

PART 1 GENERAL**1.1 RELATED DOCUMENTS**

- A. The requirements of the General Conditions, Supplementary Conditions and the following specification sections apply to all Work herein:
1. Section 26 00 10 - General Requirements
 2. Section 26 00 20 - Scope of Work

1.2 SUMMARY

- A. Provide all Pre-functional Testing, Functional Testing and Integrated Systems Testing to demonstrate proper operation as required by these Specifications, the City of San Francisco, and the authorities having jurisdiction of the Electrical System, equipment and components as indicated on the Drawings and as specified herein. Tests shall include, but not be limited to the items specified in this section and in other Division 26 Specification sections.
- B. The Division 26 Subcontractor shall take the lead responsibility for inspecting, completing and documenting the Pre-Functional Testing for the Electrical Systems to ensure the systems are fully operational and ready for Functional Testing.
- C. The Division 26 Subcontractor shall take the lead responsibility for demonstrating the operations of the Electrical systems for the Functional Tests.
- D. Testing shall in no way relieve the Subcontractor of the warranty requirements.

1.3 QUALITY ASSURANCE

- A. Submit evidence to show that the personnel who will actually test the systems are qualified to perform the required Work.
- B. All test procedures shall be in accordance with the manufacturer's recommendations for the equipment being tested.

1.4 SUBMITTAL DATA

- A. The following submittal data shall be furnished according to the General Conditions and Section 26 00 10 and shall include, but not be limited to:
1. Proposed test procedures, recording forms, test equipment, and list of personnel and qualifications for all tests proposed. Refer to Section 26 08 13 titled "Testing" for additional requirements.
 2. Test Data and Results including the following:
 - a. Test performed.
 - b. Test procedure.
 - c. System and area tested.
 - d. Date(s) and time(s) of test.
 - e. Weather conditions.
 - f. Test criteria.
 - g. Test results.
 - h. Additional pertinent data.
 - i. Instruments including documentation that such instruments were properly calibrated at the time of the testing.
 - j. Personnel printed name, title, company, and signature of persons who performed the test.
- B. All items or equipment listed above with asterisks (*) shall be certified by the manufacturer using Manufacturer Certification "MCA" as set forth in Section 26 00 10. See Section 26 00 10 for certification requirements.

PART 2 PRODUCTS**2.1 TESTING MATERIALS**

- A. Provide all materials and test equipment required for testing of specified electrical system components, including any retests required to obtain acceptable results.
- B. Testing materials that fail to provide acceptable test results shall be repaired or replaced with suitable materials as required to obtain acceptable test results.

PART 3 EXECUTION**3.1 FACTORY TESTING**

- A. Refer to the various Division 26 Specification sections for requirements for factory testing of equipment and devices.

3.2 FIELD TESTING OF ELECTRICAL SYSTEMS

- A. During the progress of the Work and upon completion, tests shall be made as specified herein and as required by authorities having jurisdiction including local inspectors, Owner, Owner's Insuring Agency, Architect or Engineer. Tests shall be witnessed by the Electrical Subcontractor as part of the Work of this Division and shall include the services of qualified personnel as well as all equipment, apparatus, and services required. Each wiring system with devices connected must test free from short circuits and from grounds and must have an insulation resistance between conductors and ground, based on maximum load, not less than the requirements of the latest edition of the National Electrical Code.
- B. In accordance with the Subcontractor Scheduling Procedures in Section 26 00 20 titled "Scope of Work", the Electrical Subcontractor shall submit in writing proposed test procedures, recording forms, list of personnel and qualifications and test equipment for the Engineer's and Owner's review.
- C. The tests shall include but not be limited to the following:
 - 1. Electrical conductor tests as specified in Section 26 05 19 titled "Electrical Conductors - 600 Volts".
 - 2. Grounding system tests as specified in Section 26 05 26 titled "Grounding and Bonding".
 - 3. Low-voltage dry-type distribution transformer tests as specified in Section 26 22 13 titled "Low-Voltage Dry-Type Distribution Transformers".
 - 4. Harmonic mitigating transformer tests as specified in Section 26 22 14 titled "Harmonic Mitigating Transformers (HMT)".
 - 5. Low-voltage switchgear tests as specified in Section 26 13 00 titled "Low-Voltage Switchgear".
 - 6. Switchboard tests as specified in Section 26 24 13 titled "Switchboards - 600 Volts".
 - 7. Busway tests as specified in Section 26 25 00 titled "Busway".
 - 8. Automatic transformer switch tests as specified in Section 26 36 23 titled "Automatic Transfer Switches".
 - 9. Operation of entire electrical power system including:
 - a. Voltage and current readings for each feeder and motor circuit under maximum operating conditions. Readings shall be submitted to the Engineer for review. Readings questioned shall be repeated for confirmation.
 - b. Operation of lighting and receptacle circuits with associated switching and controls.
 - c. Running of motors with demonstration of controls and interlocks.
 - d. Operation of transformers with voltage check while loaded to assure proper transformer tap settings.
 - e. Operation of electrical equipment and appliances whether provided under this Division or not.
 - 10. Participation in a demonstration and operating test of the entire Fire Detection, Alarm and Communication System as required by the Owner and the local authorities.
 - 11. Operation of standby power system with voltage check while the system is fully loaded to assure proper operation of the electric generating system, transfer switches, etc. Operation of the system shall simulate standby power conditions, that is, loss of main electrical power to the building by simulating normal power failure by operating all switches or breakers supplying normal power to all automatic transfer switches that are part of the emergency and standby power system being commissioned. The Electrical Subcontractor shall provide and connect to the system a remote portable water cooled or air

cooled resistor load bank sized to match the full load rating of the generation system to adequately demonstrate the operation of the standby power system. Test period shall be four (4) continuous hours of trouble free operation with a minimum of four (4) automatic transfer sequences within the period. Test shall include a demonstration of the safety shutdown devices. The Electrical Subcontractor shall furnish all fuel required for testing. See Section 26 00 20 titled "Scope of Work" for additional diesel fuel requirements. This testing is in addition to any required by the authority having jurisdiction.

12. **Alternate E-3:** After the electrical distribution system, including all new switchgear, switchboards, distribution panels, busways, transformers, control panels, motor controllers, lighting panels, etc. and equipment conductor terminations, has been checked, adjusted, finally calibrated and under load just prior to substantial completion as determined by the Project's construction schedule, it shall be subjected to a thermograph test using an infrared temperature scanning unit. This test shall be performed by Cutler Hammer, Square D, Siemens, General Electric Company Instrumentation Division or a factory authorized service testing organization. Two (2) copies of the test report shall be furnished to the Engineer upon completion of test. Connections indicated having higher temperatures than acceptable will be tightened or corrected as required. After corrections have been made the connections shall be subjected to an additional thermograph by the Electrical Subcontractor and rechecked to confirm that the problem has been corrected.
13. Refer to Division 25 BMCS specifications for testing requirements related to the communications interfaces with the Division 26 systems and equipment.

D. Insulation Resistance Testing: Where insulation resistance testing is required for testing electrical apparatus and cables within the Division 26 specifications, in the absence of manufacturer recommended values, the following test values shall be used:

Nominal Rating of Equipment in Volts	Minimum Test Voltage, DC	Minimum Insulation Resistance in Megohms
250	500	25
600	1000	100
1000	1000	100
2500	1000	500
5000	2500	1000
8000	2500	2000
15000	2500	5000
25000	5000	20000
35000	15000	100000

E. Neutral-Ground Isolation Test: Upon completion of the electrical system, including all grounding, the Electrical Subcontractor shall test the system for stray currents, ground shorts, etc. These tests shall be performed in a manner acceptable to the Engineer. Approved instruments, apparatus, services and qualified personnel shall be utilized. If stray currents, shorts, etc., are detected, eliminate or correct as required. This test shall be performed at the service entrance and at each separately derived system. The test procedure shall be as outlined:

1. Open all main disconnects for the system being tested.
2. Disconnect the system neutral from the service entrance or step down transformer neutral connection.
3. Connect a DC ohmmeter across the system neutral and equipment ground.
4. An ohmmeter reading in excess of 100 ohms shall indicate that the system neutral and equipment ground are properly isolated.
5. An ohmmeter reading less than 100 ohms shall indicate that the system neutral contains ground shorts or bonds at some point along the system neutral.
6. Grounded neutrals may be identified by disconnecting individual neutral conductors from the system one at a time and retesting as described in step 3 above until ohmmeter reading indicates that the neutral is isolated from the equipment ground.
7. Any system which is found to not be properly isolated shall be promptly investigated and corrected and additional tests shall be performed. The systems shall be retested after correction of all ground shorts is complete.
8. The field test results shall be submitted by the Subcontractor for review. Field test reports shall include, but not be limited to:
 - a. Test performed.
 - b. Test procedure.
 - c. Separately derived system service entrance equipment name or transformer name and location.
 - d. Date(s) and time(s) of test.

- e. Test results.
 - f. Additional pertinent data.
 - g. Instruments including documentation that such instruments were properly calibrated at the time of the testing.
 - h. Personnel printed name, title, company, and signature of persons who performed the test.
- F. Submit six (6) copies of each complete test report specified herein to the Engineer for review and send two (2) copies of each report to the Owner. See Section 26 00 10 for requirements. The Contractor shall submit individual test reports for each individual system in accordance with the Subcontractor Scheduling Procedures in Section 26 00 20 titled "Scope of Work".
- G. The foregoing shall in no way relieve the Contractor of any warranty requirements.

END OF SECTION