

High Voltage Full-Load Interrupter Switches



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Revision History

CSA C22.2 No. 193:M83, High Voltage Full-Load Interrupter Switches

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General Instruction No. 2

C22.2 No. 193-M1983
May, 1986

CSA Standard C22.2 No. 193-M1983, High Voltage Full-Load Interrupter Switches, was published in March, 1983; it consisted of 13 pages, each of which was dated March, 1983.

Amendments to Tables 1 and 2 have been formally approved. These and an erratum to Clause 5.6.3.3 are incorporated (and identified by a vertical line in the margin) in the attached replacement pages.

CSA Standard C22.2 No. 193-M1983 now consists of the following pages:

3—8, and 13 dated March, 1983;

9—12 dated May, 1986.

These replacement pages are to be inserted into your copy of the Standard; the pages replaced should be kept for reference.

5. Tests

5.1 General

5.1.1 The switch, including its fuses, where applicable, together with its functional components and accessory devices with which it is equipped, shall be subjected to tests in accordance with Clauses 5.2 to 5.8. More than one sample of the switch may be required to complete all of the tests and to utilize the test facilities efficiently.

5.1.2 For testing purposes, switches shall be mounted with clearance distance to grounded metallic surroundings as specified by the manufacturer.

5.1.3 The tests of Clauses 5.2, 5.3, and 5.6.5 shall be applied as follows:

(a) **Terminals to Ground**—With the switch closed, apply the test voltage simultaneously to all terminals;

(b) **Between Phases**—With the switch closed, apply the test voltage to the terminals of the centre phase with the terminals of the other two phases grounded;

(c) **Across the Open Contacts**—With the switch open, apply a 10% higher test voltage simultaneously to the terminals on the line with the terminals on the load side grounded.

5.2 Impulse Withstand

5.2.1 Three positive and three negative impulse voltages, having a crest value equal to the impulse crest value specified in Table 1 and having a wave shape of $1.2 \times 50 \mu\text{s}$ shall be applied without causing damage or flashover.

5.2.2 The tolerance on the impulse wave shall be $1.2 \pm 30\% \times 50 \pm 20 \mu\text{s}$.

5.2.3 If flashover occurs on only one test during any group of three consecutive tests, three more tests shall be made.

5.2.4 If the switch successfully withstands all three of the second group of tests specified in Clause 5.2.3, the flashover in the first group shall be considered as a random flashover and the switch shall be considered as complying with the requirements of Clause 5.2.1.

5.2.5 Impulse withstand tests shall be made under the temperature and humidity conditions normally obtained in commercial testing with appropriate correction factors applied as outlined in EEMAC Standard G8-2, Switchgear Assemblies.

5.3 Dielectric Strength

5.3.1 Switches shall withstand a 1 min dielectric strength test with voltages as shown in Table 2.

5.3.2 The magnitude and wave shape of the 50 or 60 Hz test voltage shall be measured as specified in EEMAC Standard G8-2.

5.3.3 The test voltage for control circuits may be reduced to 1 500 V. Fractional horsepower motors, wiring devices, instruments, etc, need not be tested if such items are within the scope of other Standards of the Canadian Electrical Code, Part II, or otherwise comply with the lower test voltage requirements, but may be disconnected and tested separately in conformity with the applicable standards.

5.4 Temperature Rise

5.4.1 The switch shall be mounted approximately as under the usual service conditions, including all normal covers of any part of the switch, and shall be protected against undue external heating or cooling. Connections shall be such that no appreciable amount of heat is conducted away from or conveyed to the switch during the test. In case of doubt, the temperature rise at the terminals and at the connections at a distance of 1 m from the terminals shall be measured. The difference of temperature shall not exceed 5°C.

5.4.2 The temperature rises shall not exceed those given in Table 3 when rated current at $60 \text{ Hz} \pm 20\%$ is circulated through the current-carrying parts of the switch until the temperature becomes constant. A temperature shall be considered to be constant when 3 successive readings taken at 15 min intervals are practically the same.

5.4.3 For enclosed switches the ambient temperature shall be measured outside the enclosure.

5.4.4 The test may be made at any ambient temperature between 10 and 40°C.

5.5 Short-Circuit

5.5.1 General

5.5.1.1 Momentary and short-time current withstand tests shall be made to demonstrate the ability of the switch to carry its short-circuit current and withstand the mechanical stresses produced by that short-circuit. The tests shall be performed to verify both the momentary, and the 2 s short-time current ratings. For three-phase devices, three-phase tests shall be conducted.

5.5.1.2 The demonstrated level of a current shall be determined by an integration of the current envelope over the required time using the method specified in Clause .05-3.6 of ANSI Standard C37.05.

5.5.2 Rated Momentary Current

5.5.2.1 The rated rms asymmetrical momentary current shall conform to the requirements of Clauses 5.5.2.2 and 5.5.2.3.

5.5.2.2 The duration of current flow shall be no less than 10 cycles on a 60 Hz basis.

Note: *The duration may be within 25% of 10 cycles provided that there is no reduction in the I^2T .*

5.5.2.3 The power factor of the test circuit shall be 4 to 15% lagging (X/R ratio of 25 to 6.6) with X and R in series connection.

5.5.2.4 The test shall be performed at any convenient voltage.

5.5.3 Rated Two-Second Short-Time Current

5.5.3.1 The rated 2 s short-time rms symmetrical current shall be not less than the rated momentary current divided by 1.6.

5.5.3.2 The current shall be monitored throughout the duration of the test.

Note: *The duration of the test may be less than 2 s provided there is no reduction in I^2T .*

5.5.3.3 If the test circuit meets the requirements of Clause 5.5.2 this test may be combined with the momentary current test.

5.5.4 Compliance. Momentary and 2 s current ratings shall be considered verified if there is no visible damage to the switch after the test, and it is still functional. However, the tests may result in some visual evidence of the switch having passed current, such as contact markings and discoloration. The switch shall be capable of being operated to the open position by the normal operating mechanism.

5.6 Fault Closing

5.6.1 A fault closing test shall be made to verify the ability of the switch to close safely at rated voltage, into a faulted circuit. For three-phase devices three-phase tests shall be conducted. Tests shall be conducted in accordance with Clauses 5.6.3 and 5.6.4.

5.6.2 Test Arrangements

5.6.2.1 The switch (or fused switch) shall be mounted as specified in Clause 5.1.2. The switch frame and the enclosure or housing shall be grounded with a copper conductor of minimum size 4/0.

5.6.2.2 Test conductors shall be braced adequately to prevent undue forces on the switch or the enclosure, or both, but such arrangements shall not add intentional bracing to the switch. Suitable means for remotely operating the switch to the closed position may be provided. This means may be either electrical or mechanical.

5.6.2.3 The applied voltage shall be the open circuit rms voltage of the test circuit immediately before fault closing, and the difference between the average value of the voltages applied on all the phases and the applied voltage of each phase shall not exceed 5% of the average value. The average value of the applied voltage before the test shall not be less than the rated voltage and shall not exceed the rated voltage by more than 10%. It shall be applied to all poles of the switch or fused switch.

Note: *For methods of determining test current values refer to ANSI Standard C37.05.*

5.6.3 Unfused Switches

5.6.3.1 Except as provided for in Clause 5.6.3.3 unfused switches shall be tested as specified in Clauses 5.6.3.2 and 5.6.3.4. Both tests may be performed on the same switch or a new switch may be used for the test in Clause 5.6.3.4.

5.6.3.2 Unfused switches, for this test, shall be closed with all poles solidly faulted on one side. The duration of the current flow shall be not less than 10 cycles on a 60 Hz basis.

Note: *The duration may be within 25% of 10 cycles provided that there is no reduction in I^2T .*

5.6.3.3 The test described in Clause 5.6.3.4 shall not be required if:

(a) in the test for Clause 5.6.3.2 the pre-arcing times does not exceed 5 ms; or

(b) an identical switch has been tested in accordance with Clause 5.6.4.

5.6.3.4 Unfused switches, for this test, shall be closed with all poles solidly faulted on one side and a short-circuit interrupting device connected between the switch and the fault. The interrupting device shall clear the fault within 1/2 to 5 cycles on a 60 Hz basis after fault initiation and shall not reduce the short-circuit current to a value substantially less than the rating of the switch. The duration of the applied voltage shall be not less than 10 cycles on a 60 Hz basis.

5.6.4 Fused Switches. Fused switches, for this test, shall be closed with all poles solidly faulted on the outgoing side. Fuses with maximum let-through current intended for use with the switch shall be used. The duration of the applied voltage shall be not less than 10 cycles on a 60 Hz basis.

5.6.5 Insulation Integrity Test. A low frequency voltage equal to 75% of the voltage specified in Clause 5.3 shall be applied to the switch in accordance with Clause 5.1.3(a) for 1 min at the conclusion of the fault closing tests.

5.6.6 Compliance. Fault closing ratings shall be considered verified if the switch closes without flashover to ground, or phase to phase, or both, and carries the current for the assigned duration. There shall be no damage caused that would endanger the safety of the operator or impair the integrity of the enclosure. The switch may require maintenance or replacement of parts, but shall be capable of carrying rated current though not necessarily at rated temperature. The switch shall be capable of being operated to the open position in its intended manner. The insulation shall withstand for 1 min a low frequency voltage equal to 75% of the voltage specified in Clause 5.3.

5.7 Mechanical Endurance. Switches shall be operated 500 times "close and open" without current through the main contacts, after which all mechanical working parts including contacts and operating mechanisms shall be in order and shall be without permanent distortion or undue wear. No adjustments shall be permitted during this test.

5.8 Load Current Interrupting Rating

5.8.1 Test Arrangements

5.8.1.1 Interrupting tests shall be made with a normal frequency recovery voltage equal to the rated voltage of the switch.

5.8.1.2 Interrupting tests shall be made on a standard operating duty cycle, allowing a maximum of 3 min between duty cycles. After every series of ten duty cycles, the switch may be allowed to cool to room temperature.

5.8.1.3 The power factor of the load circuit that is interrupted shall not be higher than 80% lagging. The load circuit shall be composed of resistance and reactance connected in parallel or the equivalent.

Note: *Methods of determining the current interrupted and the recovery voltage are described in ANSI Standard C37.05.*

5.8.2 Tests. The interrupting rating shall be verified by a series of tests on one switch operated at rated voltage. For three-phase devices, three-phase tests shall be conducted. The tests indicated in Table 4 shall be required.

5.8.3 Compliance

5.8.3.1 Switches shall perform at or within interrupting ratings, without flashover between phases or phase to ground.

5.8.3.2 At the end of any test, at or within its interrupting ratings, a switch shall be substantially in the same mechanical condition as at the beginning of the test. Also at the end of the tests specified in Clause 5.8.2, an interrupter switch shall:

- (a) have operated without failure; and
- (b) have operated without requiring maintenance or the replacement parts.

Table 1†
(See Clause 5.2.1.)
Impulse Test Voltages

Maximum Rated Voltage, V	Impulse Test Voltage*, kV
2 750	45
4 760	60
8 250	75
15 000	95
15 500	110
29 800	125
38 000	150
48 300	200

*This is a prototype test voltage only.

†Effective Date—May 31, 1986.

Table 2†
(See Clause 5.3.1.)
Dielectric Strength Test Voltages

Maximum Rated Voltage, V	50- or 60-Hz Test, kV*
2 750	15
4 760	19
8 250	26
15 000	36
15 500	50
29 800	60
38 000	80
48 300	100

*This is also the production test voltage to be used by the manufacturer on completed switchgear or its component parts for the purpose of checking the correctness of manufacturing operations and materials.

†Effective Date—May 31, 1986.

Standards Update Service

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