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UL 943C

OUTLINE OF INVESTIGATION
FOR
SPECIAL PURPOSE GROUND-FAULT CIRCUIT-INTERRUPTERS

Issue Number 2

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Summary of Topics

This is the second issue of the Outline of Investigation for Special Purpose Ground-Fault Circuit-Interrupters, Subject 943C, including revisions to the grounding monitor/interrupter, supervisory circuit, and marking requirements, and including the addition of requirements for programmable circuit components and environmental sequence.

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INTRODUCTION

1 Scope

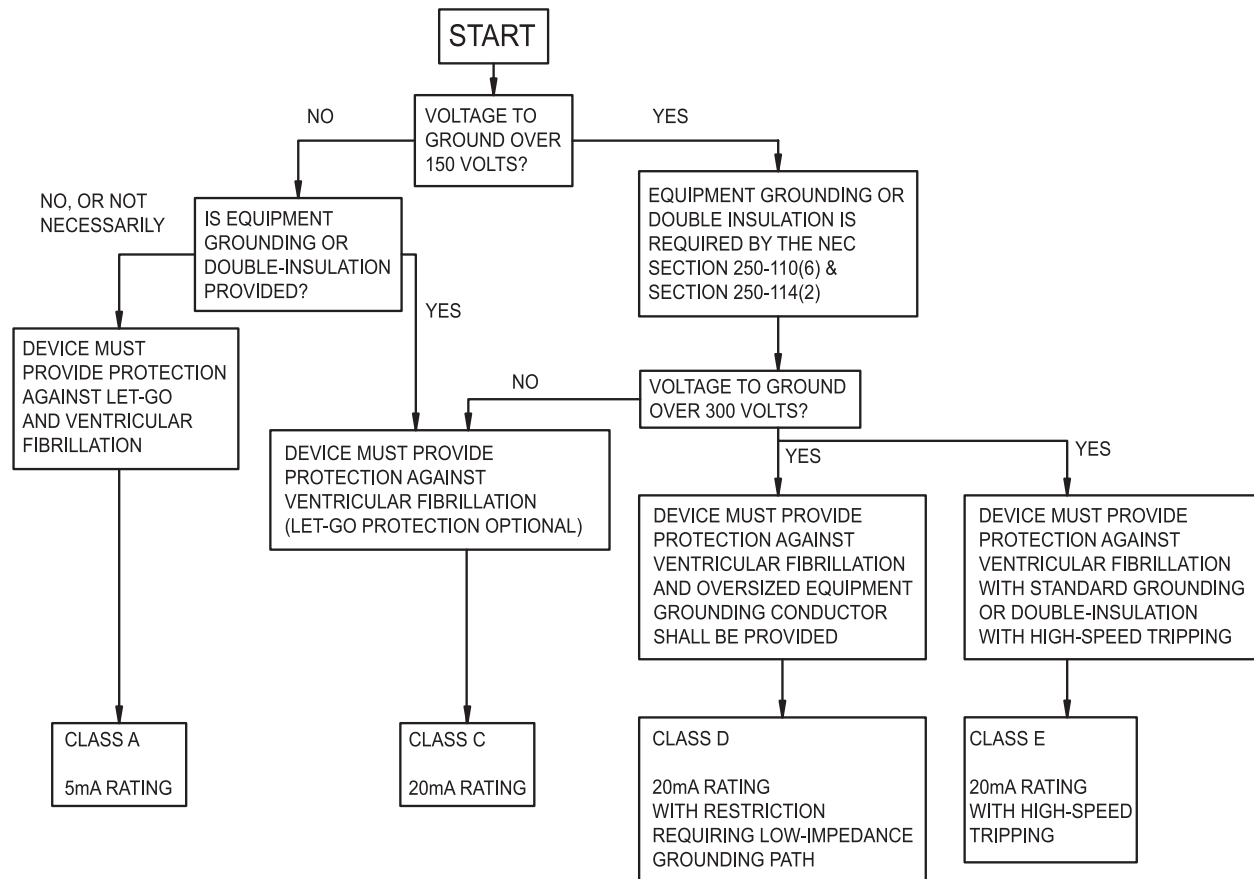
1.1 These requirements cover ground-fault circuit-interrupters intended for use in one of the following applications:

- a) Where the voltage to ground is greater than 150 volts and equipment grounding or double insulation is required by the National Electrical Code, ANSI/NFPA 70,
- b) Where the voltage to ground is 150 volts or less and equipment grounding or double-insulation is provided, but the use of a Class A ground-fault circuit-interrupter is not practical.

1.2 Ground-fault circuit-interrupters addressed by these requirements are divided into three classes, Class C, D and E, based upon voltage rating and the characteristics of the grounding circuit. Some are intended for use in circuits where grounding is not provided to the load but double-insulation is provided.

1.3 These ground-fault circuit-interrupters are intended to be applied on circuits as shown in Figure 1.1. The requirements for Class A ground-fault circuit-interrupters are in the Standard for Ground-Fault Circuit-Interrupters, UL 943.

Figure 1.1
Application of GFCIs



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2 Glossary

2.1 For the purposes of this Outline of Investigation, the following definitions apply. Additional definitions are in the Glossary of the Standard for Ground-Fault Circuit-Interrupters, UL 943.

2.2 **CLASS C GROUND-FAULT CIRCUIT-INTERRUPTER** – A ground-fault circuit-interrupter that is intended to be used in circuits with no conductor over 300 V AC to ground where reliable equipment grounding or double insulation is provided.

2.3 **CLASS D GROUND-FAULT CIRCUIT-INTERRUPTER** – A ground-fault circuit-interrupter that is intended to be used in circuits with one or more conductors over 300 volts to ground, and with specially sized, reliable grounding, to provide a low impedance path so that the voltage across the body during a fault does not exceed 150 volts.

2.4 **CLASS E GROUND-FAULT CIRCUIT-INTERRUPTER** – A ground-fault circuit-interrupter that is intended to be used in circuits with one or more conductors over 300 volts to ground but with conventional equipment grounding provided for the protected equipment in the system or double insulation. These ground-fault circuit-interrupters respond rapidly to open the circuit before the magnitude and duration of the current flowing through the person's body exceeds the limits for ventricular fibrillation.

2.5 **GROUNDING MONITOR/INTERRUPTER** – A device that monitors equipment grounding continuity in a protected system. It prevents the circuit from being energized under conditions where the grounding is not available and causes the circuit to be interrupted where the grounding is lost during operation.

2.6 **SPECIALLY SIZED GROUND** – A grounding conductor whose size is based on a ratio with respect to the size of the ungrounded conductor in order to limit the voltage to which a person would be exposed in the event of a fault to ground.

3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this Outline of Investigation shall comply with the requirements for that component.

3.2 A component need not comply with a specific requirement that:

- a) Involves a feature or characteristic not needed in the application of the component in the product covered by this Outline of Investigation, or
- b) Is superseded by a requirement in this Outline of Investigation.

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

3.4 Specific components are recognized as being 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 for which they have been recognized.

4 Units of Measurement

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

5 Undated References

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

CONSTRUCTION

6 General

6.1 The products covered by this Outline shall comply with the construction requirements of the Standard for Ground-Fault Circuit-Interrupters, UL 943, except as modified by these requirements.

7 Grounding Circuit

7.1 Except as noted in 7.2, the grounding circuit of the circuit in which these ground-fault circuit-interrupters are used shall be continuous, of low resistance, and reliable.

7.2 Equipment grounding is not required in the circuit to the load if the load is double insulated. See 10.2.

7.3 The grounding circuit of the circuit in which a Class D ground fault circuit-interrupter is used shall be of sufficiently low impedance that, should a fault to ground occur, the voltage resulting across the grounding circuit shall not exceed 150 volts. The size of the grounding conductor required for a circuit shall be determined by calculating the resistance using the following formula and converting that value to a wire gauge based on the length of the grounding conductor.

$$R_G = (150R_U)/(V_{I-g} - 150)$$

Where:

R_G = the resistance of the grounding conductor,

R_U = the resistance of the ungrounded conductor, and

V_{I-g} = the supply line to ground voltage in RMS V AC.

Refer to Appendix A for a sample calculation of grounding conductor size.

8 Spacings

8.1 Except as indicated in 8.2 – 8.5, the spacing requirements of the Standard for Ground-Fault Circuit-Interrupters, UL 943 shall apply for all locations.

8.2 The spacing requirements of the Standard for Ground-Fault Circuit-Interrupters, UL 943 for potentials of 201-400 V peak shall also apply to locations with a potential up to 425 V peak.

8.3 Except as indicated in 8.4, the spacings for potentials of 426 through 850 V peak at locations other than field wiring terminals shall be per Table 8.1

8.4 The minimum allowable spacing from any live part to a metal enclosure where the potential is 426 through 850 volts peak is 25.4 mm (1 inch).

Table 8.1
Minimum spacings at other than field wiring terminals

Operating potential between parts 426 – 850 V peak Spacings in mm (inches)			
Through air		Over surface	
Open ^a	Closed-in ^b	Open ^a	Closed-in ^b
9.5 (3/8)	6.4 (1/4)	12.7 (1/2)	6.4 (1/4)
^a A space that is not specially protected from deposition of dirt. ^b A space that is specially protected from deposition of dirt; that is, a sealed housing that meets the requirements of the dust test of the Standard for Ground-Fault Circuit-Interrupters, UL 943.			

8.5 The spacing for potentials of 426 through 850 V peak at field wiring terminals shall be per Table 8.2.

Table 8.2
Minimum spacings at field wiring terminals

Operating potential between parts 426 – 850 V peak Spacings in mm (inches)	
Through air	Over surface
12.7 (1/2)	12.7 (1/2)