise. After acceptance of the report, Contractor shall submit an electronic copy of the report in PDF format.
- C. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
- D. The testing firm shall have a designated safety representative on the project to supervise operations with respect to safety.

- E. The testing firm shall have a calibration program that assures that all applicable test instrumentation is maintained within rated accuracy. The accuracy shall be directly traceable to the National Bureau of Standards. Instruments shall be calibrated in accordance with the following frequency schedule:
- F. Field Instruments: Analog - 6 months maximum
 Digital - 12 months maximum
- G. Laboratory Instruments: 12 months
- H. Leased specialty equipment: 12 months
- I. Dated calibration labels shall be visible on all test equipment.
- J. Records must be kept up to date which show date and results of instruments calibrated or tested.
- K. An up-to-date instrument calibration instruction and procedure will be maintained for each test instrument.
- L. Calibrating standard shall be of higher accuracy than that of the instrument tested.

1.8 GENERAL

- A. An outline of tests required is included in this section. Refer to applicable NETA, ANSI, NEMA, IEEE and other test standards for exact procedures, methods and requirements.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 TESTS

- A. Upon completion of the work, the entire electrical system shall be tested and shall be shown to be in perfect working condition, in accordance with the intent of the specifications.
- B. Testing Agency shall perform thermographic study of all terminations in the new electrical system prior to acceptance. Thermographic study shall be performed after load is placed on the system
- C. All 600 volt and below cables shall be tested as specified after being installed but prior to being terminated.
- D. Ground resistance tests shall be performed at the pad mounted transformer, at the Service Entrance and at each step-down/step-up transformer as specified.
- E. All terminations (lugs, split-bolts, etc.) shall have their "tightness" torque values measured and verified against NEC and manufacturer's requirements.

3.2 GROUND RESISTANCE TESTS

- A. Inspect ground system for compliance with plans and specifications.
- B. Perform 3-point fall-of-potential test per IEEE Standard No. 81, Section 9.04 on the main grounding electrode or system.

- C. Perform the 2-point method test per IEEE No. 81, Section 9.03 to determine the grounding resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points.
- D. Alternate Method to Item C Above: Perform ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point. This test shall be made by passing a minimum of ten (10) amperes dc current between ground reference system and the ground point to be tested. Voltage drop shall be measured and resistance calculated by voltage drop method.
- E. The main ground electrode system resistance to ground shall be no greater than one (1) ohm at the pad mounted transformer at the Service Entrance and at all step-down/step-up transformers.

3.3 LOW VOLTAGE CABLE, 600 V MAXIMUM

- A. Compare cable data with drawings and specifications. Inspect exposed sections of cables for physical damage and correct connection in accordance with one-line diagram.
- B. Verify tightness of accessible bolted connection by calibrated torque wrench in accordance with manufacturer's published data. Perform thermographic survey.
- C. Inspect compression-applied connectors for correct cable match and indentation.
- D. Verify cable color-coding with applicable Engineer's specifications.
- E. For all service entrances, switchboards, and all panelboard feeders, perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for one minute.
- F. Perform continuity test to insure correct cable connection.
- G. Bolt-torque levels shall be in accordance with manufacturer's requirements. Measure and record results.
- H. Minimum insulation-resistance values shall be not less than 50 mega-ohms.
- I. Investigate and report on all deviations between adjacent phases.

3.4 PHASING AND ROTATION:

- A. Perform phasing test on each circuit tie section energized by separate sources.
- B. Perform tests from permanent source.
- C. Damage caused due to omission of this test shall be corrected at Contractor's expense.

3.5 THERMOGRAPHIC SURVEY:

- A. Thermographic survey shall be performed with equipment utilizing long wave technology that provides photo record of deficient areas.
- B. Equipment to be inspected shall include all current-carrying devices installed under this contract, generally, all new high and low voltage cable terminations and splices. Specific equipment to be surveyed includes the following.

1. Switchboards
 2. Panelboards
 3. Safety Switches (fused and non-fused)
- C. Inspect physical, electrical and mechanical condition. Remove all necessary covers prior to thermographic inspection.
- D. Provide report including the following:
1. Discrepancies.
 2. Temperature difference between the area of concern and the reference area.
 3. Cause of temperature difference.
 4. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.
 5. Identify load conditions at time of inspection.
 6. Provide photographic thermograms of all equipment (non-deficient and deficient areas). Provide corresponding digital photograph (non-thermal image) of electrical equipment scanned.
 7. Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 degree C at 30 degrees C.
 8. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 9. Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to NFPA 70B-1994, Section 18-16 (Infrared Inspection).
 10. Temperature differences for 1 degree C to 3 degrees C indicate possible deficiency and warrant investigation.
 11. Temperature differences of 4 degrees C to 15 degrees C indicated deficiency; repair as time permits.
 12. Temperature differences of 16 degrees C and above indicate major deficiency; repair immediately.

END OF SECTION 26 05 71