



Bender Series 2 High Resistance Grounding System Guideform Specification Complete with NGR Monitoring, Pulsing and Feeder Level Fault Location

To specifying engineers: the square brackets are used to notify the specifier when a selection is available. Please choose the selection that best suits the project. For any clarification or assistance please contact your Bender sales representative or inside sales technical support.

1.1 Standards

1. The latest versions of the following codes and standards used by the authority having jurisdiction shall apply during design and manufacturing.

Electrical codes:

- a. CSA C22.1 – Canadian Electrical Code
- b. NFPA 70 – National Electrical Code

Enclosure standards:

- c. CSA C22.2 No. 94.1 – Enclosures for electrical equipment, nonenvironmental considerations
- d. CSA C22.2 No. 31 – Switchgear assemblies
- e. UL 50 – Enclosures for Electrical Equipment
- f. NEMA ICS 6 – Industrial Control and Systems: Enclosures
- g. NEMA 250 – Enclosures for electrical equipment (1000 Volts Maximum)
- h. ANSI/IEC 60529 – Degree of protection provided by enclosures (IP Code)
- i. ANSI Z535.4 – Safety labels

Industrial control equipment standards:

- k. C22.2 No. 14 – Industrial Control Equipment
- l. ANSI C19.3 – Industrial Control Apparatus – General
- m. UL 508 – Industrial Control Equipment

Neutral grounding devices standards:

- n. IEEE 32 – Requirements, Terminology, and Test Procedure for Neutral Grounding Devices
- o. IEEE 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems
- p. IEEE C57.32 – IEEE Standard for Requirements, Terminology, and Test Procedures for Neutral

Grounding Devices

- q. CSA C22.2 No. 295 – Neutral Grounding Devices, and other applicable CSA Standards
- r. CSA M421 – Use of Electricity in Mines



Ground fault relay standards:

- s. UL 1053 – Standard for Ground-Fault Sensing and Relaying Equipment
- t. CSA C22.2 No. 14 – Industrial Control Equipment
- u. CAN/CSA C22.2 No. 144 – Ground Fault Circuit Interrupters

Part 2 – Products

2.1 Intent

This specification provides design and performance details of the Bender Series 2 High Resistance Grounding System. The supplied system shall meet or exceed therequirements of this specification.

2.2 Scope of Work

Provide a Bender High Resistance Grounding system (B-HRG) to high-resistance ground, and detect and locate ground faults on, an electrical power distribution system, while providing monitoring and protection for the ground faults and resistor and ground path faults. The scope of work includes but is not limited to the following:

- a. Review of proposed electrical power distribution system equipment design with a Bender technical representative prior to submission of pricing. Ensure proposal meets the full requirements to complete work, meets owner’s requirements, and addresses the manufacturer recommendations.
- b. Review conductor and bussing sizes, if requested, to verify that correct ground-fault current transformer types, sizes and quantities are selected.
- c. Identification of components and equipment.
- d. Test the system as recommended by Bender.

2.3 High Resistance Grounding System

The B-HRG system is supplied as a pre-engineered package that grounds the power-distribution system and limits ground-fault current to a level that allows continuous operation during a single-phase-to-ground fault (where allowed by code). The B-HRG system detects and annunciates ground fault and resistor faults. Local indication and remote communication as described below should be provided. The HRG system shall meet the following:

2.3.1 System Controls

- a. Shall be mounted [internal and integrated into the power distribution equipment / external as standalone equipment in [one or two] enclosures].
- b. [NGRM700 or NGRM500] Neutral-Grounding-Resistor Monitor.
- c. Shall provide local and remote indication of the occurrence of ground fault by local LED lamps, dry contacts, HMI interface and Modbus communication.
- d. Ground-fault information including neutral current, neutral voltage, DC content, harmonic analysis of ground-fault current, and phase voltage is displayed with a color touchscreen HMI.
- e. Event History recording the previous 1000 events with time stamp shall be included.

2.3.2 Alternating-Current Current Transformers (AC CT)

- a. Detect AC ground faults.
- b. AC CTs, when specified, are to be installed to monitor individual feeders or loads.
- c. CT integrity and connections shall be continuously monitored.
- d. AC CT configurations include toroidal, rectangular, and split-core rectangular and have the designations of CTAC, W, WR, and WS series.
- e. The AC CT shall be rated for 600 V.

2.3.3 AC/DC Current Transformers (AC/DC CT)

When the power system has a combination of both AC and DC components, as in the case of VFD and UPS applications, that portion of the system should be monitored with AC/DC CT's.

- a. Protects the electrical power system's DC and mixed AC/DC components against ground faults.
- b. AC/DC CT's, when specified, are to be installed to monitor individual feeders or loads.
- c. Feeder ground-fault CT integrity and connections shall be continuously monitored.
- d. AC/DC CTs are toroidal in shape and have the designation of CTUB10x-CTBC series.
- e. The AC/DC CT shall be rated for 600 V.

2.4 Neutral Grounding Resistor (NGR)

- 2.4.1 The NGR shall be [internal as an integral component of the System Controls / external and remote as stand alone equipment].
- 2.4.2 Ground neutral(s) of three phase electrical power distribution system(s) using NGR(s). Refer to the single-line drawing or specifications for NGR ratings.
- 2.4.3 If the power-system neutral is not available or accessible, or a neutral is required on the system bus, a zig-zag transformer must be specified to create an artificial neutral. [A zig-zag transformer is to be supplied in the HRG System Controls / A zig-zag transformer is to be supplied in the external HRG Control/ A zig-zag transformer is to be supplied by others.]
- 2.4.4 The NGR limits ground-fault current to the designed value [10 A]. A pulsing function is included [to reduce the current to 5 A or the system shall start at 5 A nominal and pulse up to 10 A].
- 2.4.5 Resistive elements are to be made of stainless steel. Wire-wound and edge-wound types are acceptable.
- 2.4.6 The enclosure of a separately enclosed NGR shall be NEMA 3R of galvanized steel, painted ANSI 61 grey.

2.5 Grounding Resistor Monitor

The integrity of the resistance grounding path shall be monitored by an NGRM series relay [NGRM700 or NGRM500]. NGR and grounding-connection resistance alarm settings shall have a 10 to 200% of nominal-resistance range.

- 2.5.1 Detect both open and shorted grounding path. When measured resistance exceeds the NGRM setting (high or low), the general alarm contact changes state, the Resistor Fault lamps are turned on, and the resistor failure status is displayed on the HMI screens.
- 2.5.2 The relay shall be able to provide a wide ground-fault detection frequency range including AC and DC fault. Display of Harmonic content of neutral current and voltage are required.
- 2.5.3 Ground-fault detection shall remain active with an open NGR.

3 System Operation

LED lamps and a touchscreen HMI display operational conditions. Push buttons allow setting of operational parameters. Ground-fault information including DC content, harmonic analysis of ground-fault current, and phase voltage is displayed through HMIs with LCD displays.

Ground-Fault detection- when a fault exceeds the ground-fault trip level:

- a. Ground fault lamp stays on, ground fault auxiliary relay is energized, both general alarm dry contact and first ground fault dry contact change state and the HMI screen displays the fault condition.
- b. [Systems equipped with RCMS feeder level ground-fault protection shall indicate the faulted feeder]
- c. The power distribution system can operate with the ground fault indefinitely
- d. The pulsing function can be activated to locate a ground fault on the still-energized feeder. Locating the ground fault should be performed soon after the occurrence of the first fault.
- e. For bus-tie systems, the NGR monitoring and ground-fault system must be compatible with normally open and normally normally closed tie-breaker control schemes.

3 Indication and Communication

Local and remote communication shall be provided. The following must be included as minimum.

- 3.1 Alarm contacts for remote annunciation of faulted conditions.
- 3.2 HMI Indication of the NGR resistance in ohms.
- 3.3 Modbus TCP and web interface over Ethernet

4 Miscellaneous

- 5.1 [Include portable ground detector with a split-core type ammeter and multiple range switch. The clamp must be capable to enveloping a minimum 6" diameter for locating ground fault. / Delete this paragraph if this equipment is not required.]
- 5.2 [Delete this paragraph if not required / In the case of outdoor NEMA3R rated NGR enclosure, an anti-condensation heater shall be provided.]

6 The product(s) covered by this specification shall be warranted by the manufacturer to be free of manufacturing defects for 24 months from the ship date.

7 Submittals

After order Bender to supply Submit shop drawings for products specified in this Section. The submittal should include but not belimited to the following:

- a. Manufacturer's bill of material.
- b. Manufacturer's instruction manual with schematic and wiring diagrams.
- c. Product dimensional drawings.
- d. Manufacturer's testing and commissioning instructions.