This standard is designed to verify that a medium voltage vacuum circuit breaker 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 5: Overpotential Test Voltages for Non-Inductive Electrical Apparatus
Table 7: Power Factor/Dissipation Factor Recommended Test Voltage Values
Table 11: Insulation resistance and test temperature conversion to 20°C values.

I TEST EQUIPMENT

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

1. Insulation Resistance Test Set (Megohmeter) 2500 Vdc minimum

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

1. AC Overpotential Test Set (Hipot)
2. DC Overpotential Test Set (Hipot)

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

1. AC Overpotential Test Set (Hipot)
2. DC Overpotential Test Set (Hipot)
3. Power Factor Test Set
4. Dissipation Factor Test Set

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

II EVALUATION

The following procedures shall be used to determine the condition of a medium voltage vacuum circuit breaker under this standard.

1 INSPECTION

1.1 Frame

1.1.1 Ensure that the nameplate data is legible.
1.1.2 Ensure that the third party listing service label is legible.
1.1.3 Ensure that the frame is plumb and square.
1.1.4 Inspect for missing screws, bolts, nuts, fasteners, retainers and keepers.
1.1.5 Inspect for rust and corrosion.
1.1.6 Inspect ground connection for excessive and inappropriate lubrication.
1.1.7 Inspect primary disconnects/stabs for excessive and inappropriate lubrication, signs of overheating and missing and defective parts.
1.1.8 Inspect secondary disconnects/stabs for excessive and inappropriate lubrication, signs of overheating and missing and defective parts.
1.1.9 Inspect interference interface for correct position based on frame rating.
1.1.10 Inspect insulation structure for signs of overheating and deterioration.
1.1.11 Record results on an approved PEARL Evaluation Form.

1.2 Operating Mechanism

1.2.1 Inspect for signs of rust and corrosion.
1.2.2 Inspect for excessive and inappropriate lubrication.
1.2.3 Inspect charging motor, when applicable.
1.2.4 Inspect control relays.
1.2.5 Inspect spring release relay, when applicable.
1.2.6 Inspect closing springs, when applicable.
1.2.7 Inspect opening springs, when applicable.
1.2.8 Inspect closing coil, when applicable.
1.2.9 Inspect insulating links (push rods).
1.2.10 Inspect for missing screws, bolts, nuts, fasteners, retainers and keepers.
1.2.11 Record results on an approved PEARL Evaluation Form.

1.3 Interphase Barriers

1.3.1 Inspect for dust, dirt and foreign materials.
1.3.2 Inspect for chips, cracks and deterioration.
1.3.3 Inspect for overheating.
1.3.4 Record results on an approved PEARL Evaluation Form.

1.4 Vacuum Bottle

1.4.1 Inspect for cracks and chips.
1.4.2 Check erosion gap on each phase, if available.
1.4.3 Record results on an approved PEARL Evaluation Form.

1.5 Racking/Drawout Mechanism

1.5.1 Inspect for signs of rust and corrosion.
1.5.2 Inspect for excessive and inappropriate lubrication.
1.5.3 Inspect for missing screws, bolts, nuts, fasteners, retainers and keepers.
1.5.4 Record results on an approved PEARL Evaluation Form.

1.6 Interlocks

1.6.1 Ensure that all circuit breaker interlocks all present.
1.6.2 Record results on an approved PEARL Evaluation Form.

1.7 Limit Switches

1.7.1 Inspect all circuit breaker limit switches for proper operation.
1.7.2 Check all terminal connections.
1.7.3 Inspect for chips, cracks and defective limit switch cases.
1.7.4 Record results on an approved PEARL Evaluation Form.

1.8 Auxiliary/Secondary Contact Block

1.8.1 Inspect circuit breaker auxiliary contact block for proper operation.
1.8.2 Check all terminal connections.
1.8.3 Inspect for chips, cracks and defective auxiliary contact block assembly.
1.8.4 Record results on an approved PEARL Evaluation Form.

1.9 Devices

1.9.1 Inspect shunt trip unit for signs of overheating and deteriorated insulation.
1.9.2 Check shunt trip unit for loose and defective terminal connectors.
1.9.3 Inspect anti-pump unit for signs of overheating and deteriorated insulation.
1.9.4 Check anti-pump unit for loose and defective terminal connectors.
1.9.5 Inspect other control devices for signs of overheating and deteriorated insulation.
1.9.6 Record results on an approved PEARL Evaluation Form.

1.10 Control Wiring

1.10.1 Inspect for overheating.
1.10.2 Inspect for damage and deteriorated insulation.
1.10.3 Check for loose and defective terminal connectors.
1.10.4 Record results on an approved PEARL Evaluation Form.

1.11 Operation

1.11.1 Operate racking/drawout mechanism three (3) times while checking for smooth operation.
1.11.2 Manually operate circuit breaker a minimum of five (5) times while checking for proper operation of the:
  1.11.2.1 Quick-make and quick-break feature.
  1.11.2.2 Counter operation.
  1.11.2.3 Close/Open indicator flag.
1.11.3 Electrically operate (close/open) circuit breaker a minimum of five (5) times while checking for proper operation.
1.11.4 Record results on an approved PEARL Evaluation Form.

2 TESTING

2.1 Insulation Resistance

2.1.1 Perform an insulation resistance at test values specified in Table 2 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.

2.2 Compare results to manufacturer's recommendations or industrial standards (Table 2).

CAUTION

Check with manufacturer for radiation warnings and test voltage limitations.

2.3 Vacuum Bottle Integrity Test

2.3.1 Perform a vacuum bottle integrity test on each phase using specific manufacturer's literature guidelines for test voltage and test sets.

2.3.2 Circuit breaker in the open position - Line to Load using an overpotential test set.

2.3.3 Record results on an approved PEARL Evaluation Form.

2.3.4 Compare results to manufacturer's guidelines.

2.4 Timing

2.4.1 Perform a timing test on the close operation using the 52a contacts.

2.4.2 Perform a timing test on the open operation using the 52b contacts.

2.4.3 Compare with manufacturer’s recommendations.

<u>Either Test</u>; the "Overpotential Test" (Step 2.5) or the "Power Factor Test" (Step 2.6) must be performed. It is <u>not</u> a requirement to do both.

2.5 Overpotential Test

2.5.1 Perform an overpotential test at test voltage specified in Table 5 as follows:

2.5.2 Circuit breaker in the open position with arc chutes installed

2.5.2.1 Line to load

2.5.2.2 Line to ground

2.5.2.3 Load to ground

2.5.3 Circuit breaker in the closed position

2.5.3.1 Phase to phase

2.5.3.2 Phase to ground

2.5.4 Record results on an approved PEARL Evaluation Form.

2.5.5 Compare results to manufacturer's guidelines or industrial standards.

2.5.6 The test results must be within the guidelines recommended in order for the product to become a PEARL labeled product.

2.6 Power Factor/Dissipation Factor Test

2.6.1 "A" Phase test

2.6.1.1 Perform a power factor test at rated voltage or below.

2.6.1.2 Breaker is in the OPEN position with arc chutes installed.

2.6.1.3 Connect the HIGH voltage test lead to the line side of "A" phase.

2.6.1.4 Connect the LOW voltage test lead to the load side of "A" phase.

2.6.1.5 Connect the GROUND test lead to the frame of the breaker.

2.6.1.6 Run a power/dissipation factor test in the "GUARD" mode.

2.6.1.6.1 This is the "A-phase line to ground".

2.6.1.6.2 Correct for temperature, if necessary. Refer to test equipment manufacturer's guidelines.

2.6.1.6.3 Record results on an approved PEARL Evaluation Form.

2.6.1.7 Run a power/dissipation factor test in the "UST" mode

2.6.1.7.1 This is the "A-phase line to load".

2.6.1.7.2 Correct for temperature, if necessary. Refer to test equipment manufacturer's guidelines.

2.6.1.7.3 Record results on an approved PEARL Evaluation Form.

2.6.1.8 Move the HIGH voltage test lead to the load side of "A" phase and the LOW voltage test lead to the line side of "A" phase.

2.6.1.9 Run a power/dissipation factor test in the "GUARD" mode.

2.6.1.9.1 This is the "A-phase load to ground".

2.6.1.9.2 Correct for temperature, if necessary. Refer to test equipment manufacturer's guidelines.

2.6.1.9.3 Record results on an approved PEARL Evaluation Form.

2.6.2 "B" Phase test

2.6.2.1 Perform a power factor test at rated voltage or below.

2.6.2.2 Breaker is in the OPEN position with arc chutes installed.

2.6.2.3 Connect the HIGH voltage test lead to the line side of "B" phase.

2.6.2.4 Connect the LOW voltage test lead to the load side of "B" phase.

2.6.2.5 Connect the GROUND test lead to the frame of the breaker.

2.6.2.6 Run a power/dissipation factor test in the "GUARD" mode.

2.6.2.6.1 This is the "B-phase line to ground".

2.6.2.6.2 Correct for temperature, if necessary. Refer to test equipment manufacturer's guidelines.

2.6.2.6.3 Record results on an approved PEARL Evaluation Form.

2.6.2.7 Run a power/dissipation factor test in the "UST" mode.

2.6.2.7.1 This is the "B-phase line to load".

2.6.2.7.2 Correct for temperature, if necessary. Refer to test equipment manufacturer's guidelines.

2.6.2.7.3 Record results on an approved PEARL Evaluation Form.

2.6.2.8 Move the HIGH voltage test lead to the load side of "B" phase and the LOW voltage test lead to the line side of "B" phase.

2.6.2.9 Run a power/dissipation factor test in the "GUARD" mode.

2.6.2.9.1 This is the "B-phase load to ground".

2.6.2.9.2 Correct for temperature, if necessary. Refer to test equipment manufacturer's guidelines.

2.6.2.9.3 Record results on an approved PEARL Evaluation Form.

2.6.3 "C" Phase test

2.6.3.1 Perform a power factor test at rated voltage or below.

2.6.3.2 Breaker is in the OPEN position with arc chutes installed.

2.6.3.3 Connect the HIGH voltage test lead to the line side of "C" phase.

2.6.3.4 Connect the LOW voltage test lead to the load side of "C" phase.

2.6.3.5 Connect the GROUND test lead to the frame of the breaker.

2.6.3.6 Run a power/dissipation factor test in the "GUARD" mode.

2.6.3.6.1 This is the "C-phase line to ground".

2.6.3.6.2 Correct for temperature, if necessary. Refer to test equipment manufacturer's guidelines.

2.6.3.6.3 Record results on an approved PEARL Evaluation Form.

2.6.3.7 Run a power/dissipation factor test in the "UST" mode.

2.6.3.7.1 This is the "C-phase line to load".

2.6.3.7.2 Correct for temperature, if necessary. Refer to test equipment manufacturer's guidelines.

2.6.3.7.3 Record results on an approved PEARL Evaluation Form.

2.6.3.8 Move the HIGH voltage test lead to the load side of "C" phase and the LOW voltage test lead to the line side of "C" phase.

2.6.3.9 Run a power/dissipation factor test in the "GUARD" mode.

2.6.3.9.1 This is the "C-phase load to ground".

2.6.3.9.2 Correct for temperature, if necessary. Refer to test equipment manufacturer's guidelines.

2.6.3.9.3 Record results on an approved PEARL Evaluation Form.

2.6.4 Compare results to manufacturer's guidelines or industrial standards.

2.6.5 The test results must be within the guidelines recommended in order for the product to become a PEARL labeled product.

2.7 Contact Resistance

2.7.1 Perform a contact resistance, millivolt drop test or watt-loss test from line to load on each phase of a closed circuit breaker with the test points at the line and load primary stabs/disconnects.

2.7.2 Record results on an approved PEARL Evaluation Form.

2.7.3 Compare test results to manufacturer's recommendations.

2.7.4 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.

2.8 Timing

2.8.1 Perform a timing test on the close operation using the 52a contacts.

2.8.2 Perform a timing test on the open operation using the 52b contacts.

2.8.3 Compare with manufacturer’s recommendations.

2.9 Torque

2.9.1 Check all screw and bolt connections for the proper torque per manufacturer's recommendations or industrial standards (Table 1).

2.9.2 Record results on an approved PEARL Evaluation Form.

NOTE: If the original equipment manufacturer has designed the parts 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.

2.10 Checks and Adjustments

2.10.1 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.

2.10.2 All checks and adjustments must be within the guidelines recommended in order for the product to become a PEARL labeled product.

2.10.3 Record results on an approved PEARL Evaluation Form.

2.11 Torque

2.11.1 Check all screw and bolt connections for the proper torque per manufacturer's recommendations or Table 1 of Section 6000.

2.11.2 Record results on an approved PEARL Evaluation Form.

2.12 Final Operation

2.12.1 Ensure that all components, structures, devices and assemblies are complete and equipment is ready for service prior to beginning operations.

2.12.2 Manually operate the device a minimum of ten (10) times while checking for proper operation of the quick-make and quick-break feature.

2.12.3 Manually operate (close/open) circuit breaker ten (10) times while checking for proper operation of the operating mechanism.

2.12.4 Electrically operate (close/open) circuit breaker ten (10) times while checking for proper operation.

2.12.5 Verify operation of any accessories.

2.12.6 All devices must operate properly in order for the product to become a PEARL labeled product.

2.12.7 Record results on appropriate PEARL Evaluation Form.

2.12.8 Ensure that the nameplate/label data is complete, correct and legible.

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.

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.