



UL 489B

STANDARD FOR SAFETY

Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures for Use with Photovoltaic (PV) Systems

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UL Standard for Safety for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures for Use with Photovoltaic (PV) Systems, UL 489B

First Edition, Dated March 7, 2016

Summary of Topics

This revision of ANSI/UL 489B dated May 19, 2021 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

As noted in the Commitment for Amendments statement located on the back side of the title page, UL and CSA are committed to updating this harmonized standard jointly. However, the revisions dated May 19, 2021 will not be jointly issued by UL and CSA as these revisions address UL ANSI approval dates only.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated March 5, 2021.

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First Edition



Underwriters Laboratories Inc.
UL 489B
First Edition

Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures for Use with Photovoltaic (PV) Systems

March 7, 2016

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Commitment for Amendments

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This ANSI/UL Standard for Safety consists of the First Edition including revisions through May 19, 2021. The most recent designation of ANSI/UL 489B as a Reaffirmed American National Standard (ANS) occurred on May 19, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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PREFACE

This is the harmonized CSA Group and UL standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures for Use with Photovoltaic (PV) Systems. It is the First edition of CSA C22.2 No. 305 and the First edition of UL 489B.

This harmonized standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the Technical Harmonization Subcommittee, THSC 121A, Photo Voltaic Circuit Breakers on the Harmonization of Electrotechnical Standards of the Nations of the Americas (CANENA), are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This standard was reviewed by the CSA Subcommittee on Molded Case Circuit Breakers for PV Applications, under the jurisdiction of the CSA Technical Committee on Industrial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

This standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of Harmonization

This standard uses the IEC format but is not based on, nor is it considered equivalent to, an IEC standard.

This standard is published as an identical standard for CSA Group and UL.

An identical standard is a standard that is exactly the same in technical content except for national differences resulting from conflicts in codes and governmental regulations. Presentation is word for word except for editorial changes.

Reasons for Differences From IEC

This standard provides requirements for molded-case circuit breakers, molded-case switches, and circuit-breaker enclosures for use with photovoltaic (PV) systems for use in accordance with the electrical installation codes of Canada and the United States. At present there is no IEC standard for these products for use in accordance with these codes. Therefore, this standard does not employ any IEC standard for base requirements.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

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Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures for Use with Photovoltaic (PV) Systems

ALL DEVICES

INTRODUCTION

1 Scope

1.1 These requirements cover molded-case circuit breakers, molded-case switches, and circuit-breaker enclosures rated up to 1500 V dc, intended for use with photovoltaic (PV) systems and Ref. No. 1 of Annex [B](#).

1.2 These requirements are intended to be used in conjunction with the requirements in Ref. No. 2 of Annex [B](#), except as modified or supplemented by this Standard.

1.3 These requirements do not cover molded-case circuit breakers or molded-case switches intended for use in battery circuits.

2 Components

2.1 Except as indicated in [2.2](#), a component of a product covered by this Standard shall comply with the requirements for that component. See Annex [A](#) for a list of standards covering components generally used in the products covered by this Standard. A component shall comply with the CSA and UL Standards as appropriate for the country where the product is to be used.

2.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this Standard; or
- b) Is superseded by a requirement in this Standard.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3 Units of Measurement

3.1 The values given in SI (metric) units shall be normative. Any other values given shall be for information purposes only.

4 Normative References

4.1 Products covered by this Standard shall comply with the referenced installation codes and standards noted in Annex [B](#) as appropriate for the country where the product is to be used. When the product is intended for use in more than one country, the product shall comply with the installation codes and standards for all countries where it is intended to be used.

4.2 Where reference is made to any Standards, such reference shall be considered to refer to the latest editions and revisions thereto available at the time of printing, unless otherwise specified.

4.3 For products intended for use in Canada, general requirements are given in Ref. No. 3 of Annex B. In the US, this does not apply.

5 Definitions

5.1 For the purpose of this Standard, the following definitions apply.

5.2 PHOTOVOLTAIC (PV) MOLDED-CASE CIRCUIT BREAKER (PV circuit breaker) – A DC molded-case circuit breaker intended to operate in a photovoltaic (PV) system to provide overcurrent protection and disconnecting means, hereafter referred to as PV circuit breaker.

5.3 PHOTOVOLTAIC (PV) CIRCUIT-BREAKER ENCLOSURE – A circuit-breaker enclosure intended for use in a photovoltaic (PV) system, hereafter referred to as PV enclosure.

5.4 PHOTOVOLTAIC (PV) MOLDED-CASE SWITCH (PV switch) – A DC molded-case switch intended to operate in a photovoltaic (PV) system to provide disconnecting means, hereafter referred to as PV switch.

PHOTOVOLTAIC (PV) MOLDED-CASE CIRCUIT BREAKERS

CONSTRUCTION

6 General

6.1 The construction of a PV circuit breaker shall comply with the requirements as specified in Clause 6.1 of Ref. No. 2 of Annex B, except as noted in Clauses 6 – 8 of this Standard as applicable.

6.2 PV circuit breakers shall be considered as single poles for individual PV sources or strings that are permitted to use multiple sets of contacts in series, unless marked in accordance with 17.5. See also 9.9.

7 Spacings

7.1 The electrical spacings for PV circuit breakers rated 600V or less shall meet the requirements of Clause 6.1.6 of Ref. No. 2 of Annex B. Those PV circuit breakers rated 601 – 1500V shall meet the requirements of Ref. No. 2 of Annex B for 600V.

8 Wire Terminals

8.1 A field wiring terminal of a PV circuit breaker shall have a capacity acceptable for the number, wire size, and type of stranding associated with the circuit breaker and in addition shall be acceptable for at least the size indicated in Table 8.1.

Table 8.1
75°C conductor size corrected to 50°C ambient temperature

Terminal current ^a , A	Copper conductors ^{b,c}		Aluminum conductors ^{b,c}	
	Number of conductors	AWG or kcmil	Number of conductors	AWG or kcmil
15 or less	1	14	1	12
20	1	10	1	10
25	1	10	1	8
30	1	8	1	8
40	1	6	1	4
50	1	4	1	3
60	1	4	1	2
70	1	3	1	1
80	1	2	1	1/0
90	1	1	1	1/0
100	1	1/0	1	2/0
110	1	1/0	1	3/0
125	1	2/0	1	4/0
150	1	3/0	1	250
175	1	250	1	350
200	1	300	1	400
200	2	1/0	2	2/0
225	1	350	1	500
225	2	1/0	2	3/0
250	1	400	1	600
250	2	2/0	2	4/0
275	1	500	1	700
300	2	3/0	2	250
325	2	4/0	2	300
350	2	250	2	350
350	3	2/0	4	1/0
400	2	300	2	400
450	2	350	2	500
450	3	3/0	3	250
500	2	400	2	600
500	3	250	3	300
550	2	500	3	350
600	3	300	3	400
700	3	400	3	500
800	3	500	4	400
800	4	300	5	300
1000	4	400	4	600
1200	5	400	6	400
1200	6	300	8	250
1200	4	600	5	600
1400	5	500	6	500
1400	6	400	9	250
1600	6	500	6	700

Table 8.1 Continued on Next Page

Table 8.1 Continued

Terminal current ^a , A	Copper conductors ^{b,c}		Aluminum conductors ^{b,c}	
	Number of conductors	AWG or kcmil	Number of conductors	AWG or kcmil
1600	7	400	8	400
2000	6	500	10	400
2000	8	400	8	600
2500	9	500	10	600

^a For terminal current other than indicated, the next higher rating is to be used – for example, if rated 35 A, enter at 40 A.

^b Table is based on 75°C wire ampacities.

^c Based on 50°C correction factor in Ref. No. 5 of Annex B.

8.2 A PV circuit breaker may also be evaluated for use with PV wire or other class and strand configurations as indicated by marking. See [17.8](#).

8.3 A wire terminal for a PV circuit breaker shall be evaluated for use with the wire type and stranding as marked on the device in accordance with Ref. No. 4 of Annex B.

PERFORMANCE

9 General

9.1 The representative device selection shall be as specified in [Table 9.1](#). The performance shall be as specified in Ref. No. 2 of Annex B except as modified in [Table 9.2](#) and Clauses [9](#) – [15](#) of this Standard.

Table 9.1
Representative device selection

Frame rating	Number of representative devices per sequence ^a		
	A	B	C
0 – 400A	3	3	3
401 and higher ^b	1	1	1

^a See [9.5](#).

^b See [9.7](#).

Table 9.2
Test sequences

Test	Reference	Sequence		
		A	B	C
135 percent calibration	7.1.2.3 of Ref. No. 2 of Annex B	X	X	
200 percent calibration	7.1.2.2 of Ref. No. 2 of Annex B	X	X	X
Endurance	10	X		
Temperature	11	X		
100 percent calibration at 50°C	12	X		
Limited fault interrupting	13		X	
Standard fault interrupting	14			X
Trip-out at 200 percent	7.1.2.2 of Ref. No. 2 of Annex B	X		X
Dielectric voltage-withstand	15	X	X	X

9.2 Representative devices shall be wired in accordance with the instructions of the PV circuit breaker manufacturer. See also [9.9](#) and [17.5](#).

9.3 For the Endurance, Limited Fault Interrupting, and Standard Fault Interrupting Tests, the dc circuit shall have a time constant of not less than 1.0 msec.

9.4 When a PV circuit breaker is marked "line" and "load" in accordance with [17.11](#), the Endurance and Temperature Tests shall be conducted with the device wired in the normal (forward) direction. The Limited Fault Interrupting and Standard Fault Interrupting Tests shall be conducted in the reverse direction. The Calibration and Trip-out Tests may be conducted in any convenient direction.

9.5 When a PV circuit breaker is not marked "line" and "load" in accordance with [17.11](#), for Sequences A, B, and C, one representative of the test set, or an additional representative for each test set, shall be provided and tested with opposing line and load connections rather than as required in [9.4](#). When only one representative constitutes a set, a second representative is required for opposing line-load connection tests.

9.6 Notwithstanding [9.5](#), for a circuit breaker that is required to be wired in series such that the same number of poles (contacts) are exposed to the current in both directions simultaneously, testing in both the forward and reverse direction is not required.

9.7 When a PV circuit breaker has interchangeable trip units, one representative of the frame and three representatives of the trip unit shall constitute a set.

9.8 For the purposes of this Standard, testing in the forward direction requires the positive terminal of the source to be connected to the normal line terminal of the device. Wiring in the reverse direction requires the positive terminal of the source to be wired to the normal load terminal of the device.

9.9 Each pole of a multipole PV circuit breaker shall be tested individually unless marked in accordance with [17.5](#) and [17.6](#), as applicable, and investigated in accordance with [9.10](#) of this Standard.

9.10 A PV circuit breaker shall be connected in accordance with the wiring instructions of the manufacturer. Multipole PV circuit breakers marked for more than one wiring configuration shall be subjected to a sufficient number of tests to represent all configurations. Examples:

- a) For interrupting tests, a configuration with the least number of poles energized would represent configurations with more poles energized.
- b) For temperature tests, a configuration with the most number of poles energized would represent configurations with a fewer number of poles energized.

Calibration tests shall be conducted on the configurations with both the most and least number of poles energized.

9.11 For the Endurance, Limited Fault Interrupting, and Standard Fault Interrupting Tests, a PV circuit breaker intended for use on a system having one conductor grounded shall be tested with the enclosure or mounting surface connected to the negative conductor through a fuse as described in 7.1.1.21 of Ref. No. 2 of Annex [B](#).

9.12 For a field wired PV circuit breaker, the wire used to connect to the terminal for the test in Clause [12](#) shall be sized in accordance with [Table 8.1](#). For the test in Clause [10](#), the wire may be sized based on either the requirements of Ref. No. 2 of Annex [B](#) or [Table 8.1](#). When the tests in Clauses [11](#) and [12](#) are combined, the wire shall be sized in accordance with [Table 8.1](#).

9.13 Notwithstanding 9.12, a circuit breaker not intended for wire connection shall be connected to copper bus bars in accordance with 7.1 of Ref. No. 2 of Annex B.

10 Endurance Test

10.1 A PV circuit breaker shall be capable of performing successfully when subjected to the Endurance Test specified in 7.1.5 of Ref. No. 2 of Annex B at the maximum rated dc voltage specified for the circuit breaker. The number of operations of the Endurance Test shall be in accordance with Table 10.1.

10.2 Prior to the Temperature Test, the PV breaker shall be subjected to at least 10 percent of the required electrical operations and 100 percent of the mechanical operations of Table 10.1. Upon completion of the Temperature Test, the remaining electrical operations shall be completed before conducting the Trip-Out Test.

Table 10.1
Endurance test

Device rating	No. of operations	
	With load	Without load
249 A and less	1000	1000
250 A and greater	400	400

11 Temperature Test

11.1 A PV circuit breaker shall be subjected to the Temperature Test as specified in Clause 7.1.4 of Ref. No. 2 of Annex B except as noted in 11.2 and 11.3.

11.2 A PV circuit breaker shall not exceed the values in Clause 7.1.4 and 7.6.5 of Ref. No. 2 of Annex B except the temperature rise limits shall be adjusted by subtracting 10°C from the allowable rise.

11.3 At the request of the manufacturer, the Temperature Test may be conducted in conjunction with the 100 Percent Calibration Test described in Clause 12, in which case the temperature rise limits shall not require the 10°C correction factor described in 11.2.

11.4 Fusible PV circuit breakers shall be tested with PV fuses in place. Testing with actual fuses shall be conducted at 80 percent rated current.

11.5 A PV circuit breaker rated 1001 – 1500V shall be rated for continuous operation at 100 percent of its ampere rating in compliance with the requirements of 7.1.4.3 of Ref. No. 2 of Annex B.

12 100 Percent Calibration at 50°C

12.1 In addition to the Calibration Test specified in Clause 7.1.2 of Ref. No. 2 of Annex B, a PV circuit breaker shall be capable of carrying rated current at 50°C in accordance with 12.2.

12.2 A PV circuit breaker shall be wired with a conductor sized in accordance with Table 8.1 or, if intended for bus bars, in accordance with 7.1.4.1.17 – 7.1.4.1.19 of Ref. No. 2 of Annex B, and subjected to an ambient temperature of 50°C for a period of 3 hours or until temperatures stabilize. While at 50°C, the circuit breaker shall be subjected to the Calibration Test at 100 percent of rated current as described in 7.1.2.4 of Ref. No. 2 of Annex B, until temperatures stabilize. The PV circuit breaker shall not trip.

13 Limited Fault Interrupting Test

13.1 PV circuit breakers shall perform successfully when operated under conditions indicated in 7.1.7 of Ref. No. 2 of Annex B at the maximum rated voltage specified by the manufacturer. The test current shall be 200 percent of rated current. The operations shall be conducted "O" – "CO" – "O".

13.2 During this test, the PV circuit breaker may open automatically or, at the option of the manufacturer, by manual or electrical means, such as with a shunt trip or an electrical operator. When a manual or electrical means is employed, the current shall flow for at least 1 second before opening.

14 Standard Fault Interrupting Test

14.1 A PV circuit breaker shall perform successfully when operated under conditions indicated in 7.1.7 of Ref. No. 2 of Annex B at the nominal rated voltage specified by the manufacturer, except that the prospective current shall be at the standard interrupting rating of the device, but not less than the prospective current used during the Limited Fault Interrupting Test, Clause 13. The operations shall be "O" – "CO" – "O". See 16.4 and 13.2.

14.2 Notwithstanding 14.1, the Standard Fault Interrupting Test may instead be conducted at a higher value as tabulated in Table 8.1 of Ref. No. 2 of Annex B.

15 Dielectric Voltage-Withstand Test

15.1 PV circuit breakers shall be subjected to the Dielectric Voltage-Withstand Test specified in 7.1.9 of Ref. No. 2 of Annex B at the voltages specified in 15.2.

15.2 The test potential shall be the following values for alternating-current:

- a) 500 volts – For PV products rated not more than 50 volts; and
- b) 1000 volts plus twice the rated voltage – For PV products rated greater than 50 volts.

15.3 The test specified in 15.2 may be conducted with a dc source except the test potential shall be equal to a value of 1.414 times that required in 15.2.

RATINGS

16 General

16.1 In addition to the requirements of Clause 8 of Ref. No. 2 of Annex B, a PV circuit breaker shall comply with 16.2 – 16.7.

Note: A PV circuit breaker rated between 601 – 1500V is not marked with a closing or momentary short circuit rating.

16.2 A PV circuit breaker shall be rated for one or more dc voltages, 1500V maximum. "Slash" ratings are not permitted.

16.3 The rated ambient temperature for a PV circuit breaker is minus 20 to +50°C (minus 4°F to +122°F).

16.4 The interrupting rating of a PV circuit-breaker shall be a value no greater than the prospective current used during the Standard Fault Interrupting Test and shall be a value as tabulated in Table 16.1.

16.5 Notwithstanding [16.4](#), a PV circuit breaker additionally investigated to the high available fault current sequence of 7.1.11 at a dc value as tabulated in Table 8.1 of Ref. No. 2 of Annex [B](#), shall have an interrupting rating not to exceed the prospective current used during the test.

16.6 Notwithstanding [16.4](#), a PV circuit breaker investigated in accordance with [14.2](#), shall have an interrupting rating not to exceed the prospective current used during the test.

Table 16.1
Standard fault interrupting ratings, dc amperes

50	800	2,000
100	1,200	3,000
400	1,600	5,000

16.7 PV circuit breakers rated 1001 – 1500V shall be 100 percent rated.

MARKINGS

Advisory Note: In Canada, there are two official languages, English and French. Annex [C](#) provides translations in French of the English markings specified in this Standard. Markings required by this Standard may have to be provided in other languages to conform with the language requirements of the country where the product is to be used.

17 General

17.1 A PV circuit breaker shall be provided with the applicable required markings specified in Clause 9 of Ref. No. 2 of Annex [B](#), except as modified by this Standard.

17.2 A PV circuit breaker shall be marked "Photovoltaic" or "PV." Location Category B.

17.3 A PV circuit breaker shall be marked with the nominal dc voltage rating. Location Category B.

17.4 A PV circuit breaker shall be marked with an interrupting rating in accordance with [16.4](#). Location Category B.

17.5 A multipole PV circuit breaker shall be marked to indicate the proper configuration of connections of the terminals as appropriate. See [9.5](#) and [9.6](#). Location Category C.

17.6 Notwithstanding [17.5](#), if there are multiple configurations, a separate document shall be included with the circuit breaker and the circuit breaker shall be marked with a permanently affixed label that reads: "For the proper configuration of connections of the terminals, refer to Publication No. _____ provided with this circuit breaker. If additional information is necessary, contact _____ (PV circuit breaker manufacturer's name)." The document shall include:

- a) The PV circuit breaker manufacturer's name and type designation or equivalent;
- b) Publication number and date or equivalent;
- c) PV circuit breaker current ratings, voltage rating, number of poles; and
- d) A schematic of each of the intended wiring configurations.

17.7 A PV circuit breaker may be marked "Suitable for Use in Photovoltaic Systems in Accordance with _____". The blank shall be filled in with the appropriate national installation code in Ref. No. 1 of Annex B. The word "photovoltaic" may be abbreviated "PV". Location Category C.

17.8 A PV circuit breaker may also be marked with metric sizes, PV wire range, "PV wire" or "photovoltaic wire" and/or other class and strand configurations in accordance with 8.2. The marking shall include wire size or wire range, the type and/or class of wire and the stranding if different from Class B concentric and compressed, or Class C concentric. Location Category B.

17.9 If a PV circuit breaker has ratings for other applications in accordance with Ref. No. 2 of Annex B, the markings shall be clearly separate from the PV ratings.

17.10 A PV circuit breaker shall be marked "50°C". Location Category C.

17.11 A PV circuit breaker shall be marked "line" and "load" as appropriate unless evaluated in accordance with 9.5. When required to be marked "line" and "load", the wording may be replaced with "+", "positive", or "POS", and "-", "negative", or "NEG" as appropriate. Location Category B.

17.12 A PV circuit breaker shall be marked as being suitable for 75°C (167°F) wire only. Location Category B.

17.13 A PV circuit breaker investigated using bus bars larger or smaller than those specified in Table 7.1.4.1.3 of Ref. No. 2 of Annex B, shall be marked to show the minimum size bus bar with which it can be used. Location Category B.

17.14 A PV circuit breaker shall be marked for either a grounded or ungrounded system, unless rated for both systems, as intended by the manufacturer. Location Category C.

PHOTOVOLTAIC (PV) MOLDED-CASE SWITCHES

CONSTRUCTION

18 General

18.1 The construction of a PV switch shall comply with the requirements of Clause 10 of Ref. No. 2 of Annex B, and as modified by Clauses 6 – 8 of this Standard.

PERFORMANCE

19 General

19.1 The representative device selection shall be as specified in Table 19.1. PV switches shall comply with the general performance requirements as specified in Clause 11 of Ref. No. 2 of Annex B except as modified by Table 19.2, Clauses 9 – 11 as applicable, and Clauses 19 – 23 of this Standard.

Table 19.1
Representative device selection

Frame rating	Number of representative devices per sequence ^a		
	E	F	G
0 – 400A	3	3	3
401 and higher ^b	1	1	1
^a See 9.5 .			
^b See 9.7 .			

Table 19.2
Test sequences

Test	Reference	Sequence		
		E	F	G
Temperature	11.1.2 of Ref. No. 2 of Annex B and 11	X		
Endurance	10	X		
Abnormal current opening	20		X	
Short circuit current withstand	21			X
Dielectric voltage-withstand	22	X	X	X

19.2 For a PV switch that is identical in ratings and construction to a PV circuit breaker that complies with the requirements of this Standard, and in which the release element is either omitted or made inactive, only Sequence F and G need to be conducted.

19.3 For a PV switch that is identical in ratings and construction to a PV circuit breaker that complies with the requirements of this Standard and in which the release element is either omitted or made inactive, except for the instantaneous release, no additional testing is required.

19.4 For the Endurance, Short Circuit Current Withstand, and Abnormal Current Opening Tests, the dc circuit shall have a time constant of not less than 1.0 msec.

19.5 For a PV switch the entire Endurance Test may be conducted at the conclusion of the Temperature Test.

19.6 For the Endurance, Abnormal Current Opening, and Short Circuit Current Withstand Tests, a PV switch intended for use on a system having one conductor grounded shall be tested with the enclosure or mounting surface connected to the negative conductor through a fuse as described in 7.1.1.21 of Ref. No. 2 of Annex [B](#).

20 Abnormal Current Opening Test

20.1 A PV switch shall perform successfully when operated either manually or electrically to break 200 percent of the rated current, at the nominal rated voltage of the device in accordance with 11.1.7.6 of Ref. No. 2 of Annex [B](#), except as modified in [20.2](#).

20.2 A PV switch shall be subjected to 3 closing, then opening operations. At the conclusion of this 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.

20.3 At the conclusion of the test, the Dielectric Voltage Withstand Test shall be conducted in accordance with [22.1](#).

21 Short Circuit Current Withstand Test

21.1 A PV switch shall perform successfully when operated under conditions indicated in 11.1.7 of Ref. No. 2 of Annex [B](#) except as modified by [21.2](#). The test shall be conducted at the nominal rated voltage and short circuit current in accordance with [Table 16.1](#) of this Standard or Table 12.1 of Ref. No. 2 of Annex [B](#).

21.2 A PV switch shall withstand the designated current until the overcurrent protective device opens. For a PV switch not marked as requiring a specific PV circuit breaker or PV fuse, the test current shall be maintained for 0.050 sec. or the time required for an instantaneous release mechanism to respond.

22 Dielectric Voltage-Withstand Test

22.1 The Dielectric Voltage-Withstand Test described in [15.1](#) shall be conducted following both the Abnormal Current Opening and the Short Circuit Current Withstand Tests.

RATINGS

23 General

23.1 A PV switch shall comply with the requirements of Clause 12 of Ref. No. 2 of Annex [B](#), as modified by [16.2](#), [23.2](#), and [23.3](#).

23.2 The short circuit current withstand rating of a PV switch shall not be greater than that value of the prospective current used during the test in Clause [21](#) or 11.1.7.2 of Ref. No. 2 of Annex [B](#).

23.3 A PV switch rated 1001 – 1500V shall be rated for continuous operation at 100 percent of its ampere rating in compliance with the requirements of 7.1.4.3 of Ref. No. 2 of Annex [B](#).

MARKINGS

Advisory Note: In Canada, there are two official languages, English and French. Annex [C](#) provides translations in French of the English markings specified in this Standard. Markings required by this Standard may have to be provided in other languages to conform with the language requirements of the country where the product is to be used.

24 General

24.1 A PV switch shall be provided with the applicable required markings specified in Clause 13 of Ref. No. 2 of Annex [B](#), except as modified by [17.2](#), [17.3](#), [17.5](#) – [17.8](#), [17.10](#) – [17.13](#), [24.2](#), and [24.3](#).

24.2 A PV switch shall be marked with a short circuit current rating not greater than the prospective current used in Clause [21](#). Location Category B.

24.3 Notwithstanding [24.2](#), a PV switch investigated with a test current in accordance with Table 12.1 of Ref. No. 2 of Annex [B](#) may be marked with a short circuit current rating not greater than the prospective current used in 11.1.7 of Ref. No. 2 of Annex [B](#).