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UL 98B

Outline of Investigation for Enclosed and Dead-front Switches for use in
Photovoltaic Systems

Issue Number 3

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Summary of Topics

This is the third issue of the Outline of Investigation for Enclosed and Dead-Front Switches for Use in Photovoltaic Systems, Subject 98B. These requirements cover enclosed and dead-front switches rated up to 1500 V dc, intended for use in dc photovoltaic (PV) systems and installed in accordance with Article 690 of the National Electrical Code, ANSI/NFPA-70. These switches are intended for ambient conditions between minus 20 to +50°C.

The following table lists the future effective dates with the corresponding reference.

Future Effective Dates	References
December 31, 2019	Paragraphs 13.5, 13.6, 13.10, 13.12, 14.5, 22.1, 23.3, 23.6, 23.12 – 23.17, Sections 17, 20, and 24 – 27.

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INTRODUCTION

1 Scope

1.1 These requirements cover open, enclosed and dead-front switches rated up to 1500 V dc, intended for use in dc photovoltaic (PV) systems and installed in accordance with Article 690 of the National Electrical Code, ANSI/NFPA-70. These switches are intended for ambient conditions between minus 20 to +50°C.

1.2 These requirements are intended to be used in conjunction with requirements in the Standard for Enclosed and Dead-Front Switches, UL 98, except as modified or supplemented by the following requirements.

1.3 Unless otherwise specified, when the term switch is used in this outline, it refers to a photovoltaic, enclosed, open, or dead-front switch.

1.4 Fusible switches are intended for use with photovoltaic (PV) fuses which comply with the requirements of Outline for Low-Voltage Fuses – Fuses for Photovoltaic Systems, UL 2579.

1.5 These requirements also apply to open type switches, used in conjunction with the Outline of Investigation for Open Type Switches, UL 98A.

1.6 These requirements also cover fused and unfused electrically tripped PV switches.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this outline shall comply with the requirements for that component.

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 outline; or
- b) Is superseded by a requirement in this outline.

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 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this outline shall be interpreted as referring to the latest edition of that code or standard.

5 Glossary

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

5.2 PHOTOVOLTAIC (PV) SWITCH – an open, enclosed or dead-front switch, with or without fuseholders, intended to operate in photovoltaic (PV) systems.

CONSTRUCTION

6 General

6.1 The construction of a PV switch shall comply with the requirements as specified in Section 6 of the Standard for Enclosed and Dead-Front Switches, UL 98, except as noted in 6.2 – 6.5 as applicable.

6.2 Multi-pole switches shall be considered as individual poles for individual loads unless marked in accordance with 23.5.

6.3 Fusible PV switches shall isolate the fuseholders from the line and load connections when the switch is in the open position.

Exception: Fusible PV switches that do not isolate the fuseholders from both the line and load connections when in the open position shall be marked in accordance with 23.10.

6.4 Doors shall be interlocked to prevent access to the interior of the switch enclosure when the switch is in the closed position.

Exception: A means requiring the use of a tool may be provided to bypass the interlock.

6.5 The investigation of a PV switch shall take into consideration both the line and load terminals may be connected to a PV source.

7 Spacings

7.1 The electrical spacings for PV switches shall meet the requirements of the Standard for Enclosed and Dead-Front Switches, UL 98. Those PV switches rated 601 – 1500 V shall meet the requirements for 600 V of the Standard for Enclosed and Dead-Front Switches, UL 98.

8 Wire Terminals

8.1 The field wiring terminal of a PV switch shall have a capacity acceptable for the number, wire size and type of stranding associated with the maximum ampere rating of the switch, and shall be acceptable for at least one size indicated in Table 8.1.

Table 8.1
50°C ambient corrected conductor size

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	3	4/0
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

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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
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
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 of Table 310.15(B)(2)(a) of the ampacities of Table 310.15(B)(16) of the National Electrical Code, ANSI/NFPA-70.

8.2 PV enclosed switches may also be evaluated for use with PV wire, or other class and strand configurations as indicated by marking. See 23.7.

9 Bus Bars

9.1 If a PV switch has terminals without provision for wire connectors, the connections to the terminals during the Temperature Test shall be made with copper bus bars. The size of the bus bar used for the Temperature Test shall be 1.55 A/mm² (1000 A/in²) of copper, based on the maximum ampere rating of the switch, except that when the switch is intended for use with a smaller bus bar, such smaller bus bars shall be used. The bus bars shall be mounted as intended during actual service. The length of the bus bar shall be at least 1.219 m (4 feet) in length. The spacing between multiple bus bars shall be 6.4 mm (1/4 inch), with no intentional greater spacing except as necessary at the individual terminals of the switch.

10 Enclosure Doors

10.1 Enclosed switches with external top hinged doors shall be provided with stops to hold them in the open position.

10.2 Enclosed switch doors shall be capable of being opened 90 degrees or more from the closed position.