

CATHODIC PROTECTION RECTIFIER SPECIFICATION

UTILITY AIR-COOLED LINE



INTEGRATED RECTIFIER TECHNOLOGIES, INC.

15360 – 116 Avenue, Edmonton, Alberta, Canada T5M 3Z6

Phone: (780) 447-1114 Fax: (780) 454-0004 Email: admin@irtrectifier.com

Website: www.irtrectifier.com

INTEGRATED RECTIFIER TECHNOLOGIES, INC.
UTILITY AIR-COOLED LINE CATHODIC PROTECTION RECTIFIER SPECIFICATION

This specification shall outline the features of the Integrated Rectifier Technologies, Inc. Utility Air-Cooled line of Cathodic Protection Rectifiers.

1.0 GENERAL

- 1.1 The Utility line rectifiers are manufactured in accordance with the following applicable standards:
 - a) Canadian Standards Association (CSA) Specifications:
 - C 22.2 / No. 0 – General Requirements
 - C 22.2 / No. 66 – Specialty Transformers
 - C 22.2 / No. 94 – Special Purpose Enclosures
 - C 22.2 / No. 107– General Use Power Supplies
 - b) National Electrical Manufacturers Association (NEMA) Standard No. 250.
 - c) Canadian Electrical Code (CEC) & National Electrical Code (NEC).
- 1.2 The rectifiers are designed to meet or exceed the National Association of Corrosion Engineers (NACE) criterion for Cathodic Protection use.
- 1.3 The Utility line rectifiers are available with a 115 Volt, single-phase AC input at an input frequency of 60 Hz. A 230 Volt input may be optionally available. The rectifier shall be designed to provide rated DC output with an AC input at 5% below the nominal level specified and such that an AC input of 10% above nominal AC input voltage shall not damage any rectifier components.
- 1.4 The rectifiers are designed to operate in an ambient range of -50°C (-58°F) to $+45^{\circ}\text{C}$ (113°F).

2.0 ENCLOSURE

- 2.1 The Utility air-cooled line enclosures are constructed in accordance with CSA requirements for outdoor weatherproof, "Type 3R" enclosures. This shall be equivalent to NEMA 3R standards.
- 2.2 The Utility line enclosures are constructed from 14 gauge wiped coat, mill galvanized steel and finished with 3-5 mils of white, fusion bond, polyester powder paint. The enclosures are vented to allow for natural air convection and all openings shall be screened against insects and debris. The enclosures are supplied with suitably sized wall / pole mounting brackets and also, suitably sized conduit knockouts (on the bottom rear) to allow for connection of AC and DC field cabling. The single, front opening door of the enclosure is hinged on the left side and has a heavy duty, lockable draw latch on the right side that will accept a maximum 3/8" (9.5mm) padlock. The draw latch is constructed of zinc dichromate plated steel or optionally, of Series 300 stainless steel.

3.0 CONTROL METHOD

- 3.1 The Utility air-cooled rectifiers are designed for manual, Constant Voltage control via variable transformer adjustment. The adjustment knob of the variable transformer is easily accessible from the front of the rectifier instrument panel.

4.0 MAIN TRANSFORMER / ADJUSTMENT

- 4.1 The Utility air-cooled rectifiers are equipped with a full isolation type transformer designed to interact with the variable transformer to allow for near stepless output adjustment.
- 4.2 The transformer is designed to operate properly at 115% of the specified rated output to allow for reserve capacity.
- 4.3 The main transformer is equipped with separate, isolated primary and secondary windings. The transformer windings are constructed from heavy polythermaleze (HPTZ) insulated magnetic wire with a minimum cross sectional area of 800 circular-mils per ampere of rated current. The transformer core is constructed from interleaved, "E" & "I" type, grain-oriented steel laminations for maximum permeability. For transformers utilizing 29 gauge laminations, a design calculation for a maximum flux density of 13,000 gauss is used. For transformers utilizing 26 gauge laminations, a design calculation for a maximum flux density of 11,500 gauss is used. Maximum core losses are limited to 0.7 watts per pound or less. The transformer efficiency shall be no less than 94% and voltage regulation from a "no load" to a "full rated load" condition shall not exceed 5%. The transformer core and coil are constructed from materials with a Class "H" (180°C) operation rating. The transformer lead wires are sized for a minimum cross sectional area of 500 circular-mils per ampere of rated current. The transformer lead wires are silver brazed to the coil magnet wire, taped, and covered with Class "H" silicon impregnated sleeving.
- 4.4 After fabrication, the transformer shall successfully pass a dielectric strength test, as per CSA Standard requirements, between the primary and secondary windings and between each winding and the lamination core.
- 4.5 The transformer dielectric and thermal properties are further enhanced by dipping in a thermo-setting varnish (Class "H") until the entire body of the transformer is saturated. The transformer is then oven baked for a suitable period until such time that the varnish coating has hardened to provide a suitable environmental seal.

5.0 INSTRUMENT PANEL

- 5.1 The instrument panel for Utility line rectifiers is constructed from a minimum of 0.1875" NEMA Grade "XX" laminated phenolic, rated for Class "B" (105°C) operation.

6.0 RECTIFYING DEVICES

- 6.1 The rectifier circuit typically consists of a single molded diode bridge module. For rectifiers with DC output current ratings above 16 amperes, individual diode devices are utilized. The diode module is sized for approximately 200% of the nominal current through the device at rated rectifier output. The module is sized for a minimum Peak Inverse Voltage (PIV) rating of 300% of the voltage impressed on it, or 600 volts, whichever is greater. Modules with a higher PIV rating are available on request.

INTEGRATED RECTIFIER TECHNOLOGIES, INC.
UTILITY AIR-COOLED LINE CATHODIC PROTECTION RECTIFIER SPECIFICATION

- 6.2 The molded diode bridge module is mounted to a suitably sized heatsink. The heatsink is fabricated from either gold or black anodized aluminum to enhance the thermal transfer of the heat generated by the diode to the ambient air. The heatsink is sized to ensure that the case temperature of the module does not exceed 100°C at rated ambient and rated rectifier DC output. The heatsink assembly is constructed to allow for proper diode cooling via natural air convection. Fan cooling is not permitted.
- 6.3 The rectifying devices are constructed into a modular assembly to allow for ease of any possible field maintenance.
- 6.4 For ambient temperatures above 45°C, all diodes are oversized as required and in accordance with manufacturers design recommendations.

7.0 MONITORING COMPONENTS

- 7.1 The Utility line rectifiers are constructed with a single analog meter connected to a toggle switch for monitoring of the rectifier DC output voltage and current. The meter is a minimum of 2.5" rectangular type with a scale length of 2.29". Meter scales are of a metallic or plastic type and are mechanically affixed to the meter. Adhesive paper type scales are not acceptable. The standard metering utilized is the Yokogawa Model 260 Series (or equivalent) with a 50mV full-scale-deflection (FSD) utilizing a taut-band type movement with "four-to-one swamping". This means that the internal meter resistance is comprised of 25% coil winding resistance and 75% fully temperature compensated dropping resistor resistance, which provides for superior temperature range performance. The taut-band type movement allows for greater meter sensitivity and improved shock resistance. The metering accuracy shall be 2% of FSD and shall comply with the requirements of ANSI C39.1. The metering scales are selected such that the rated output indicator (red-line or shading) is within a range of 70% – 95% of the FSD of the meter scale.
- 7.2 Optional digital metering is available for certain applications requiring improved accuracy and resolution. The digital meters utilized are Summit Model SI469 Series (or equivalent) with a meter accuracy of 0.1% \pm 2 digits with a sample rate of 3.4 per second. These meters shall provide a 3.5 digit display and 0.56" high intensity numerals.
- 7.3 The rectifier ammeter receives a millivolt input from a "block" style shunt resistor located on the front of the instrument panel. The standard shunt utilized is a Holloway Type "SW" shunt with an accuracy of 0.25%. The shunt is clearly marked with the current and millivolt rating.

8.0 PROTECTIVE DEVICES

- 8.1 The Utility line rectifiers are constructed with a fully magnetic AC input circuit breaker to provide "OFF-ON" control, short-circuit protection, and input overload protection. The circuit breaker is of the manually reset type and has a time delay rating sufficient to avoid false tripping due to transformer in-rush current or other minor transients. The circuit breaker is sized for the next industry standard current rating above the maximum AC input current rating of the rectifier.

INTEGRATED RECTIFIER TECHNOLOGIES, INC.
UTILITY AIR-COOLED LINE CATHODIC PROTECTION RECTIFIER SPECIFICATION

- 8.2 The Utility line rectifiers are constructed with slow-blow type fusing in the AC secondary of the transformer. This fusing provides protection for the rectifier components against output short circuit or overload conditions. The fusing is sized to allow for proper rectifier operation up to 110% of rated output. A spare shall be supplied for each fuse utilized in the rectifier.
- 8.3 The Utility line rectifiers are protected against lightning and other surges by Metal Oxide Varistor (MOV) devices. The rectifier AC input is protected by a disk style MOV with a minimum extreme surge duty rating of 8 KA, based on a 8X20us wave, and an AC voltage rating that corresponds to the nominal AC input rating of the rectifier shall be used. The rectifier DC output is protected by a disk style MOV with a minimum extreme surge duty rating of 8 KA, based on a 8X20us wave, and a DC voltage rating as close as practical to the maximum peak voltage output rating of the rectifier. The DC surge arrester is sized such that it conducts the surge current and clamps the transient voltage at a level below the PIV rating of the diodes. Optional high energy surge arrestors are available for rectifiers that are to be installed in an area that may be subject to frequent transients or surges. The bridge diodes are protected from surges by a disk style MOV with a minimum extreme surge duty rating of 8 KA, based on a 8X20us wave, across the AC input to the bridge

9.0 ELECTRICAL CONNECTIONS

- 9.1 The AC input terminals for the Utility line rectifier are provided via a terminal block located at the lower rear of the inside of the rectifier enclosure. The AC input terminals are clearly labeled to indicate the location for the input wire connection and the rating of the AC input for the rectifier. A suitably sized electrical barrier is installed over the AC input terminals, as required, to prevent accidental contact with AC line voltages and is fitted with a warning label.
- 9.2 The DC output terminals for the Utility line rectifier are compression type lug terminals suitably sized for the rated DC output current of the rectifier. The DC terminals are located on the lower front of the instrument panel and typically labeled as "ANODE (+)" and "STRUCTURE (-)".
- 9.3 The rectifier is equipped with an extra terminal on the AC input terminal block to allow for connection of an electrical grounding wire.
- 9.4 All electrical wiring within the rectifier is CSA Type TEW wire with a temperature rating of 105°C or Type Exane cable with a temperature rating of 110°C. The wire is sized as per the manufacturers recommendations for the maximum current through the wire.
- 9.5 All electrical hardware used within the Utility line rectifiers is copper or brass with an electroless nickel-plating for superior atmospheric corrosion protection. All electrical connections utilize the "double-nut" method of fastening resulting in all electrical connection points being compressed between two nut / lockwasher assemblies. No electrical connections will rely on the compression properties of the panel material to maintain a secure connection. All electrical studs and connection bars are suitably sized for the maximum rated current through them.

10.0 DOCUMENTATION & LABELING

- 10.1 The rectifier shall be provided with a permanently imprinted nameplate with the following information:
- a) Manufacturer Name
 - b) Model Designation
 - c) Serial Number
 - d) AC Input Voltage
 - e) AC Input Current
 - f) AC Input Frequency / Phase
 - g) Rated DC Output Voltage
 - h) Rated DC Output Current
 - i) Maximum Operating Ambient (°C)
 - j) Enclosure Type
- 10.2 The components on the front of the instrument panel are identified via vinyl adhesive labels with black lettering on a white background, silk-screening or by 1/16" lamicoïd (plastic laminate), adhesive type labels with white lettering on a black background. For rectifiers that are to be installed in a high humidity or high temperature environment, the lamicoïd adhesive labels are mechanically affixed via stainless steel screws or drive screws.
- 10.3 Each rectifier is supplied with a comprehensive data package, enclosed in a waterproof envelope and placed inside of the enclosure door. The data package includes a manual with details on installation, general operation, maintenance, and troubleshooting tips. A detailed electrical schematic and a parts / data page are also provided. Formalized rectifier test results (detailed below) may be optionally requested for inclusion in the data package.

11.0 TESTING AND QUALITY CONTROL

- 11.1 Each rectifier main transformer is subject to and has successfully passed the following electrical performance tests prior to installation into a rectifier unit.
- a) Excitation current and no-load secondary voltage.
 - b) Voltage, current, and conversion efficiency at rated load.
 - c) Voltage, current, and conversion efficiency at 115% of rated load.
- 11.2 Each rectifier is thoroughly mechanically inspected; both during and after the manufacturing process, to ensure that the specification parameters indicated previously have been adhered to. Any discrepancies are documented, reviewed and corrected prior to electrical testing. Overall workmanship quality is also reviewed.
- 11.3 Each rectifier is subject to dielectric strength testing as per CSA Standard requirements and successfully passes this testing prior to further electrical testing.

INTEGRATED RECTIFIER TECHNOLOGIES, INC.
UTILITY AIR-COOLED LINE CATHODIC PROTECTION RECTIFIER SPECIFICATION

- 11.4 Each rectifier is subject to and successfully passes the following electrical performance tests at rated DC output prior to release for final packaging.
- a) AC input voltage and current.
 - b) Apparent power, effective power, & power factor.
 - c) DC output voltage, current, wattage, and ripple voltage.
 - d) Overall conversion efficiency.
- 11.5 Each rectifier meter is checked for calibration accuracy to ensure the specifications indicated previously have been met.
- 11.6 After installation into the required enclosure, the rectifier is subject to a final overall inspection including:
- a) Documentation and labeling.
 - b) Overall construction.
 - c) Protective barriers.
 - d) Adherence to the general specification and customer specific requirements.