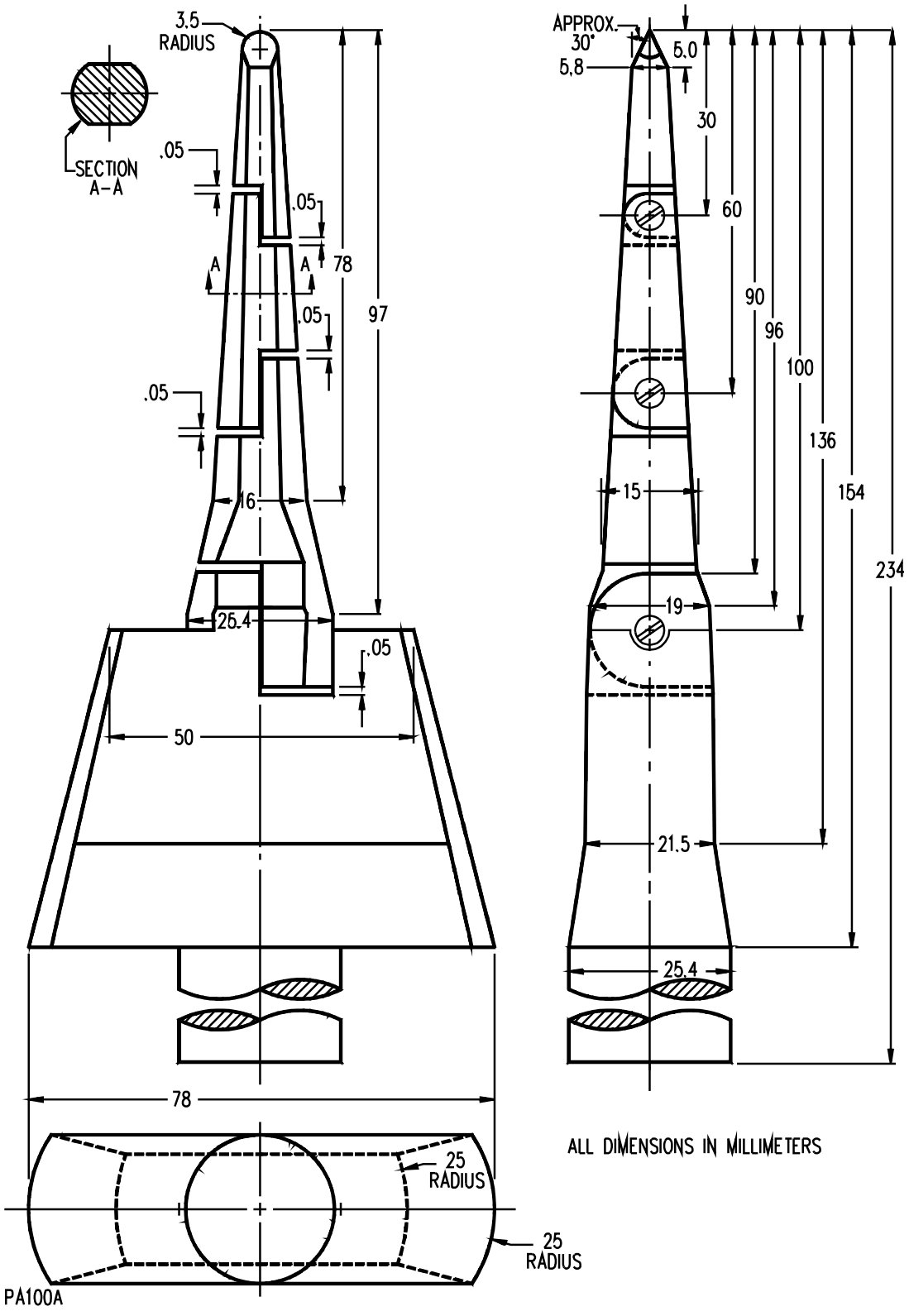
Figure 11.1.7.2.1
Articulated probe



11.1.7.3 Dielectric voltage-withstand test

11.1.7.3.1 Unless the same sample is to be subjected to the closing test, a switch that has been subjected to the short-circuit withstand test shall comply with the requirements in 7.1.11.7.1, 7.1.11.7.2 and 7.1.11.7.4.

11.1.7.4 Closing test

11.1.7.4.1 A sample of the switch shall be closed on a circuit capable of providing the maximum short circuit withstand current. After the circuit has cleared, the switch shall comply with the requirements in 11.1.7.2.1(a), (b), and (d).

11.1.7.4.2 The sample for this test shall be that used for the short-circuit withstand test, or at the option of the submitter a previously untested sample. The conditions of the closing test shall be the same as for the short-circuit withstand test, except that random closing shall be employed. Complete physical closure of the switch contacts need not be established.

11.1.7.5 Dielectric voltage-withstand test

11.1.7.5.1 The dielectric voltage-withstand test described in 7.1.11.7.1, 7.1.11.7.2, and 7.1.11.7.4 shall be conducted following the closing test.

11.1.7.6 Contact opening test

11.1.7.6.1 An electrically tripped switch shall be capable of being operated by the electrical tripping mechanism to break levels of current as indicated in Table 11.1.1.3. The number of operations shall be three except that a switch intended for use on single-phase circuits only, shall be tested for five operations. The circuit on which the test is conducted shall have a normal frequency recovery voltage equal to the rated voltage of the device, except that the recovery voltage need not be determined if the closed-circuit voltage is not less than 90 percent of the rated voltage of the device. The open-circuit voltage shall not be more than 110 percent of the rated voltage except that a higher open-circuit voltage may be used if agreeable to the submitter and the testing agency. See 11.1.1.11.

11.1.7.6.2 The test circuit power factor shall be:

a) 0.45 – 0.50 lagging for a switch rated 1200 A or less,

b) 0.25 – 0.30 lagging for a switch rated 1201 – 2500 A,

c) 0.15 – 0.20 lagging for a switch rated 2501 – 6000 A.

A lower power factor shall be permitted if agreeable to the submitter and the testing agency.

11.1.7.6.3 At the conclusion of the test, the device shall be in operable condition. The fuse connected to indicate arc-over to the enclosure or grounded metal shall not have opened.

11.1.7.7 Dielectric voltage-withstand test

11.1.7.7.1 The dielectric voltage-withstand test described in 7.1.11.7.1, 7.1.11.7.2 and 7.1.11.7.4 shall be repeated following the contact opening test.

11.2 Draw-out switches

11.2.1 General

11.2.1.1 A draw-out switch shall additionally comply with the requirements in Section 11.2.2.

11.2.2 Electrical Continuity Test

11.2.2.1 Switches shall comply with the electrical continuity test requirements of 7.12.1.

12 Ratings

12.1 A switch shall be rated in accordance with the requirements of 8.1 and 8.2 and with the additional requirements of 12.2.

12.2 The short-circuit rating of a switch shall be one or more of the values shown in Table 12.1. The rating shall not be greater than that of the specified overcurrent protective device or integral fuses. The rating shall be 10,000 A for plug, Class H, and Class K fuses. The rating shall not be less than 25,000 A for Class G, J, L, R, and T fuses.

12.3 A 300 V rated fuse may be specified for switches rated 120, 127, 120/240, 240, or 277 V. See also 13.12.

12.4 A 300 V rated fuse may be specified for a switch rated 480Y/277 V if the switch is marked in accordance with 13.13.

Table 12.1
Short circuit current rating, rms

Symmetrical amperes		
5,000	25,000	65,000
7,500	30,000	70,000
10,000	35,000	85,000
14,000	42,000	100,000
18,000	45,000	125,000
20,000	50,000	150,000
22,000	60,000	200,000

13 Markings

13.1 Switches shall be marked in accordance with the requirements of General, Section 9.1 and Markings, Section 17, and the additional requirements of this Section. Location of required markings shall be in accordance with the ″Location Categories″ given in Table 13.1.

Advisory Note: For products intended for use in Canada, markings shall be in English or in French and English; caution and warning markings shall be in French and English. For products intended for use in Mexico, all markings shall be at least in Spanish. For products intended for use in the United States, all markings shall be at least in English. See Annex D for suitable translations of caution and warning markings.

Table 13.1
Location of markings – switches

Clause numbers	Subject	Location categories (See notes)
	General	
13.1	Location	–
9.1.1.2	Type designation	B
9.1.1.2	Manufacturer's name	B
9.1.1.2	Voltage rating	B
9.1.1.4	Durability and legibility	–
13.4	Ampere rating	B
13.5	Ampere rating – 100 A or less	B
9.1.1.11 – 9.1.1.13	Special characteristics	C, F
9.1.1.14	Line and load	B
9.1.1.15	Factory identification	H
13.2, 13.3	Switch identifier/Caution statement	A, B
	Position indication	
13.6	Open or close (on or off)	A
13.6	Intermediate position – reset	B, D
9.1.1.17	Electrical operator (on or off)	B, E
	Short circuit ratings	
13.7 – 13.17	Ratings	B, C
	Terminations	
9.1.2.1 – 9.1.2.4	CU-AL	B
9.1.2.5, 9.1.2.6	Tightening torque	B, C
9.1.2.7	Maximum wire size	C, G
9.1.2.8	Multiple-conductor connectors	C
9.1.2.9, 9.1.2.10	60°C/75°C – 125 A Max.	B, C
9.1.2.11	Separately shipped connectors	C
	Accessories	
17.1, 17.2	Ratings	C
17.3	Shunt release	C
17.4, 17.5	Separately shipped	–

Table 13.1 Continued on Next Page

Table 13.1 Continued

Clause numbers	Subject	Location categories (See notes)
17.6	External dropping resistor	C
	Special markings	
13.14	Automatic opening	B
9.1.1.19	Non-conducting enclosures	C
9.1.1.20	Ventilated enclosures	B
9.1.1.21	2-pole, 3-phase rated	B
9.1.1.22	Multi-wire circuit	C
9.1.1.23	DC rated 3-pole	B

A Marking shall be visible without removing the trim or cover of enclosure.

B Marking shall be visible without disassembling or removing device and shall be visible when the trim or cover of enclosure is removed, and may be visible with the trim or cover in place.

C Marking may be on any convenient location except on the rear.

D Marking of intermediate position and ″RESET″ need not be provided if on intended receiving device.

E ″ON″ and ″OFF″ marking need not be visible on switch if on electrical operator.

F Part replacement marking need not be visible on switch if on electrical operator.

G Marking shall be visible when wire connector is in place.

H Marking need only be visible after removal of switch from panel of enclosure.

13.2 An unfused switch shall be marked in accordance with either of the following:

a) With the switch symbol: —/— , or

b) ″Caution″ and with the following or equivalent statement ″Does not provide over-current protection.″

Location Category A.

13.3 An unfused switch shall be marked ″Caution″ and with the following or equivalent statement ″Does not provide over-current protection″, Location Category B, unless the device is marked in accordance with 13.2(b).

13.4 The ampere rating of a switch shall be distinct so that it may be clearly understood what is the ampere rating on the switch. Location Category B.

13.5 The ampere rating of a switch rated 100 A or less shall be permitted to be stamped, etched, or similarly marked into the handle or the escutcheon area of the switch so as to be visible without removing the trim or cover of the enclosure with which it may be properly used. Location Category B.

13.6 A switch shall indicate clearly whether it is open or closed and such marking shall be visible with a trim or cover in place except that when enclosed it may require the opening of a hinged cover or door. If a switch handle has an additional or intermediate position which it takes upon automatic opening, that position shall be marked to indicate that the switch has automatically opened. Instructions for resetting the switch shall be included. The word ″tripped″ shall be permitted to be used on the handle but shall not be used in the instructions. Location Categories B and D. Marking indicating the intermediate open position and the resetting instructions shall not be required on the switch if they are provided on the intended receiving device. Location Category D.

13.7 Except as permitted by 13.8 – 13.11, an unfused switch shall be marked, ″This switch is suitable for use on a circuit capable of delivering not more than _____ ampere, rms symmetrical, _____ volts maximum when protected by Class _____ fuses (type _____ circuit breaker) rated _____ amperes maximum″, or with an equivalent marking. See 12.2. Refer to 13.16 and 13.17 for location.

13.8 If the short-circuit rating is 10,000 A, the class of fuse shall not be required but the current rating (I_n) shall be provided. Location Category C.

13.9 If the short-circuit rating is 5,000, 7,500, or 10,000 A, and the rated current (I_n) of the specified circuit breaker or fuse does not exceed that of the switch, the type designation and manufacturer of the circuit breaker shall not be required.

13.10 The type designation and manufacturer of the circuit breaker or Class of fuse shall not be required if:

a) The short-circuit rating is 5,000, 7,500, or 10,000 A;

b) The continuous-current rating (I_n) of the specified circuit breaker or fuse exceeds that of the switch; and

c) The combination was tested for three cycles as indicated in 11.1.7.2.1.

13.11 If the short-circuit rating is greater than 10,000 A and the combination was tested for three cycles as indicated in 11.1.7.2.1, the type designation and manufacturer of the circuit breaker and Class of fuse shall not be required. Location Category C.

13.12 When the overcurrent protective device is a 300 V rated fuse, the marking mentioned in 13.7 shall include ″300 volts maximum″ after the ″rated _____ amperes maximum.″ Location Category C.

13.13 A switch rated 480Y/277 V that is specified for use with a 300 V fuse shall be marked with the following or equivalent wording: ″For use with line-to-neutral loads only.″ Location Category C.

13.14 A switch having an instantaneous release shall additionally be marked as part of its short circuit rating ″May open circuit above _____ A″ or equivalent wording or ″May open automatically″. When the latter marking is provided, the likely tripping current shall be published in other literature which is made available to system designers, and the like. Location Category B.

13.15 The marking in 13.7 – 13.11 shall be permitted to be repeated for several different types of protection. Location Category C.

13.16 The short circuit rating of a switch shall be located where it will be visible when a front or trim is removed. If there is more than one rating marked on the switch, all such ratings shall appear together. Location Category B.

13.17 Notwithstanding 13.16, a switch that is 38.1 mm (1-1/2 inch) wide per pole or less may have the marking at any convenient location on the switch except on the rear. Location Category C.

13.18 A fused molded-case switch constructed to accept only Class CC, G, J, R or T fuses shall be marked with the following statement ″Suitable for use on a circuit capable of delivering not more than _____ amperes, RMS symmetrical, _____ volts maximum: Use Class _____ fuses.″

13.19 A fused molded-case switch shall be marked, ″Continuous load current not to exceed 80 percent of the marked rating of fuses″.

13.20 For recommended symbols and abbreviations, see Annex F.

ACCESSORIES

14 Construction

14.1 General

14.1.1 General Details

14.1.1.1 A component part of an accessory shall comply with the requirements for that accessory.

14.1.2 Installation

14.1.2.1 A circuit breaker or switch may have provision for field-installed accessories provided the following conditions are met:

a) The circuit breaker or switch is acceptable for use with or without the accessory.

b) Each accessory is acceptable for the intended use.

c) Each accessory may be installed without the breaking of a seal and without the disassembly of factory-installed circuit breaker parts except for:

1) Those parts necessary to install or replace a circuit breaker trip unit;

2) A circuit breaker or switch operating handle;

3) Other parts that if omitted are considered not to affect the intended performance of the circuit breaker or switch; or

4) Essential parts that if omitted are effectively replaced by an accessory if the circuit breaker or switch is tested in accordance with 15.1.5 and marked in accordance with 17.4 and 17.11.

d) Instructions for the installation, operation, and necessary adjustments are provided with each accessory.

e) The installation of an accessory does not require the use of other than normally available tools, such as screwdrivers, pliers and wrenches, unless such a tool and instructions for its use are furnished with each accessory.

f) A barrier that is necessary because spacing would otherwise be less than required, or for any other reason, is securely attached at the factory to either the circuit breaker or switch, or to the accessory to be installed.

g) The accessory is an essentially complete unit and does not require detailed assembly in the field. Except as permitted in (h), the installation of the accessory does not expose live or mechanical functional parts that would not be exposed during the replacement of an interchangeable trip unit. An arrangement that requires cutting, splicing of existing wires, or resoldering of connections within the circuit breaker housing is not acceptable.

h) Except as noted in (i) and (j) means for mounting the accessory require no drilling, cutting, or filing of holes. Openings to provide for the accessory actuator to operate the trip mechanism may be provided in the trip unit housing. If breakouts are provided for this purpose they shall be removable in one piece.

i) Drilling, cutting, or filing is acceptable in the circuit breaker or switch housing only to provide an opening for the accessory leads and the location of such openings is indicated by drill points or breakouts.

j) It is possible to accomplish the operation described in (i) in a manner so that debris inside the circuit breaker or switch housing does not accumulate.

k) Strain or pushback relief, if required to meet the requirements of 14.1.5.1 and 14.1.5.2, is provided as an integral part of the accessory or is furnished as part of the kit along with any instructions or tools necessary to comply with the requirements of this standard.

l) The accessory complies with the marking requirements of 17.4.

m) The installation of the accessory does not affect the performance of the circuit breaker or switch.

14.1.2.2 So that instructions are always available should it become necessary to replace a circuit breaker or trip unit, a circuit breaker or interchangeable trip unit intended to accept field-installed accessories shall be provided with information for the proper reinstallation of the accessory.

a) If interchangeable trip units are involved, this information may be:

1) Part of the trip unit installation instruction;

2) Marked on the trip unit; or

3) Provided on a separate tag attached to the trip unit.

b) If noninterchangeable trip units are involved, this information may be:

1) Marked on the circuit breaker; or

2) Provided on a separate sheet packaged with the circuit breaker.

c) The information shall comply with one of the following:

1) Be complete as required by 14.1.2.1 (d).

2) Provide a condensed version of the instructions specified in 14.1.2.1 (d); or

3) Refer to where installation instructions for each accessory may be obtained; in this case, the information shall include a statement of the need to determine that the accessory performs its intended function after it has been reinstalled.

14.1.3 Mounting

14.1.3.1 An accessory shall be securely mounted in position and prevented from loosening or turning if such motion may affect adversely the intended performance of the circuit breaker or switch or reduce the minimum spacing to less than that indicated in 14.1.6.1.

14.1.4 Field Wiring

14.1.4.1 An accessory shall be provided with means for the connection of wires having ampacity corresponding to the rating of the accessory. See Tables 6.1.4.2.1 and 14.1.4.1.

14.1.4.2 Terminal leads of a circuit breaker accessory shall consist of wire suitable for the particular application, when considered with respect to the temperature and voltage and conditions of service to which the wiring is likely to be subjected.

14.1.4.3 Terminal leads shall be 24 AWG (0.20 mm^2) minimum. The free length of a terminal lead shall be at least 150 mm (6 inches).

Table 14.1.4.1
Ampacities of insulated conductors

Wire size		60°C (140°F)	
AWG	(mm^2)	Copper	Aluminum
24	(0.20)	2	–
22	(0.32)	3	–
20	(0.52	5	–
18	(0.82)	7	–
16	(1.3)	10	–

14.1.4.4 A pressure connector provided for use with an accessory shall comply with 6.1.4.2.2.

14.1.5 Strain Relief

14.1.5.1 Strain relief shall be provided to prevent a mechanical stress on the accessory supply leads to which field connections are made from being transmitted to terminals, splices, or interior wiring. See 15.1.3.

14.1.5.2 Means shall be provided to prevent the accessory supply leads to which field connections are made from being pushed into the housing of a circuit breaker or switch through the lead entry holes, if such displacement is likely to subject the lead to mechanical injury, or if it is likely to reduce spacings – such as to a metal strain-relief clamp – below the minimum acceptable values, or if the mechanical operation of the circuit breaker or switch, or accessory is impaired.

14.1.5.3 Any surface with which the leads may come in contact shall be free from any projections, sharp edges, burrs, fins, or the like that may cause abrasion of the insulation on the conductors.

14.1.6 Spacings

14.1.6.1 With any combination of accessories installed, the circuit breaker or switch spacings shall not be less than those required in General, 6.1.6.1.

14.1.6.2 The requirements in 14.1.6.1 do not apply:

a) Between uninsulated live parts of opposite polarity within a component, such as an auxiliary switch;

b) Between uninsulated live parts of the component and dead metal that is part of the component; or

c) Between uninsulated live parts of the component and that part of the dead metal surface of the circuit breaker or switch on which the component is mounted in the intended manner.

14.1.6.3 The requirements in 14.1.6.1 do apply:

a) Between live parts in different components; and

b) Between an uninsulated live part of a component and a live part or the dead metal of the circuit breaker or switch, other than the dead metal surface on which the component is mounted.

14.1.6.4 The spacings at an accessory and its field-wiring terminals shall be in accordance with Table 14.1.6.1.