

Powell Service Division

MG2001

PowlVac 5kV & 15kV Vacuum Circuit Breakers

Instruction Bulletin Supplement - Dielectric Testing Recommendations

The PowlVac vacuum circuit breaker has been in service since 1982. Through the years, Powell has improved the design and updated our recommendations for dielectric testing of the breaker. Dielectric testing for circuit breaker design and production is defined in the ANSI standards. Field maintenance or acceptance testing is less defined and often constrained by the availability of test equipment. This supplement may be added to any existing PowlVac circuit breaker.

Each PowlVac circuit breaker nameplate references an instruction bulletin, which recommends maintenance dielectric testing. Customers often ask questions about the dielectric testing recommendations, which appear in the older instruction bulletins as compared with present day recommendations and preferences. Testing recommendations found in the individual PowlVac instruction bulletins are correct and can be used as stated. Customers with varying breaker models may desire to use a single procedure. The following comments are intended to outline a uniform maintenance dielectric testing recommendation for all PowlVac breakers.

This test recommendation covers (a); vacuum integrity testing to confirm the condition of the vacuum interrupter and (b); overall breaker dielectric testing to verify integrity of the insulation system phase to phase and phase to ground.

Field Maintenance or acceptance dielectric testing is intended to verify the integrity of the insulating properties of a circuit breaker element. Two dielectric tests are recommended: (a) Vacuum integrity - the dielectric strength of the open vacuum interrupter and (b) High Voltage Insulation Integrity - the insulation resistance of the operating or "push rods" and primary conductor supports.

Safety precautions must always be followed when conducting high voltage testing. Personnel must be familiar with the test equipment and the test procedure. Maintain safe distances from the tested breaker and barrier the test area to prevent others from contacting dangerous voltages. Caution must be exercised when using a DC hipot across open vacuum interrupter contacts, measures should be taken to shield the operator from the possible emission of X-rays. **The use of half-wave DC hipots or the testing of partially closed VI's must be avoided as this may increase the emission of X-rays.**

VACUUM INTEGRITY

Powell recommends AC testing for reliable verification of vacuum integrity. PowlVac 5kV and 15 kV breakers should be tested with 25kVAC

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applied across fully open contacts for 10 to 15 seconds. No dielectric breakdown during the test period constitutes a successful test. **NOTE: This test does not replace the AC hipot test used to determine "high voltage insulation integrity".**

Powell recognizes the widespread use of DC hipot test equipment in the field and the desire to use this equipment to verify vacuum integrity. However, the capacitive component of the vacuum interrupter during DC testing may yield false negative test results, which are often misinterpreted as VI failure. If the equipment owner, prefers DC testing, a test set providing a full wave rectified 50kVDC hipot voltage can be applied for 5 seconds as a "go - no go" test. Recording the leakage readings is not necessary, as a dielectric breakdown will trip all portable DC hipot test sets. If a DC test breakdown occurs, the test must be repeated with the polarity of the DC test voltage reversed. A vacuum interrupter should be questioned only if it has failed both DC polarity tests.

Powell offers a compact and lightweight AC vacuum interrupter integrity test set, designed specifically for PowlVac circuit breakers, which provides the appropriate 25kVAC voltage for the prescribed time. This test set eliminates the element of leakage interpretation. Two high voltage leads are connected across a fully open vacuum interrupter and the test is initiated. A red neon lamp indicates the test is in progress. The test is automatically timed and terminated with a green LED for pass, or a red LED for fail.

Powell also offers this vacuum integrity test set incorporated into a "PowlVac Test Cell". This test unit can be included in a line up of PowlVac equipment or as a "stand alone" cubicle. A PowlVac breaker can be inserted for high voltage testing without handling high voltage leads. The 25kVAC vacuum integrity tests can then performed easily and safely from controls on the front door of the unit. This unit also serves as a functional test set for checking electrical close and trip functions, as well as verification of all position interlocking of the circuit breaker.

HIGH VOLTAGE INSULATION INTEGRITY

The breaker's high voltage insulation system, which consists of the "push rods" and primary conductor supports assemblies, should be hipot tested prior to initially placing the breaker in service or following the interruption of a fault. The circuit breaker primary phase-to-phase and phase-to-ground insulation should be tested with the circuit breaker in the "closed" position. Test each pole of the breaker separately, with the other two poles and the breaker frame grounded.

Field maintenance insulation resistance testing can be conducted with either AC or DC hipot test sets. DC testing is very common due to the availability of the equipment. Consistent and historical readings are more important than predetermined values. A clean dry breaker will help yield accurate and consistent readings.

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Recommended maintenance insulation withstand test voltages for PowlVac circuit breakers are:

*5kV breakers @ 14kVAC or 20kVDC for one minute.

*15kV breakers @ 27kVAC or 37kVDC for one minute.

Optional Power Factor Testing

Power factor testing is occasionally performed as a site specific or third party testing recommendation. This is typically a 10 or 12 kV AC watts loss test. The PowlVac breaker utilizes bulk insulation and has no capacitive graded bushings, which are usually the target of this type of testing. This testing is not defined nor required by ANSI and the results are not necessarily indicative of the dielectric condition of the PowlVac breaker. We have however conducted tests that indicate that a measurement of less than 0.15 watt loss is an acceptable level. Results may vary widely however below this level. This "acceptable level" is only applicable in addition to the recommended one minute withstand test.