

2001 Maintenance Testing Specification as per NETA



Test Values

1. Compare bolted connection resistance to values of similar connections.
2. Bolt-Torque level shall be in accordance with table 10.12 unless otherwise specified by manufacturer.
3. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from adjacent poles or similar switches by more than 25 percent of the lowest value.
4. Circuit breaker insulation resistance shall be in accordance with table 10.1.
5. Control wiring insulation resistance shall be a minimum of two megaohms.
6. Trip characteristics of breakers shall fall within the manufacturer's published time-current characteristics tolerance band, including adjustment factors.
7. For molded-case circuit breakers all trip times shall fall within table 10.7. Circuit breakers exceeding specified trip time at 300 percent of pickup shall be toggled defective.
8. For molded-case circuit breakers instantaneous pickup value shall be within values shown in table 10.8.

TABLE 10.1
Insulation Resistance Tests
on
Electrical Apparatus and Systems

Maximum Rating of Equipment in Volts	Minimum Test Voltage, dc in Volts	Recommended Minimum Insulation Resistance in Megaohms
250	500	25
600	1,000	100
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
35,000	15,000	100,000
45,000	15,000	100,000
69,000	15,000	100,000

In the absence of consensus standards dealing with insulation-resistance tests, the NETA Technical Committee suggests the above representative values.

See Table 10.14 for temperature correction factors.

Actual test results are dependant on the length of the conductors being tested, the temperature of the insulating material, and the humidity of the surrounding environment at the time of the test. In addition, insulation resistance tests are performed to establish a trending pattern and a deviation from the baseline information obtained during maintenance testing enabling the evaluation of the insulation for confined use.

TABLE 10.2
Switchgear Low-Frequency Withstand Test Voltages

Type of Switchgear	Rated Maximum Voltage (kv) (ms)	Maximum Test Voltage kV	
		ac	dc
LV (low-Voltage Power Circuit Breaker Switchgear)	.254/.508/.635	1.6	2.3
MC Metal-Clad Switchgear	4.76	14.0	20.0
	8.25	27.0	37.0
	15.0	27.0	37.0
	38.0	60.0	+
SC (Station-Type Cubicle Switchgear)	15.5	37.0	+
	38.0	60.0	+
	72.5	120.0	+
MEI (Metal-Enclosed Interrupter Switchgear)	4.76	14.0	20.0
	8.25	19.0	27.0
	15.0	27.0	37.0
	15.5	37.0	52.0
	25.8	45.0	+
	38.0	60.0	+

Derived from ANSI/IEEE C37.20.1 - 1993, Paragraph 5.5, standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear, C37.20.2 - 1993, Paragraph 5.5, Standard for Metal-Clad and Station-Type Cubicle Switchgear and C37.20.3 - 1993, Paragraph 5.5, Standard for Metal Enclosed Interrupter Switchgear, and includes 0.75 multiplier with fraction rounded down.

The column headed "DC" is given as a reference only for those using dc tests to verify the integrity of connected cable installations without disconnecting the cables from the switchgear. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for the voltage rating of switchgear. The presence of this column in no way implies any requirements for a dc withstand test on ac equipment or that a dc withstand test represents an acceptable alternative to the low-frequency withstand tests specified in this specification, either for design tests, production tests, conformance tests, or field tests. When making dc tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

Because of the variable voltage distribution encountered when making dc withstand tests, the manufacturer should be contacted for recommendations before applying dc withstand tests to the switchgear. Voltage transformers above 34.5kV should be disconnected when testing with dc. Refer to ANSI/IEEE c57-13-1987 (R1987) IEEE Standard Requirements for Instrument Transformers [10], Section 8 and, in particular 8.8.2, (the last paragraph) which reads "Periodic kenotron tests should not be applied to transformers of higher than 34.5 kV voltage rating."

+ Consult Manufacturer

TABLE(s) 10.12
Bolt Torque

Grade	SAE 1&2	SAE 5	SAE 7	SAE 8
Minimum Torque (PSI)	64K	105K	133K	150K
Bolt Diameter in inches	Torque (Foot Pounds)			
1/4	4.0	5.6	8.0	8.4
5/16	7.2	11.2	15.2	17.6
3/8	12.0	20.0	27.2	29.6
7/16	19.2	32.0	44.0	48.0
1/2	29.6	48.0	68.0	73.6
9/16	42.4	70.4	96.0	105.6
5/8	59.2	96.0	133.6	144.0
3/4	96.0	160.0	224.0	236.8
7/8	152.0	241.6	352.0	378.4
1	225.6	372.8	528.0	571.2

Bolt Torque for Bus Connections
Silicon Bronze Fasteners *1
Torque (Foot Pounds)

Bolt Diameter in inches	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

* 1 Bronze alloy bolts shall have a minimum tensile strength of 7,000 pounds per square inch

Aluminum Alloy Fasteners
*2 Torque (Foot Pounds)

Bolt Diameter in inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

* 2 Aluminum alloy bolts shall have a minimum tensile strength of 55,000 PSI

Bolt Torques for Bus Connections Stainless Steel Fasteners *3 Torque (foot Pounds)

Bolt Diameter in inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

* 3 Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy. Beville washers: 302 alloy

TABLE 10.14
Insulation Resistance Conversion
Factors For Conversion of Test
Temperature to 20C

Temperature		Multiplier	Multiplier
C	F	Apparatus Containing Immersed Oil Insulation	Apparatus Containing Immersed Oil Insulation
0	32	0.25	0.40
5	41	0.36	0.45
10	50	0.50	0.50
15	59	0.75	0.75
20	68	1.00	1.00
25	77	1.40	1.30
30	86	1.98	1.60
35	95	2.80	2.05
40	104	3.95	2.50
45	113	5.60	3.25
50	122	7.85	4.00
55	131	11.20	5.20
60	140	15.85	6.40
65	149	22.40	8.70
70	158	31.75	10.00
75	167	44.70	13.00
80	176	63.50	16.00

TABLE 10.7
Molded-Case Circuit Breakers
Values for Inverse Time Trip Test
(At 300% of Rated Continuous Current
of Circuit)

Range of Rated Continuous Current Amperes	Maximum Trip Time for Each Maximum Frame Rating *1	
	<= 250V	251-600V
0-30	50	70
31-50	80	100
51-100	140	160
101-150	200	225
151-225	230	275
226-400	300	350
401-600		450
601-800		500
801-1000		600
1001-1200		700
1201-1600		775
1601-2000		800
2001-2500		850
2501-5000		900

* 1 for integrally-fused circuit breakers, trip times may be substantially longer if tested with the fuses replaced by solid links (shorting bars).

TABLE 10.8
Instantaneous Trip Setting Tolerances
for Field Testing of Marked Adjustable
Trip Circuit Breakers

Ampere Rating	Tolerance of High and Low Settings	
	High	Low
<250	+40%	+40%
	-25%	-30%
>250	+25%	+30%
	-25%	-30%

For circuit breakers with nonadjustable instantaneous trips, tolerances apply to the manufacturer's published trip range, i.e. +40% on the high side, -30% on the low side.

Reproduction of Table 5-4 from NEMA publication AB4 - 199