

<b>PEARL Inspect &amp; Test Standards</b>			
<b>LOW VOLTAGE INSULATED CASE CIRCUIT BREAKERS WITH SOLID STATE TRIP UNIT</b>	Revision		
	Standard	Number	Date
	<b>1221-I</b>	3	6-2009

This standard is designed to verify that a low voltage insulated case circuit breaker with a solid state trip unit is in a safe and reliable operating condition based upon the design of the original manufacturer at the time of manufacturing. PEARL testing does not verify the claims of the original equipment manufacturer as to the validity of its design criteria. In the event that the device is not in this condition then this standard cannot be used and the PEARL Reconditioning Standard needs to be followed.

PEARL does not warrant, guarantee or make any representation regarding the correctness of specifications, use for any particular purpose, quality or extent of testing, accuracy, or reliability as to any equipment, products or documentation referenced herein.

## **REFERENCES**

The following references are use in this standard. Each of these references can be found in their respective listed locations.

### Table References: Section 6000

- Table 1 US Standard bus connection bolt torque values.
- Table 2 Insulation resistance and test values for electrical apparatus.
- Table 11 Insulation resistance and test temperature conversion to 20°C values.

### National Electrical Code – NEC 2002 Edition

- Article 310 Conductors for General Wiring
- Table 310.17 Allowable Ampacities of Single-Insulated Conductors Rates 0 Through 2000 Volts in Free Air, Based on Ambient Air Temperatures of 30°C (86°F).

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## I TEST EQUIPMENT

The following test equipment is required to perform the testing requirements of this standard:

1. Insulation Resistance Test Set (Megohmmeter) 1000 Vdc minimum
2. High Current Test Set
3. Original Equipment Manufacturer's Secondary Test Set  
*Specific to the breaker being tested.*

One of the following pieces of test equipment is required to perform the contact resistance testing requirements of this standard:

1. Digital Low Resistance Ohmmeter (DLRO - 10 amp unit is sufficient.)
2. DC Current Source and a Millivoltmeter

One of the following pieces of test equipment may be required to perform the testing requirements of this standard, depending on the accessories:

1. AC Voltage Supply
2. DC Voltage Supply
3. Millivoltmeter or a Multimeter

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## **II EVALUATION**

The following procedures shall be used to determine the condition a low voltage insulated case circuit breaker with a solid state trip unit under this standard.

### **1 INSPECTION**

#### **1.1 Case**

- 1.1.1 Ensure that the nameplate/label data is legible.
- 1.1.2 Ensure that the third party listing service label is legible.
- 1.1.3 Inspect the case for cracks, chips and unused holes.
- 1.1.4 Inspect case for signs of overheating.
- 1.1.5 Inspect all control wire for signs of deterioration, overheating and damage.
- 1.1.6 Inspect for missing parts.
- 1.1.7 Record results on an approved PEARL Evaluation Form.

#### **1.2 Primary Stabs/Disconnects**

- 1.2.1 Inspect for tightness.
- 1.2.2 Inspect for signs of overheating.
- 1.2.3 Inspect plating.
- 1.2.4 Record results on an approved PEARL Evaluation Form.

#### **1.3 Secondary Stabs/Disconnects**

- 1.3.1 Inspect for tightness.
- 1.3.2 Inspect for proper operation of wipe.
- 1.3.3 Inspect for signs of overheating.
- 1.3.4 Inspect plating.
- 1.3.5 Record results on an approved PEARL Evaluation Form.

#### **1.4 Phase Separators**

- 1.4.1 Inspect for dust, dirt and foreign materials.
- 1.4.2 Inspect for chips, cracks and deterioration.
- 1.4.3 Inspect for overheating.
- 1.4.4 Ensure that phase separators match application.
- 1.4.5 Record results on an approved PEARL Evaluation Form.

#### **1.5 Arc Extinguishers/Chutes**

- 1.5.1 Inspect for loose and missing parts.
- 1.5.2 Inspect for dust, dirt, foreign material, cracks, corrosion, chips and signs of overheating.
- 1.5.3 Inspect for excessive deterioration and carbon buildup on the separator.
- 1.5.4 Record results on an approved PEARL Evaluation Form.

#### **1.6 Arcing Contacts**

- 1.6.1 Inspect for excessive deterioration.
- 1.6.2 Inspect for cracks, chips and pitting.
- 1.6.3 Check for proper alignment/seating in the closed position.
- 1.6.4 Check for proper sequence.
- 1.6.5 Record results on an approved PEARL Evaluation Form.

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- 1.7 Main Contacts**
  - 1.7.1 Inspect for excessive deterioration.
  - 1.7.2 Inspect for cracks, chips and pitting.
  - 1.7.3 Check for proper alignment/seating in the closed position.
  - 1.7.4 Check for proper sequence.
  - 1.7.5 Record results on an approved PEARL Evaluation Form.
- 1.8 Intermediate Contact (if applicable)**
  - 1.8.1 Inspect for excessive deterioration.
  - 1.8.2 Inspect for cracks, chips and pitting.
  - 1.8.3 Check for proper alignment/seating in the closed position.
  - 1.8.4 Inspect separators for defects.
  - 1.8.5 Record results on an approved PEARL Evaluation Form.
- 1.9 Current Carrying Components**
  - 1.9.1 Inspect hinge/pivot joints for signs of overheating.
  - 1.9.2 Inspect hinge/pivot joints for missing and defective parts.
  - 1.9.3 Inspect any other current carrying component for signs of overheating.
  - 1.9.4 Inspect any other current carrying component for missing and defective parts.
  - 1.9.5 Record results on an approved PEARL Evaluation Form.
- 1.10 Shunt Trip Devices (if installed)**
  - 1.10.1 Inspect shunt trip unit for missing and defective screws, bolts, nuts, fasteners and keepers.
  - 1.10.2 Inspect shunt trip unit for signs of overheating and deteriorated insulation.
  - 1.10.3 Inspect for pinched and damaged wire insulation.
  - 1.10.4 Check shunt trip unit for loose and defective terminal connectors.
  - 1.10.5 Record results on an approved PEARL Evaluation Form.
- 1.11 Auxiliary Contacts (if installed)**
  - 1.11.1 Inspect contact unit for missing and defective screws, bolts, nuts, fasteners and keepers.
  - 1.11.2 Inspect contact unit for signs of overheating and deteriorated insulation.
  - 1.11.3 Inspect for pinched and damaged wire insulation.
  - 1.11.4 Check contact unit for loose and defective terminal connectors.
  - 1.11.5 Record results on an approved PEARL Evaluation Form.
- 1.12 Bell Alarm Contact (if installed)**
  - 1.12.1 Inspect contact unit for missing and defective screws, bolts, nuts, fasteners and keepers.
  - 1.12.2 Inspect contact unit for signs of overheating and deteriorated insulation.
  - 1.12.3 Inspect for pinched and damaged wire insulation.
  - 1.12.4 Check contact unit for loose and defective terminal connectors.
  - 1.12.5 Record results on an approved PEARL Evaluation Form.

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- 1.13 Undervoltage Trip Devices** (if installed)
  - 1.13.1 Inspect undervoltage trip unit for missing and defective screws, bolts, nuts, fasteners and keepers.
  - 1.13.2 Inspect undervoltage trip unit for signs of overheating and deteriorated insulation.
  - 1.13.3 Inspect for pinched and damaged wire insulation.
  - 1.13.4 Check undervoltage trip unit for loose and defective terminal connectors.
  - 1.13.5 Record results on an approved PEARL Evaluation Form.
- 1.14 Blown Fuse Indicator Devices**
  - 1.14.1 Inspect blown fuse indicator trip unit for missing and defective screws, bolts, nuts, fasteners and keepers.
  - 1.14.2 Inspect blown fuse indicator trip unit for signs of overheating and deteriorated insulation.
  - 1.14.3 Check blown fuse indicator trip unit for loose and defective terminal connectors.
  - 1.14.4 Record results on an approved PEARL Evaluation Form.
- 1.15 Overcurrent Trip System**
  - 1.15.1 General**
    - 1.15.1.1 Inspect for signs of overheating.
    - 1.15.1.2 Inspect for corrosion and rust.
    - 1.15.1.3 Inspect for missing and defective screws, bolts, nuts, fasteners and keepers.
    - 1.15.1.4 Check for loose and defective terminal connectors.
    - 1.15.1.5 Record results on an approved PEARL Evaluation Form.
  - 1.15.2 Wiring Harness**
    - 1.15.2.1 Inspect for overheating.
    - 1.15.2.2 Inspect for pinched, damaged and deteriorated insulation.
    - 1.15.2.3 Record results on an approved PEARL Evaluation Form.
  - 1.15.3 Flux shifter**
    - 1.15.3.1 Inspect for overheating.
    - 1.15.3.2 Inspect for binding.
    - 1.15.3.3 Inspect for loose connections.
    - 1.15.3.4 Record results on an approved PEARL Evaluation Form.
  - 1.15.4 Current Sensors/Transformers**
    - 1.15.4.1 Inspect for overheating.
    - 1.15.4.2 Inspect for cracked and damaged outer casing.
    - 1.15.4.3 Inspect for loose connections.
    - 1.15.4.4 Record results on an approved PEARL Evaluation Form.
- 1.16 Control Wiring**
  - 1.16.1 Inspect for overheating.
  - 1.16.2 Inspect for damage and deteriorated insulation.
  - 1.16.3 Check for loose and defective terminal connectors.
  - 1.16.4 Record results on an approved PEARL Evaluation Form.

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**1.17 Operating Mechanism**

- 1.17.1 Inspect for signs of rust and corrosion.
- 1.17.2 Inspect for excessive and inappropriate lubrication.
- 1.17.3 Inspect for missing screws, bolts, nuts, fasteners, retainers and keepers
- 1.17.4 Inspect charging motor when applicable.
- 1.17.5 Inspect closing springs when applicable.
- 1.17.6 Inspect opening springs when applicable.
- 1.17.7 Manually operate circuit breaker a minimum of three (3) times while checking for proper operation of the quick-make and quick-break feature.
- 1.17.8 Electrically operate circuit breaker a minimum of three (3) times.
- 1.17.9 Record results on an approved PEARL Evaluation Form.

**1.18 Racking/Drawout Mechanisms**

- 1.18.1 Inspect for signs of rust and corrosion.
- 1.18.2 Inspect for excessive and inappropriate lubrication.
- 1.18.3 Inspect for missing screws, bolts, nuts, fasteners, retainers and keepers.
- 1.18.4 Operate racking/drawout mechanism a minimum of three (3) times while checking for smooth operation.
- 1.18.5 Record results on an approved PEARL Evaluation Form.

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## 2 TESTING

### 2.1 Insulation Resistance

**Consult manufacturer's instructions for any precautions before performing this test.**

- 2.1.1 Perform an insulation resistance test at test values specified in Table 2 of Section 6000 as follows:
  - 2.1.1.1 Circuit breaker in the open position
    - 2.1.1.1.1 Line to load
  - 2.1.1.2 Circuit breaker in the closed position
    - 2.1.1.2.1 Phase to phase
    - 2.1.1.2.2 Phase to ground
- 2.1.2 Correct for temperature, if necessary (Table 11).
- 2.1.3 Record results on an approved PEARL Evaluation Form.
- 2.1.4 Compare test results to manufacturer's recommendations or Table 2 of Section 6000.

### 2.2 Contact Resistance

- 2.2.1 Perform a contact resistance, millivolt drop test or watt-loss test from line to load on each phase of a closed circuit breaker.
- 2.2.2 Record results on an approved PEARL Evaluation Form.
- 2.2.3 Compare test results to manufacturer's recommendations.
- 2.2.4 A PEARL recognized method is comparing the test results of each pole. Results should be within 50% for any of the poles. Any industrial standard used shall provide at least the same integrity as the PEARL recognized standard of comparing the test results of each pole and ensuring that they are within 50% of each other.

### 2.3 Secondary Test (if possible)

- 2.3.1 Follow the instructions for the breaker type as required by the OEM specific test equipment.
- 2.3.2 Record results on an approved PEARL Evaluation Form.

### 2.4 Time Overcurrent (Long-Time) Trip Test

- 2.4.1 Perform a pickup test, if applicable.
- 2.4.2 Perform a time overcurrent trip test (recommend using 300% of rating) to the circuit breaker, if applicable
- 2.4.3 Use specific length and size of wire that meet or exceeds manufacturer's guidelines or NEC, Article 310, Table 310.17.
- 2.4.4 Record results on an approved PEARL Evaluation Form
- 2.4.5 Compare results to manufacturer's recommendations.

### 2.5 Short-Time Trip Test

- 2.5.1 Perform a short-time pickup test.
- 2.5.2 Perform a short-time overcurrent trip test (recommend using 150% of short-time setting) to the circuit breaker, if applicable.
- 2.5.3 Record results on an approved PEARL Evaluation Form.
- 2.5.4 Compare results to manufacturer's recommendations.

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**2.6 Instantaneous Overcurrent Trip Test**

- 2.6.1 Perform an instantaneous pickup test.
- 2.6.2 Perform an instantaneous overcurrent trip test to the circuit breaker, if applicable.
- 2.6.3 Record results on an approved PEARL Evaluation Form.
- 2.6.4 Compare results to manufacturer's recommendations.

**2.7 Ground Fault Trip Test**

- 2.7.1 Perform a ground fault pickup test.
- 2.7.2 Perform a ground fault trip test (recommend using 150% of ground fault setting) to the circuit breaker, if applicable.
- 2.7.3 Record results on an approved PEARL Evaluation Form.
- 2.7.4 Compare results to manufacturer's recommendations.

**2.8 Thermal Memory Feature**

- 2.8.1 Test the thermal memory feature of the circuit breaker, if applicable.
- 2.8.2 Record results on an approved PEARL Evaluation Form.
- 2.8.3 Compare results to manufacturer's recommendations.

**2.9 Zone Interlock Feature**

- 2.9.1 Test the zone interlock feature of the circuit breaker, if applicable.
- 2.9.2 Record results on an approved PEARL Evaluation Form.
- 2.9.3 Compare results to manufacturer's recommendations.

**NOTE:** If the original equipment manufacturer has designed the breaker to have field interchangeable trip units, then the device may be replaced as necessary. Otherwise, if changes are made to the trip unit then the PEARL Reconditioning Standards need to be followed.

**2.10 Shunt Trip Test (if installed)**

- 2.10.1 Close circuit breaker.
- 2.10.2 Connect appropriate voltage source to shunt trip input leads.
- 2.10.3 Increase voltage until shunt trip unit operates. Verify that the device operates properly at its minimum rated voltage.
- 2.10.4 Record results on an approved PEARL Evaluation Form.

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- 2.11 Auxiliary Contact Test** (if installed)
  - 2.11.1** Connect Megohmmeter to input leads.
  - 2.11.2** Close circuit breaker.
  - 2.11.3** Verify that the normally open contacts are closed and the resistance is within acceptable levels. Verify that the normally closed contacts are open and no continuity exists between contact points.
  - 2.11.4** Open circuit breaker
  - 2.11.5** Verify that the normally closed contacts are closed and the resistance is within acceptable levels. Verify that the normally open contacts are open and no continuity exists between contact points.
  - 2.11.6** Manually trip circuit breaker
  - 2.11.7** Verify that the normally closed contacts are closed and the resistance is within acceptable levels. Verify that the normally open contacts are open and no continuity exists between contact points.
  - 2.11.8** Record results on an approved PEARL Evaluation Form.
- 2.12 Bell Alarm Contact Test** (if installed)
  - 2.12.1** Connect Megohmmeter to input leads.
  - 2.12.2** Close circuit breaker.
  - 2.12.3** Verify that the bell alarm contact is open and no continuity exists between contact points.
  - 2.12.4** Open circuit breaker
  - 2.12.5** Verify that the bell alarm contact is open and no continuity exists between contact points.
  - 2.12.6** Manually trip circuit breaker
  - 2.12.7** Verify that the bell alarm contact is now closed and the resistance is within acceptable levels.
  - 2.12.8** Record results on an approved PEARL Evaluation Form.
- 2.13 Additional Devices**
  - 2.13.1** Test any other control devices for signs of proper operation.
  - 2.13.2** Test actuator for proper operation.
  - 2.13.3** Record results on an approved PEARL Evaluation Form.

**NOTE:** If the original equipment manufacturer has designed the accessories to be field installed, then the devices may be replaced as necessary. Otherwise, if changes are made to the accessories then the PEARL Reconditioning Standards need to be followed.

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**2.14 Blown Fuse Trip Indicator Test**

- 2.14.1 Connect voltage source to fuse trip indicator input leads for A phase (left pole).
- 2.14.2 Close circuit breaker.
- 2.14.3 Apply rated voltage to the fuse trip indicator unit for A phase.
- 2.14.4 Ensure that circuit breaker trips (opens) and fuse indicator trip unit for A phase shows proper trip indicator. Attempt to close tripped breaker. (Note - Breaker should not close.)
- 2.14.5 Repeat for B phase (center pole) and C phase (right pole).
- 2.14.6 Record results on an approved PEARL Evaluation Form.

**2.15 Checks and Adjustments**

- 2.15.1 Make all checks and adjustments per manufacturer's recommendations. In the absence of a manufacturer's recommendations, any check or adjustment made will be based upon procedures that will ensure the original manufacturer's design.
- 2.15.2 All checks and adjustments must be within the guidelines recommended in order for the product to become a PEARL labeled product.
- 2.15.3 Record results on an approved PEARL Evaluation Form.

**2.16 Torque**

- 2.16.1 Check all screw and bolt connections for the proper torque per manufacturer's recommendations or Table 1 of Section 6000.
- 2.16.2 Record results on an approved PEARL Evaluation Form.

**2.17 Final Operation**

- 2.17.1 Ensure that all components, structures, devices and assemblies are complete and equipment is ready for service prior to beginning operations.
- 2.17.2 Manually operate breaker a minimum of ten (10) times while checking for proper operation of the quick-make and quick-break feature.
- 2.17.3 All devices must operate properly in order for the product to become a PEARL labeled product.
- 2.17.4 Record results on appropriate PEARL Evaluation Form.

**3 EVALUATION REVIEW**

In order for the device to be eligible for the Inspect & Test Quality Seal, the device needs to have passed all of the preceding Inspection (1) and Testing (2) points. Any failures in the process will require that the device be "Reconditioned" at which time the PEARL Reconditioning Standard needs to be followed.

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### **III PEARL CERTIFICATION**

This product has now been inspected and tested and has passed all tests under the PEARL Inspect & Test Standard. The green PEARL Inspect & Test Quality Seal may now be placed on the device.