

Electrical routine testing of high voltage bushings

Technical information



ABB

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1 General

Before delivery, each bushing is subject to an electrical routine test. The test is made in line with IEC standards or, on request, according to relevant IEEE standards. The test is made at room temperature, and for transformer bushings with the lower end submerged in oil. Capacitance and $\tan \delta$ are measured in steps up to the power frequency withstand voltage, which is maintained for one minute.

Capacitance and $\tan \delta$ are also measured with decreasing voltage at the same voltage levels as before the one minute test. Measurements for detection of internal partial discharge (PD measurements) are also made. These measurements are carried out at the same time, and at the same levels, as the $\tan \delta$ test.

Bushings with rated voltage U_R equal to or higher than 300 kV are routine tested with a dry lightning impulse voltage withstand test, when tested according to IEC 60137.

In addition, a power frequency test of the test tap insulation is made on all bushing.

2 Test sequences

Bushing routine tests are depending on if the rated voltage U_R is below or above 300 kV.

2.1 Rated voltage $U_r < 300$ kV

Capacitance, $\tan \delta$ and PD are measured at each voltage as detailed in section 2.3.

10	[kV AC]
$1.05 \cdot U_r / \sqrt{3}$	[kV AC]
$1.5 \cdot U_r / \sqrt{3}$	[kV AC]
U_r	
Voltage withstand level, 60 s duration	
U_r	
$1.5 \cdot U_r / \sqrt{3}$	[kV AC]
$1.05 \cdot U_r / \sqrt{3}$	[kV AC]
10	[kV AC]

2.2 Rated voltage $U_r \geq 300$ kV

Capacitance, $\tan \delta$ and PD are measured at each voltage as detailed in section 2.3.

10 [kV AC]
 $1.05 \cdot U_r / \sqrt{3}$ [kV AC]
 U_r

Lightning impulse test with one reduced (60 %) and five full-wave pulses with negative polarity at specified BIL level (Standard IEC waveform)

10 [kV AC]
 $1.05 \cdot U_r / \sqrt{3}$ [kV AC]
 $1.5 \cdot U_r / \sqrt{3}$ [kV AC]
 U_r
 Voltage withstand level, 60 s duration
 U_r
 $1.5 \cdot U_r / \sqrt{3}$ [kV AC]
 $1.05 \cdot U_r / \sqrt{3}$ [kV AC]
 10 [kV AC]

2.3 Test tap insulation

The test tap comes in two sizes, depending on the bushing type. Test sequences as below.

For bushings with ANSI voltage tap type A only

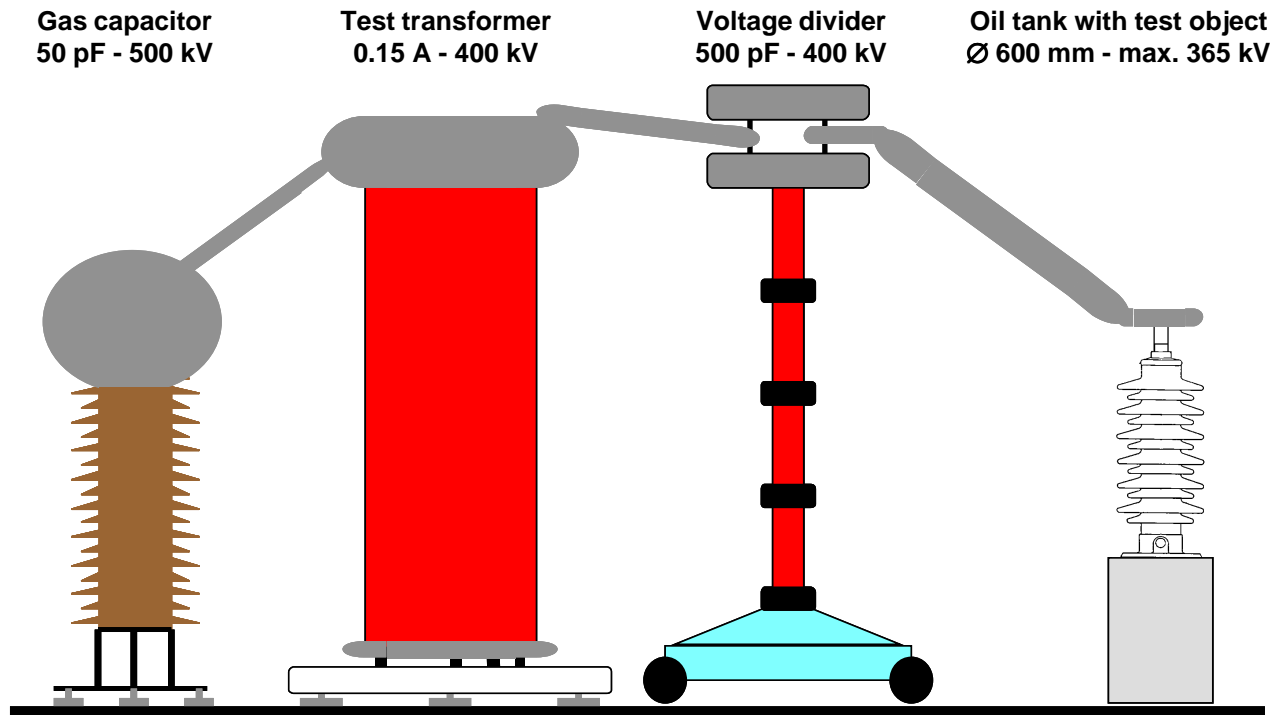
10 [kV AC] C_2
 20 [kV AC] Voltage withstand level, 60 s duration
 1 [kV AC] $C_2, \tan \delta$

IEC type test taps

2 [kV AC] Voltage withstand level, 60 s duration
 1 [kV AC] $C_2, \tan \delta$

3 Test equipment

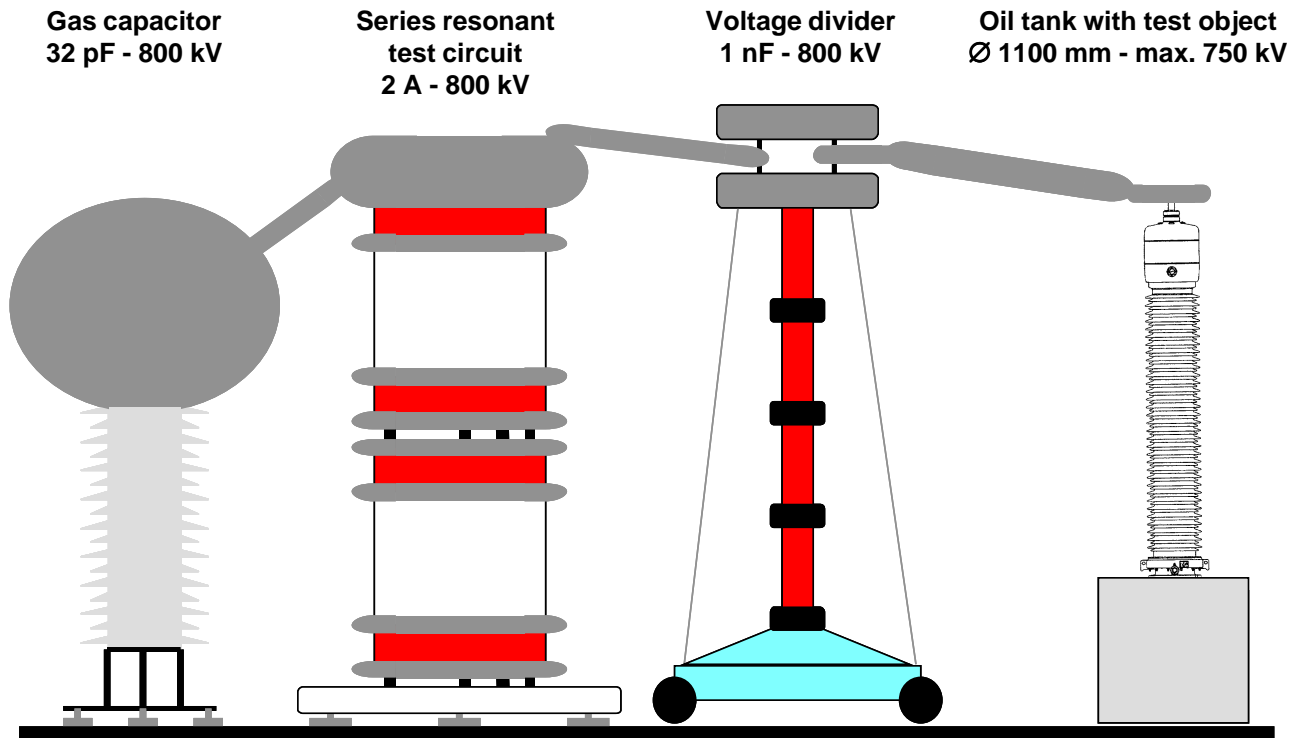
3.1 400 kV AC test facility



We reserve the right to replace the equipment with equivalent.

High voltage test transformer	Type: Rating: Duty: Oil capacity: Weight:	Hipotronics model 7400-60 475V / 400 kV – 60 kVA (Pri – parallel) 475V / 200 kV – 30 kVA (Pri – serial) 1 hour max 50 % duty 1368 litres 2794 kg
Standard capacitance	Type: Capacitance: Internal pressure: Rated voltage: Test voltage:	HAFELY 50.05 pF 3.6 kg/cm ² 500 kV 550 kV
Voltage divider	Type:	Hipotronics / Hubbell PSF 400-0.5
Zero indicator	Type:	Tettex AG 5501 / VM
Tan δ bridge	Type:	Trüb Tauber
Partial discharge detector	Type:	Robinson DDX 8003
Test tank	Width: Depth:	600 mm 3500 mm

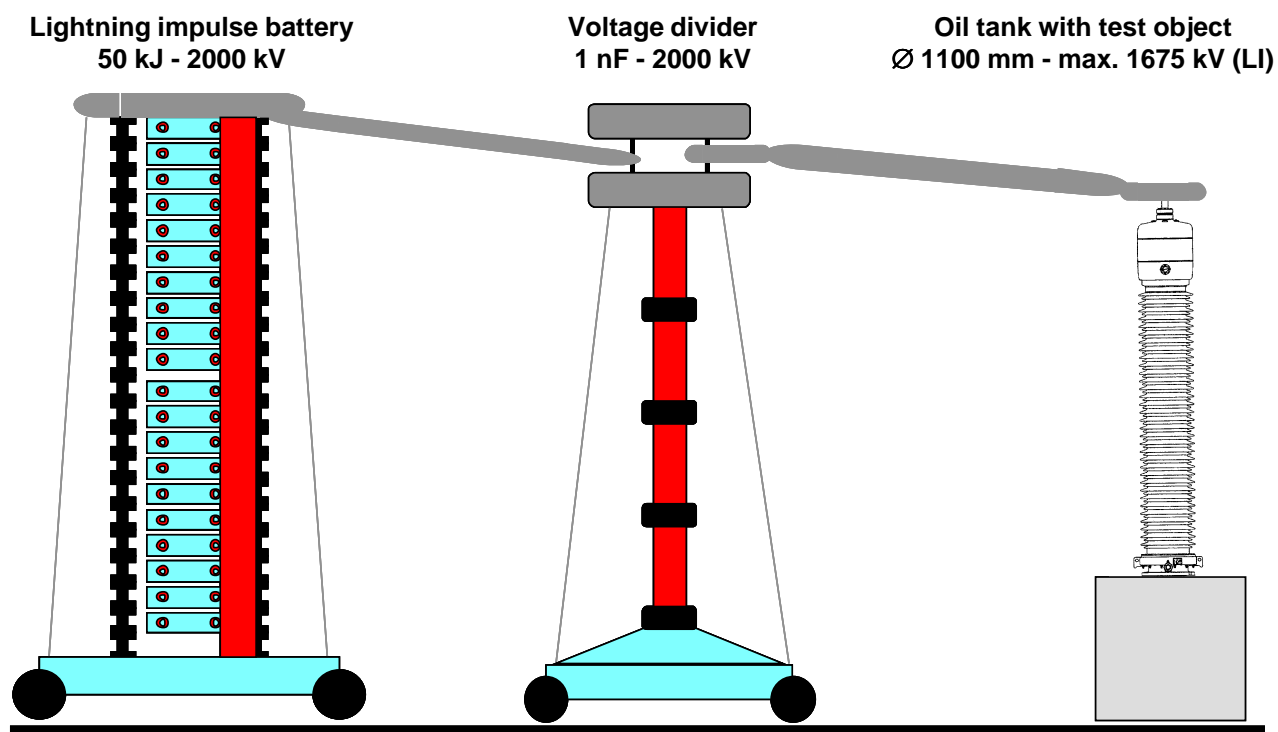
3.2 800 kV AC test facility



We reserve the right to replace the equipment with equivalent.

AC series resonant test regulator	Type: Rating: Duty: PD: Weight:	Hipotronics model 7750-1500SR 0-750 kV, 1500 kVA, 50 Hz 1 hour maximum 50 % duty <5 pC at 550 kV RMS <10 pC at 750 kV RMS 16645 kg
Standard capacitance	Type: Capacitance: Rated voltage: Test voltage: Accuracy:	ABB Components model CGA 1550 32.65 pF 750 kV 800 kV <2 pC vid 750 kV
Voltage divider	Type:	Hipotronics model CMD 2000
Tan δ and capacitance bridge	Type: Accuracy:	Tettex model 2809a Tan δ 1x10 ⁻⁵ , capacitance 30x10 ⁻⁴
Partial discharge detector	Type: Measuring sensor:	Robinson 803.1 <2 pC at 550 kV
Test tank	Width: Depth:	1100 mm 5400 mm

3.3 Lightning impulse test facility



We reserve the right to replace the equipment with equivalent.

Voltage divider	Type:	Hipotronics model CMD 2000
Impulse generator system	Type: Rating:	Hipotronics model IG 2000-50 0-2000 kV, 50 kJ, 1.2 μ s \pm 30 %
Test tank	Width: Depth:	1100 mm 5400 mm



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