

SECTION 16950
FIELD TESTING

PART 1 - GENERAL

1.1 Description

- A.** This Section covers field testing of all wire, cable, and electrical equipment.
- B.** Related Work Specified Elsewhere

GroundingSection 16450

1.2 References

1. American Society For Testing and Material (ASTM):

ASTM D877 - Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.

2. Insulated Cable Engineers Association (ICEA):

S-19-81 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

S-66-524 - Cross-Linked Thermosetting Polyethylene - Insulated Wire and Cable for the Transmission and Distribution of Electric Energy.

S-68-516 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

3. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE):

C37.20 - Switchgear Assemblies, Including Metal-Enclosed Bus.

4. National Electrical Code (NEC).

5. National Electrical Manufacturers Association (NEMA).

6. **International Electrical Testing Association (NETA)**
7. **National Fire Protection Association**
8. **Standard for Electrical Safety in the Workplace, NFPA 70E**
9. **National Electrical Safety Code, IEEE C2.**
10. **Occupational Safety and Health Administration, OSHA.**
11. As specified in each applicable section, this Division.

1.3 Quality Assurance

A. Test Reports

1. Submit as specified in Section 1330.
2. Maintain a written record of all tests showing date, personnel making tests, equipment used, equipment or material tested, tests performed, and results.
3. Notify Engineer two weeks prior to commencement of all testing except for megger tests.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Ground Test Set

1. Associated Research, Inc.
2. James G. Biddle Company.

B. Multimeter

1. Simpson Electric Company.

C. Insulation Test Set

1. Associated Research, Inc.
2. James G. Biddle Company.

2.2 Provide all testing equipment required which includes all or some of the following

- A. Wet- and dry-bulb thermometer.
- B. 500V meggers.
- C. Battery-powered portable telephone sets and portable radios.
- D. One Multimeter (Volt-Ohm-Milliammeter) rated 20 K ohms per volt (dc) or better, or digital readout multimeter.
- E. One phase rotation meter, 60-Hz.
- F. Commercial model three-point ground test set, James G. Biddle Company "Megger" Ground Tester or Associated Research, Inc., "Vibroground" tester.
- G. Miscellaneous cable, test lights, buzzers, bells, switches, receptacles, plugs, and other equipment as required.

PART 3 - EXECUTION

3.1 General Requirements

- A. Test all wire, cable, and electrical equipment installed or connected by Contractor to assure proper installation, setting, connection, and functioning as indicated or to conform to Contract Documents and manufacturer's instructions.
- B. Conduct all tests except megger insulation testing in the presence of Engineer or Owner and under the supervision of equipment manufacturer's field engineer.
- C. Include all tests recommended by the equipment manufacturer unless specifically waived by Engineer.
- D. Include all additional tests issued by Engineer that he deems necessary because of field conditions to determine that equipment and material and systems meet requirements of Contract Documents.

- E. Be responsible for all damage to equipment or material due to improper test procedures or test apparatus handling.
- F. Provide written reports of all testing to engineer within five (5) days of completion of test and prior to energizing.

3.2 Execution

A. Molded Case Circuit Breaker Tests

1. Visually inspect and manually operate each breaker, to insure proper alignment and smooth operation note any defects or operational problems.
2. Check nameplate data to drawing and specifications.
3. Check adjustable magnetic trip settings against values furnished by Engineer.
4. Megger each pole for freedom from grounds.
5. For breakers provided with shunt trips, check operation of shunt trip circuit.
6. Check all connections.
7. Check for proper current rating for circuit to which breaker is connected.

B. Motor Tests on All Motors

1. Check equipment ground to assure continuity of connections as specified in this Division.
2. Measure the insulation resistance of the stator winding before applying voltage. Compare this measured value against the manufacturer's value. If there is no insulation resistance value furnished by manufacturer, use the following:

Motor Voltage	Insulation Resistance
600 volts and below	5 megohms

If measured resistance values are lower than above, record room temperature and humidity and submit readings to Engineer before energizing. Dry out motors as required by accepted method of application of external heat, and do not apply voltage to motor until substandard resistance condition is corrected. Megger readings are to be one-minute duration, using a 500V megger for all motors 600V and below.

3. Prior to final equipment alignment, disconnect motor from driven equipment where necessary to check lubrication, starter, and control circuits. If motor is free of dirt and dust, rotate rotor by hand to determine that motor turns freely. Clean out motor if necessary. Apply voltage momentarily and note direction of rotation. Correct rotation if necessary. Reconnect motor to driven equipment.
4. After the motor is placed in operation, observe the motor for heating at the bearings or windings. If the motor appears to be running hot, notify Engineer. Note: General purpose motors may reach temperatures up to 176 degrees F with a room temperature of 104 degrees F.
5. If motor is controlled by a VFD, Take motor load ampere readings (on all three legs of three-phase motors) at 60%, 70%, 80%, 90% and 100% of full speed. Submit results to Engineer.

C. Power Switches (Disconnects and Safety)

1. Inspect contacts and clean if required.
2. Inspect arc chutes if provided on switch.
3. Inspect fuses for proper rating if furnished on switch.
4. Operate switches (de-energized) for proper functioning.

D. Float Switches

1. Inspect and test switches to conform to manufacturer's recommended field tests.
2. Adjust switches to perform the design function for proper equipment operation.

E. Wire and Cable Tests: (Feeders and Control Circuits Only)

1. Megger all 600V insulated wire with a 500V megger for one minute, and values must be approximately as follows:

Conductor Capacity <u>Amperes</u>	Resistance <u>Ohms</u>
0-24	1,000,000
25-50	250,000
51-100	100,000
101-200	50,000
201-400	25,000
501-800	12,000
Over 800	5,000

Determine the values with all switchboards, panelboards, fuse holders, switches, and overcurrent devices in place. Do not connect motors and transformers during meggering. Megger wire and cable after installation and not on the cable reel.

2. Check all control cable by megger tests similar to those described for 600V insulated wire. Check all control wiring for tightness of terminal contacts and continuity (especially of current transformer leads) through each "run" of control circuiting. Thoroughly verify all wiring by means of battery-powered lights, buzzers, bells, or telephones. After completing these checks and tests on a given control circuit, attach a temporary cardboard tag on each end of cable tested which bears date and name of Contractor's representative responsible for checking. Follow this procedure for each control circuit cable. Provide all phasing tests and make all changes necessary to assure proper rotation of all motors, the correct phasing and phase sequence of all circuits susceptible to being paralleled, the proper polarity on all instrument transformer wiring, and such other phasing tests as may be required for the equipment being connected under this Contract.

Do not test cable with an ac test set. Disconnect cables from all equipment during testing. Testing cable on reel will not be acceptable. Make testing after installation but before final connection of equipment. Make high-potential tests phase-to-ground on each individual conductor.

F. Control Schemes Tests

1. Test all electrical controls by trial operation of control equipment after all wiring is completed to see that each interlock and control function operates to conform to the description of operation, as well as with the manufacturer's operating instructions.

G. Miscellaneous Equipment Tests

Test all miscellaneous equipment furnished by equipment manufacturer as recommended by manufacturer.

H. Lighting Tests

1. Test all systems for proper operation and correct phasing prior to final acceptance.

I. Grounding Tests

1. Measure resistance of ground system at each ground riser.
2. Record results and notify Engineer if any reading exceeds 1 ohms.
3. Test at least three of each type of ground connections and not less than 25 percent of all ground connections.
4. Test by one of the following methods for resistance measurement:
 - a. Three-point method using an ammeter and voltmeter with ac or dc power supply.
 - b. Commercial instrument method using equipment as specified in this Section.

J. SCADA SYSTEM TESTING

1. Activate each monitored point in the new pump station and verify that the associated signal is received at the Central Monitoring Station at the Island Wastewater Treatment Plant.

PART 4 MEASUREMENT AND PAYMENT

4.1 Measurement

- A. No measurement will be made for this item.

4.2 Payment

- A. Payment will be made at the contract lump sum price bid and shall be considered full payment for providing labor and materials to perform this work.

**** END OF SECTION 16950 ****