

HV Bushing Wells  
Integral Stud  
Removable Stud

**Bushings**

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HV Bushing Wells, Integral and Removable Stud



**ABB Power T&D Company Inc.**



# General Description

The ABB High Voltage Bushing Well is designed for use in pad or surface mounted transformers. It is designed to terminate the leads from the primary winding at the tank wall and to mate with all bushing inserts meeting the applicable ANSI/IEEE 386-1995 Standards.

## Certification

To certify the product ratings, production samples of the 200 ampere bushing rated through 21.1/36.6Y kV were tested. The tests were conducted at the ABB Engineering Laboratories in Alamo, TN and Raleigh, NC. The tests were conducted in accordance with ANSI/IEEE Standard 386-1995.

## Design Tests

The design tests were divided into (3) three parts:

1. Dielectric Tests
  - Impulse test
  - Low Frequency 60 Hz Withstand test
  - Corona test
2. Mechanical Strength Tests
  - Leak test
  - Torque test
  - Stud Interface Strength test
3. Environmental Tests
  - Thermal Cycle test
  - Oil Compatibility test

### 1. Dielectric Tests

The purpose of these tests are to verify the insulation strength and to ensure that the component will comply with the appropriate transformer standards when installed in the transformer.

#### • Impulse Test

The purpose of this test is to verify the impulse withstand of the bushing. Sample bushing wells were assembled with test inserts for electrical testing. The bushings were subjected to two positive and two negative full wave impulses. The voltage impulse used was a standard 1.2 x 50  $\mu$ s wave having the crest value of the specified voltage. The voltage level attained was well above the BIL rating of 150 kV. Samples successfully passed 170 kV impulse test levels.

#### • Low Frequency 60 Hz Withstand Test

The purpose of the low frequency withstand test is to verify the integrity of the insulation structure of the bushing at operating frequency. Samples were assembled with electrical test inserts. The samples were tested at 60 kV for one minute and then allowed to rest for one minute. They were then retested for another minute. All samples passed this test.

#### • Corona Test

The purpose of this test is to verify that the partial discharges created by over voltage surges will subside to harmless levels once the voltage surge passes. The bushings were mounted

on a plate to simulate the tank wall. The bell end of the bushing was under oil and the plate was grounded. The well end of the bushing was filled with oil above the bushing face. All samples had partial discharge levels of 3 pC or less at 31 kV.

## 2. Mechanical Strength Tests

#### • Leak Test

The purpose of the leak test is to ensure that, over the life of the bushing well, no leak will occur between the copper stud and the polyester resin. Sample bushings were tested by mounting them in a tank pressurized to 30 psi and submerging the tank in water for 2 minutes. All bushings passed with no indication of leaking air.

#### • Torque Test

The purpose of this test is to verify the strength of the copper stud. Two 0.375" steel washers were placed under a steel nut which was torqued until failure occurred. The bushing was considered to have failed when either the threads stripped or stud sheared. The average torque value was 30 ft-lbs.

#### • Stud Interface Strength Test

The purpose of this test is to verify that no damage will result when bushing elbows are removed. Bushings were subjected to loads applied axially to the stud while at elevated temperatures. The strength of the interface between the polyester resin and the stud exceeded the maximum pull-off force for the bushing elbows.

## 3. Environmental Tests

#### • Thermal Cycle Test

The purpose of the thermal cycle test is to verify the integrity of materials used in the bushing over the expected service life of the bushing. The sample bushings previously leak tested were subjected to 20 thermal cycles in air. One cycle consists of: a 4 hour transition from -40°C to 135°C, 4 hours at 135°C, a 4 hour transition from 135°C to -40°C, then 4 hours at -40°C. After the thermal cycle test, the bushings were tested again with no bushing showing any indication of leaking at 30 psi air pressure.

#### • Oil Compatibility Test

The purpose of this test is to verify that the bushing will not degrade the transformer's oil as it ages. Bushing samples are aged under controlled conditions in a test vessel containing transformer oil. At the conclusion of the test, both the bushing and the oil are tested for degradation. The bushings passed the standard oil compatibility test. In addition, this bushing is molded from a thermoset polyester resin system which has essentially the same chemistry as that which has been used for insulators in other oil filled apparatus for over 30 years.

