

<i>PEARL Inspect & Test Standards</i>			
<i>MEDIUM VOLTAGE SF6 CIRCUIT BREAKERS STORED ENERGY - SPRING</i>	<i>PROPOSED STANDARD</i>		
	<i>Standard</i>	<i>Number</i>	<i>Date</i>
	<i>2230-I</i>	<i>3</i>	<i>6-2009</i>

This standard is designed to verify that a medium voltage sf6 type, spring stored energy, 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 standard:

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

One of the following pieces of test equipment is required to perform the 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

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II EVALUATION

The following procedures shall be used to determine the condition of a medium voltage sf6 type, spring stored energy, 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 Inspect for missing screws, bolts, nuts, fasteners, retainers and keepers.
- 1.1.4 Inspect for rust and corrosion.
- 1.1.5 Inspect ground connection for excessive and inappropriate lubrication.
- 1.1.6 Inspect interference interface for correct position based on frame rating.
- 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 excessive and inappropriate lubrication.
- 1.2.3 Inspect for missing and defective parts.
- 1.2.4 Inspect for signs of overheating.
- 1.2.5 Inspect plating.
- 1.2.6 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 excessive and inappropriate lubrication.
- 1.3.4 Inspect for missing and defective parts.
- 1.3.5 Inspect for signs of overheating.
- 1.3.6 Inspect plating.
- 1.3.7 Record results on an approved PEARL Evaluation Form.

1.4 Operating Mechanism

- 1.4.1 Inspect for signs of rust and corrosion.
- 1.4.2 Inspect for excessive and inappropriate lubrication.
- 1.4.3 Inspect charging motor, when applicable.
- 1.4.4 Inspect control relays.
- 1.4.5 Inspect spring release relay when applicable.
- 1.4.6 Inspect closing springs when applicable.
- 1.4.7 Inspect opening springs when applicable.
- 1.4.8 Inspect closing coil when applicable.
- 1.4.9 Inspect insulating links
- 1.4.10 Inspect for missing screws, bolts, nuts, fasteners, retainers and keepers.
- 1.4.11 Record results on an approved PEARL Evaluation Form.

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- 1.5 Interphase Barriers**
 - 1.5.1 Inspect for dust, dirt and foreign materials.
 - 1.5.2 Inspect for chips, cracks and deterioration.
 - 1.5.3 Inspect for tracking.
 - 1.5.4 Inspect for overheating.
 - 1.5.5 Record results on an approved PEARL Evaluation Form.
- 1.6 SF6 Bottles**
 - 1.6.1 Inspect for cracks and chips.
 - 1.6.2 Check erosion gap on each phase
 - 1.6.3 Check pressure gage.
 - 1.6.4 Record results on an approved PEARL Evaluation Form.
- 1.7 Racking/Draw-out Mechanism**
 - 1.7.1 Inspect for signs of rust and corrosion.
 - 1.7.2 Inspect for excessive and inappropriate lubrication.
 - 1.7.3 Inspect for missing screws, bolts, nuts, fasteners, retainers and keepers.
 - 1.7.4 Record results on an approved PEARL Evaluation Form.
- 1.8 Current Carrying Components**
 - 1.8.1 Inspect hinge/pivot joints for signs of overheating.
 - 1.8.2 Inspect hinge/pivot joints for missing and defective parts.
 - 1.8.3 Inspect any other current carrying component for signs of overheating.
 - 1.8.4 Inspect any other current carrying component for missing and defective parts.
 - 1.8.5 Record results on an approved PEARL Evaluation Form.
- 1.9 Interlocks**
 - 1.9.1 Ensure all circuit breaker interlocks (all present).
 - 1.9.2 Record results on an approved PEARL Evaluation Form.
- 1.10 Limit Switches**
 - 1.10.1 Inspect all circuit breaker limit switches for proper operation.
 - 1.10.2 Check all terminal connections.
 - 1.10.3 Inspect for chips, cracks and defective limit switch cases.
 - 1.10.4 Record results on an approved PEARL Evaluation Form.
- 1.11 Auxiliary/Secondary Contact Block**
 - 1.11.1 Inspect circuit breaker auxiliary contact block for proper operation.
 - 1.11.2 Check all terminal connections.
 - 1.11.3 Inspect for chips, cracks and defective auxiliary contact block assembly.
 - 1.11.4 Record results on appropriate PEARL Evaluation Report.
- 1.12 Trip Coil**
 - 1.12.1 Inspect for missing and defective screws, bolts, nuts, fasteners and keepers.
 - 1.12.2 Inspect for signs of overheating and deteriorated insulation.
 - 1.12.3 Check for loose and defective terminal connectors.
 - 1.12.4 Record results on an approved PEARL Evaluation Form.

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- 1.13 Spring Release Coil**
 - 1.13.1 Inspect for missing and defective screws, bolts, nuts, fasteners and keepers.
 - 1.13.2 Inspect for signs of overheating and deteriorated insulation.
 - 1.13.3 Check for loose and defective terminal connectors.
 - 1.13.4 Record results on an approved PEARL Evaluation Form.
- 1.14 Anti-Pump Coil**
 - 1.14.1 Inspect for missing and defective screws, bolts, nuts, fasteners and keepers.
 - 1.14.2 Inspect for signs of overheating and deteriorated insulation.
 - 1.14.3 Check for loose and defective terminal connectors.
 - 1.14.4 Record results on an approved PEARL Evaluation Form.
- 1.15 Control Wiring**
 - 1.15.1 Inspect for overheating.
 - 1.15.2 Inspect for damage and deteriorated insulation.
 - 1.15.3 Check for loose and defective terminal connectors.
 - 1.15.4 Record results on an approved PEARL Evaluation Form.
- 1.16 Operation**
 - 1.16.1 Operate racking/draw-out mechanism three (3) times while checking for smooth operation.
 - 1.16.2 Manually operate (charge-close-trip) circuit breaker a minimum of three (3) times while checking for proper operation of the;
 - 1.16.2.1 Quick-make and quick-break feature.
 - 1.16.2.2 Counter operation.
 - 1.16.2.3 Close/Open indicator Flag.
 - 1.16.3 Electrically operate (charge-close-trip) circuit breaker a minimum of five (5) times while checking for proper operation of the:
 - 1.16.3.1 Charging motor cutoff circuit
 - 1.16.3.2 Spring release circuit
 - 1.16.3.3 Anti-Pump circuit
 - 1.16.3.4 Counter operation.
 - 1.16.3.5 Close/Open indicator Flag.
 - 1.16.4 Record results on an approved PEARL Evaluation Form.
- 1.17 Checks and Adjustments**
 - 1.17.1 Make all checks per manufacturer's recommendations. In the absence of a manufacturer's recommendations, any checks made will be based upon procedures that will ensure the original manufacturer's design.
 - 1.17.2 Record results on an approved PEARL Evaluation Form.

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2 TESTING

2.1 Insulation Resistance

- 2.1.1** Perform an insulation resistance 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 results to manufacturer's recommendations or industrial standards (Table 2).

Either Test; the “Overpotential Test” (Step 2.2) or the “Power Factor Test” (Step 2.3) must be performed. It is not a requirement to do both.

2.2 Overpotential Test

- 2.2.1** Perform an overpotential test at test voltage specified in Table 5 as follows:
- 2.2.1.1** Circuit breaker in the open position
 - 2.2.1.1.1** Line to Load
 - 2.2.1.1.2** Line to ground
 - 2.2.1.1.3** Load to ground
 - 2.2.1.2** Circuit breaker in the closed position
 - 2.2.1.2.1** Phase to phase
 - 2.2.1.2.2** Phase to ground
- 2.2.2** Record results on an approved PEARL Evaluation Form.
- 2.2.3** Compare results to manufacturer's guidelines or industrial standards.

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2.3 Power Factor/Dissipation Factor Test

2.3.1 Setup

2.3.1.1 Select a test voltage to be used for all tests (rated voltage or below).

2.3.1.2 Place breaker in the OPEN position

2.3.2 “A” Phase test

2.3.2.1 Connect the HIGH voltage test lead to the line side of “A” phase.

2.3.2.2 Connect the LOW voltage test lead to the load side of “A” phase.

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

2.3.2.4 Run a power/dissipation factor test in the “GUARD” mode.

2.3.2.4.1 This is the “A-phase line to ground reading”.

2.3.2.4.2 Correct for temperature, if necessary. Refer to test equipment manufacturer’s guidelines.

2.3.2.4.3 Record results on appropriate PEARL Evaluation Report.

2.3.2.5 Run a power/dissipation factor test in the “UST” mode.

2.3.2.5.1 This is the “A-phase line to load reading”.

2.3.2.5.2 Correct for temperature, if necessary. Refer to test equipment manufacturer’s guidelines.

2.3.2.5.3 Record results on an approved PEARL Evaluation Form.

2.3.2.6 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.

2.3.2.7 Run a power/dissipation factor test in the “GUARD” mode.

2.3.2.7.1 This is the “A-phase load to ground reading”.

2.3.2.7.2 Correct for temperature, if necessary. Refer to test equipment manufacturer’s guidelines.

2.3.2.7.3 Record results on an approved PEARL Evaluation Form.

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2.3.3 “B” Phase test

2.3.3.1 Connect the HIGH voltage test lead to the line side of “B” phase.

2.3.3.2 Connect the LOW voltage test lead to the load side of “B” phase.

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

2.3.3.4 Run a power/dissipation factor test in the “GUARD” mode.

2.3.3.4.1 This is the “B-phase line to ground reading”.

2.3.3.4.2 Correct for temperature, if necessary. Refer to test equipment manufacturer’s guidelines.

2.3.3.4.3 Record results on an approved PEARL Evaluation Form.

2.3.3.5 Run a power/dissipation factor test in the “UST” mode.

2.3.3.5.1 This is the “B-phase line to load reading”.

2.3.3.5.2 Correct for temperature, if necessary. Refer to test equipment manufacturer’s guidelines.

2.3.3.5.3 Record results on an approved PEARL Evaluation Form.

2.3.3.6 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.

2.3.3.7 Run a power/dissipation factor test in the “GUARD” mode.

2.3.3.7.1 This is the “B-phase load to ground reading”.

2.3.3.7.2 Correct for temperature, if necessary. Refer to test equipment manufacturer’s guidelines.

2.3.3.7.3 Record results on an approved PEARL Evaluation Form.

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- 2.3.4 “C” Phase test**
 - 2.3.4.1** Connect the HIGH voltage test lead to the line side of “C” phase.
 - 2.3.4.2** Connect the LOW voltage test lead to the load side of “C” phase.
 - 2.3.4.3** Connect the GROUND test lead to the frame of the breaker.
 - 2.3.4.4** Run a power/dissipation factor test in the “GUARD” mode.
 - 2.3.4.4.1** This is the “C-phase line to ground reading”.
 - 2.3.4.4.2** Correct for temperature, if necessary. Refer to test equipment manufacturer’s guidelines.
 - 2.3.4.4.3** Record results on an approved PEARL Evaluation Form.
 - 2.3.4.5** Run a power/dissipation factor test in the “UST” mode.
 - 2.3.4.5.1** This is the “C-phase line to load reading”.
 - 2.3.4.5.2** Correct for temperature, if necessary. Refer to test equipment manufacturer’s guidelines.
 - 2.3.4.5.3** Record results on an approved PEARL Evaluation Form.
 - 2.3.4.6** 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.
 - 2.3.4.7** Run a power/dissipation factor test in the “GUARD” mode.
 - 2.3.4.7.1** This is the “C-phase load to ground reading”.
 - 2.3.4.7.2** Correct for temperature, if necessary. Refer to test equipment manufacturer’s guidelines.
 - 2.3.4.7.3** Record results on an approved PEARL Evaluation Form.
- 2.3.5** Compare results to manufacturer's guidelines or industrial standards.

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- 2.4 Contact Resistance**
- 2.4.1** 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.
- 2.4.2** Record results on an approved PEARL Evaluation Form.
- 2.4.3** Compare test results to manufacturer's recommendations.
- 2.4.4** A PEARL recognized method for evaluation of the current carrying path is comparing the test results of each pole. Results should be within 50% for any of the poles. Any other industrial standard used for evaluation of the current carrying path 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.
- 2.5 Timing**
- 2.5.1** Perform a timing test on the close operation using the 52a contacts.
- 2.5.2** Perform a timing test on the open operation using the 52b contacts.
- 2.5.3** Compare with manufacturer's recommendations.
- 2.5.4** Record results on an approved PEARL Evaluation Form.
- 2.6 Trip Coil Test**
- 2.6.1** Close the circuit breaker.
- 2.6.2** Connect appropriate voltage source to trip coil input leads.
- 2.6.3** Increase voltage until trip coil operates.
- 2.6.4** Verify that the trip coil operates properly at its minimum rated voltage. In the absence of a manufacturer's recommended minimum operating voltage, a voltage of 70% of the coil rating shall be used.
- 2.6.5** Note: If the trip coil fails to operate at the minimum voltage, then continue to increase the applied voltage until trip coil operates. Do not exceed 110% of coil rating.
- 2.6.6** Record results on an approved PEARL Evaluation Form.
- 2.7 Spring Release Coil Test**
- 2.7.1** Charge the circuit breaker springs.
- 2.7.2** Connect appropriate voltage source to spring release coil input leads.
- 2.7.3** Increase voltage until spring release coil operates and the breaker closes.
- 2.7.4** Verify that the spring release coil operates properly at its minimum rated voltage. In the absence of a manufacturer's recommended minimum operating voltage, a voltage of 70% of the coil rating shall be used.
- 2.7.5** Note: If the spring release coil fails to operate at the minimum voltage, then continue to increase the applied voltage until spring release coil operates. Do not exceed 110% of coil rating.
- 2.7.6** Record results on an approved PEARL Evaluation Form.

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2.8 Torque

- 2.8.1** Check all screw and bolt connections for the proper torque per manufacturer's recommendations or industrial standards (Table 1).
- 2.8.2** 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.

2.9 Checks and Adjustments

- 2.9.1** 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.
- 2.9.2** All checks and adjustments must be within the guidelines recommended in order for the product to become a PEARL labeled product.
- 2.9.3** Record results on an approved PEARL Evaluation Form.

2.10 Torque

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

2.11 Final Operation

- 2.11.1** Ensure that all components, structures, devices and assemblies are complete and equipment is ready for service prior to beginning operations.
- 2.11.2** Manually operate the device a minimum of ten (10) times while checking for proper operation of the quick-make and quick-break feature.
- 2.11.3** Manually operate (close/open) circuit breaker ten (10) times while checking for proper operation of the operating mechanism.
- 2.11.4** Electrically operate (close/open) circuit breaker ten (10) times while checking for proper operation.
- 2.11.5** Verify operation of any accessories.
- 2.11.6** All devices must operate properly in order for the product to become a PEARL labeled product.
- 2.11.7** Record results on appropriate PEARL Evaluation Form.
- 2.11.8** Ensure that the nameplate/label data is complete, correct and legible.

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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.