SECTION 16999 - SUPPLEMENTAL

ELECTRICAL ACCEPTANCE TESTS

PART 1 - GENERAL (COMBINED WITH PARTS 2 AND 3)

1.1 GENERAL

1.1.01 Related Documents. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.

1.2 DESCRIPTION OF SYSTEMS

1.2.01 Preliminary inspections and tests: Visual inspections of electrical equipment, wire checks of factory wiring and any other preliminary work required to prevent delays during performance of electrical acceptance tests.

1.2.02 Electrical acceptance tests: Those inspections and tests required to show that the workmanship, methods, inspections, and materials used in erection and installation of the electrical equipment and systems conforms to accepted engineering practices as included in Division 16 Sections and the following:

1.2.02.01 IEEE.

1.2.02.02 National Electrical Code (NEC).

1.2.02.03 NEMA Standards.

1.2.02.04 ICEA.

1.2.02.05 InterNational Electrical Testing Association (NETA).

1.2.02.06 ANSI.

1.2.03 Operating tests: Those tests performed on all electrical equipment installed under 16000 Series Sections, and under other Sections, to show that the electrical equipment will perform the functions for which it was designed.

1.2.04 Furnish all labor, materials, test equipment, and technical supervision to perform and record the electrical tests as specified, including tests on electrical power distribution equipment, 600 volt wire and cable, rotating equipment, control panels,

control devices, grounding, special service systems and relays, unless otherwise specified.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS.

1.3.01 Operating tests on mechanical and electrical equipment installed under other Sections to prove capability of such equipment to perform as specified in the Section covering specific equipment.

1.3.02 Repair or replacement of equipment installed under other Sections and not meeting acceptance tests specified in this Section and therefore not acceptable.

1.3.03 Uncoupling of motors installed under other Sections where reverse rotation could damage equipment during acceptance tests for proper rotation.

1.4 FINAL ACCEPTANCE.

1.4.01 Final acceptance of electrical equipment will not only depend on equipment integrity as determined by the electrical acceptance test, but will also depend on complete operational tests, whether performed under this or other Sections.

1.5 TEST REPORT SUBMITTALS.

1.5.01 Submit test reports, including complete data on actual readings taken and corrected values, to the Contracting Officer for approval after each test period. Have all test reports signed by the authorized witnesses present at tests prior to submission. Do not energize any equipment or material for operating tests until test data has been approved.

1.5.02 Submit copies of final approved test report to the Owner at the completion of the work under this Section. See Section 01340 for number of copies to be submitted.

1.6 HUMIDITY. Do not perform megger or high potential tests during times of high relative humidity.

1.7 WEATHER. Do not perform tests on outdoor equipment during inclement weather. Do not perform tests on direct burial bare ground conductors or on ground rods within a 48 hour period following rainfall.

1.8 PROTECTION OF PERSONNEL. During cable tests, station a man at each point where cable has exposed connections.

1.9 SCHEDULING OF TESTS.

1.9.01 Perform all acceptance and operating tests in the presence of the Contracting Officer.

1.9.02 Schedule sequence of tests so that equipment can be energized immediately after completion of the applicable tests and approval of test reports. Notify the Contracting Officer of time of test at least 48 hours prior to testing.

1.9.03 Notify vendors and manufacturers of electrical equipment of the time of tests and extend reasonable cooperation to them or their representatives to permit them to witness tests should they so request. Obtain list of approved manufacturers of Owner furnished equipment from the Contracting Officer.

1.10 PRELIMINARY WORK. Perform preliminary inspections and tests immediately prior to performing acceptance tests. Fuses and fusing devices, such as cable limiters, shall be omitted from cable tests and tests involving cables.

1.11 MEGGER TESTS.

1.11.01 Megger readings specified are the minimum readings desired at an ambient temperature of 60°F (15.56^{o}C) and at a low relative humidity. When megger readings are taken at other than 60°F, convert readings to equivalent values at 60°F.

1.11.02 When megger readings fall below the specified minimum values at 60°F, devise some means of applying heat for the purpose of drying out the equipment subject to the approval of the Contracting Officer. If drying is to be done by applying an electric potential to a piece of equipment, do not exceed the continuous voltage or current ratings of the equipment being dried, either directly or by induction.

1.12 CONTINUITY TESTS. Perform continuity tests with a DC type device using a bell or buzzer. Do not use phones for continuity test; use phones only for communication.

1.13 TESTS ON WIRE AND CABLE IN 480 VOLT AND LOWER SERVICE

1.13.01 General: Give each 480 volt power feeder and subfeeder cable a continuity test and a megger test. Verify wire identification for each power feeder and subfeeder cable. Verify identification of all lighting circuits and 120 volt circuits on panel directories and make operational checks on all lighting circuits and 120 volt circuits to prove that the circuits perform all functions for which they are designed. Check all power feeder and subfeeder cable connections for workmanship and conformance with standard practice by visual inspection.

1.13.02 Connections: Isolate power cables to be megger tested by opening switches or breakers at each end of cable prior to testing where such disconnecting means exists. Where cables are direct connected without a disconnecting means, do not disconnect cables; test as connected.

1.13.03 Megger Tests: Use a 1000 volt D.C. megger for each megger test. Apply megger tests between each conductor and ground with the other two conductors in the conduit or cable grounded to the same ground. Test each conductor in the same manner. Minimum acceptable reading: For disconnected cables, 100 megohms; for connected cables, 5 megohms. Record all megger readings. Testing of cables having megger readings lower than average, even though meeting minimum requirements, shall be stopped and await further instructions from the Contracting Officer.

1.13.04 Acceptance: Cable must pass all inspections and tests.

1.13.05 Records. Include the following information in test report on each 480 volt power cable.

1.13.05.01 Complete cable identification and description of isolation means. Megger readings, including converted values. Approximate average cable temperature.

1.14 TESTS ON CONTROL WIRING.

1.14.01 General: Give each single conductor and multi-conductor control wire or cable a continuity test and an insulation strength test. Verify identification of conductors.

1.14.02 Connections: Disconnect and fan out conductors to be tested.

1.14.03 Insulation Strength Tests:

1.14.03.01 Subject each control wire to a 1000 volt, 60 hertz test. Apply test between each conductor in a wire group and ground with all other conductors in the wire group grounded to the same ground. Use a test set having an accurate means of insuring 1000 volt test voltage and provide a series resistance to limit fault when a ground is found. Hold test voltage only long enough to read instruments. Test each conductor in the same manner. In lieu of the above insulation strength test, megger each control wire as specified for 480 volt power conductors.

1.14.03.02 Acceptance: Wires must pass all tests.

1.14.04 Records. Include the following information in test report on each wire group.

1.14.04.01 Wire and group identification.

1.14.04.02 Type of test, insulation strength or megger.

1.15 TESTS ON LOW VOLTAGE PANELBOARDS.

1.15.01 General: Check and test all ground connections per "Tests on Grounding". Give each breaker and bus a megger test. Perform operational tests on breakers.

1.15.02 Megger Tests:

1.15.02.01 Apply megger tests on bus.

1.15.02.02 Hold all volt megger tests until the reading reaches a constant value and until three consecutive equal readings one minute apart are obtained.

1.15.02.03 Minimum acceptable megger readings and megger voltage are as follows:

Equipment	Megger Voltage	Minimum Megger Reading-Megohms
Main buses	1000	100
Breakers	1000	200

1.15.03 Acceptance: Equipment must pass all inspections and tests.

1.15.04 Records: Make complete and accurate records of each test. Include the following in each test report: Megger readings versus time data, including converted values and ambient temperature at time of test.

1.16 TESTS ON ROTATING EQUIPMENT.

1.16.01 General: Inspect all motors installed under all other Sections for damage, moisture, alignment, proper lubrication, oil leaks, phase identification and cleanliness. Check for proper rotation. Coordinate uncoupling of motors where reverse rotation would damage equipment. Give each motor a megger test.

1.16.02 Connections: For single phase motors, disconnect motor from service.

1.16.03 Megger Tests:

1.16.03.01 For single phase motors, apply megger test between phase and neutral conductor tied together and ground, with motor at ambient temperature.

1.16.03.02 Hold all megger tests for one minute or until the reading maintain a constant value for 15 seconds.

1.16.03.03 Minimum acceptable megger readings and megger voltage are listed below:

Equipment	Megger Voltage	Minimum Megger Reading-Megohms
480/208 volt, 1 and 3 phase induction motor	1,000	50
115 volt, 1 phase induction motor	1,000	50

1.16.04 Operating Tests: Run motor long enough to prove satisfactory performance including operating temperature, lubrication, vibration.

1.16.05 Acceptance: Motor must pass all inspections and tests.

1.16.06 Records. Make complete and accurate records of all tests and inspections. Include the following in each test report:

1.16.06.01 Megger readings, including converted values.

1.16.06.02 Ambient temperature at time of test.

1.17 TESTS ON CONTROL DEVICES.

1.17.01 General: Perform operating tests on all control, alarm or indicating devices installed under DIVISION 16000 Series Sections.

1.17.02 Connections:

1.17.02.01 Include motors and protective control devices in test circuitry where operation of motors will not damage attached equipment.

1.17.02.02 Where equipment could be damaged by energizing motors, disconnect motor leads at the load side of starters.

1.17.02.03 Jumper or disconnect, as applicable, control devices installed under all other Sections as necessary to permit testing those devices and circuitry installed under 16000 Series Sections.

1.17.02.04 Coordinate these connections and tests with the Contractor responsible for the installation of motors.

1.17.03 Acceptance: Control devices and circuitry must pass all tests to prove that all design functions are satisfactorily performed, including manual and automatic operation and interlocking.

1.17.04 Records: Make complete records of all tests.

1.18 TESTS ON GROUNDING.

1.18.01 General: Inspect ground conductors and connections for conformance with design specifications and for satisfactory workmanship. Test resistance to earth of each ground rod. Test ground paths for equipment and structural steel grounding.

1.18.02 Connections: Include associated ground rods and interconnecting wiring in tests on each grid system for resistance to earth.

1.18.03 Include ground bus on equipment, and associated intermediate copper ground conductors in tests on ground paths for electrical equipment.

1.18.04 Tests On Individual Ground Rods:

1.18.04.01 Test each ground rod for resistance to earth by a standard method. Use a Biddle ground tester or the method of using two auxiliary ground rods as described in IEEE Standard No. 550, paragraph 3.42. The IEEE method requires the use of AC test current. Place auxiliary test rods sufficiently far away from the rod under test so that the regions in which their resistance is localized do not overlap. Calculate ground resistance from the readings taken. Maximum acceptable resistance to earth: 2 ohms.

1.18.04.02 If the resistance is found to be higher than 2 ohms, drive additional rods with a minimum separation of 10 feet and connect in parallel with the rod under test until 5 ohms or less is obtained, or increase the length of the rod under test until 5 ohms maximum is obtained.

1.18.05 Tests On Ground Paths: Test ground paths for electrical equipment for continuity by applying a low voltage DC source of current, capable of furnishing up to 100 amperes. The ground path for electrical equipment using ground rod must conduct 100 amperes. Resistance as calculated from the current and voltage must not exceed 0.010 ohms.

1.18.06 Acceptance: Grounding materials and connections must pass all inspections and must meet all specified maximum and minimum values.

1.18.07 Records: Make complete records of all tests. Include resistance values obtained, calculations of same, and methods of test and calculation.

1.19 INTERCOM SYSTEM.

1.19.01 Operating Tests: Perform operating tests on all system components of the intercom

system to demonstrate that all system design functions are satisfactorily performed. The Contractor shall submit a detailed system test procedure for Contracting Officer approval, at least 2 weeks prior to scheduling system tests.

1.19.02 Speaker Orientation: Adjust orientation of speakers for best performance of the intercom system. The final orientation angle for each speaker shall be field marked on the speakers and documented in test report.

1.20 TESTS ON SPECIAL SERVICE SYSTEMS. Perform operating tests on all special service systems to prove that all design functions are satisfactorily performed.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

End of Supplemental Section