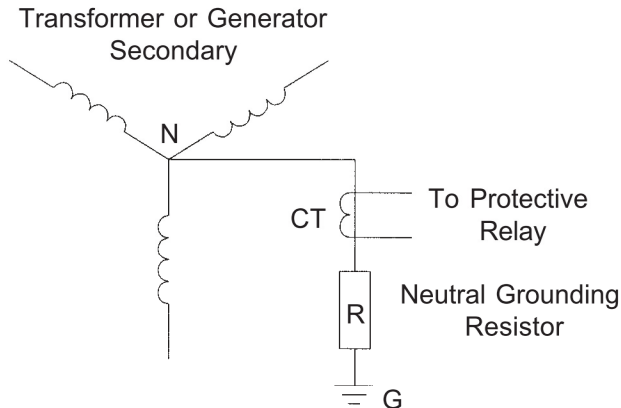


Type NR Neutral Grounding Resistors

APPLICATION

Powerohm Type NR Neutral Grounding Resistors are used in industrial power systems for resistance grounding of wye-connected generators and transformers. A neutral grounding resistor limits the fault current to a value which is sufficient enough to operate protective relays, yet prevent unwanted fault damage.

Neutral Grounding Resistor Schematic



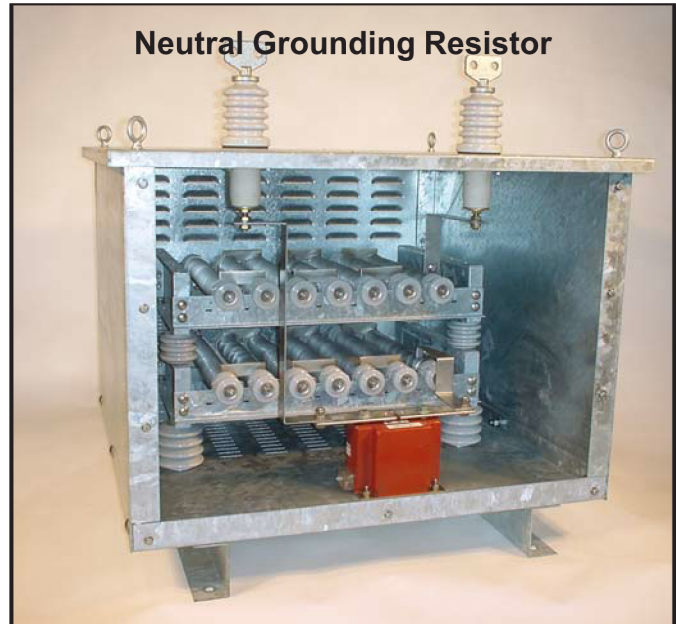
DESIGN REQUIREMENTS

Neutral grounding resistors are rated in line-to-neutral voltage (system voltage divided by 1.732), initial fault current and maximum time on. Powerohm neutral grounding resistors are designed to dissipate the required amount of energy and not exceed the temperature limitations of IEEE Standard 32-1972. As defined in this publication, the time and temperature ratings for neutral grounding resistors are as follows:

Short time: Short time ratings are 10 and 60 seconds. Since short time rated resistors can only withstand rated current for short periods of time, they are usually used with fault clearing relays. The short time temperature rise for the resistive element is 760°C.

Extended time: A time on rating greater than ten minutes which permits temperature rise of resistive elements to become constant, but limited to an average not more than 90 days per year. The extended temperature rise for the resistive element is 610°C.

Continuous: Capable of withstanding rated current for an indefinite period of time. The continuous temperature rise for the resistive element is 385°C.



BASIC CONSTRUCTION

Resistor Assembly: The resistor coils consist of a stainless steel edgewound element wound around a ceramic core supported on a through-rod. Glazed insulators are attached to each end of the coils and fastened to a heavy gage, corrosion resistant frame. The unit is designed to permit the expansion of supporting rods when submitted to high operating temperatures. Resistor elements are joined by stainless steel connectors, which are welded in place, to form a positive electrical path.

Safety Enclosure: Our resistor assemblies are available with grounded safety enclosures to protect personnel and wildlife from harm. Screened and louvered enclosures are available in a variety of finishes including painted, powder coated, mill galvanized, hot-dipped galvanized, aluminum and stainless steel.

Options: A number of additional options are available including entrance bushings, current transformers, elevating stands and disconnect switches.

ELECTRICAL TESTS

All units are factory tested in accordance with IEEE Standard 32-1972, specifically Sections 10.1.4 and 10.3.2. The procedure includes a resistance measurement test to verify that the tolerance is within + 10%, and an applied potential test. A copy of the test report is included with each shipped unit.

Ratings & Dimensions of Standard Size Units

RATINGS: The following table contains information on the most common size units, other variations are available.

DIMENSIONS: The dimensions listed in the table are in inches. Information subject to change without notice.

10 SECOND TIME RATINGS

CATALOG NUMBER	INITIAL AMPS	RESIS-TANCE	A	B	C	APPROX. WEIGHT
1390 VOLTS LINE-TO-NEUTRAL (2400 VOLT SYSTEM)						
NR1390-100-10	100	13.90	38	38	30	280
NR1390-200-10	200	6.95	38	38	30	290
NR1390-300-10	300	4.63	38	38	30	300
NR1390-400-10	400	3.48	38	38	30	310
NR1390-500-10	500	2.78	38	38	30	320
NR1390-600-10	600	2.32	38	38	30	340
NR1390-800-10	800	1.74	38	38	30	350
NR1390-1000-10	1000	1.39	38	38	30	360

2400 VOLTS LINE-TO-NEUTRAL (4160 VOLT SYSTEM)

NR2400-100-10	100	24.00	38	38	30	380
NR2400-200-10	200	12.00	38	38	30	390
NR2400-300-10	300	8.00	38	38	30	400
NR2400-400-10	400	6.00	38	38	30	410
NR2400-500-10	500	4.80	38	38	30	420
NR2400-600-10	600	4.00	38	38	30	430
NR2400-800-10	800	3.00	38	38	36	490
NR2400-1000-10	1000	2.40	38	38	36	500

4160 VOLTS LINE-TO-NEUTRAL (7200 VOLT SYSTEM)

NR4160-100-10	100	41.60	38	38	36	550
NR4160-200-10	200	20.80	38	38	36	560
NR4160-300-10	300	13.87	38	38	36	570
NR4160-400-10	400	10.40	38	38	36	580
NR4160-500-10	500	8.32	38	38	36	590
NR4160-600-10	600	6.93	38	38	36	600
NR4160-800-10	800	5.20	44	54	54	680
NR4160-1000-10	1000	4.16	44	54	54	700

8000 VOLTS LINE-TO-NEUTRAL (13800 VOLT SYSTEM)

NR8000-100-10	100	80.00	44	54	54	820
NR8000-200-10	200	40.00	44	54	54	830
NR8000-300-10	300	26.70	44	54	54	840
NR8000-400-10	400	20.00	44	54	54	850
NR8000-500-10	500	16.00	44	54	54	870
NR8000-600-10	600	13.30	44	54	54	880
NR8000-800-10	800	10.00	44	54	84	950
NR8000-1000-10	1000	8.00	44	54	84	990

EXTENDED TIME RATINGS

1390 VOLTS LINE-TO-NEUTRAL (2400 VOLT SYSTEM)

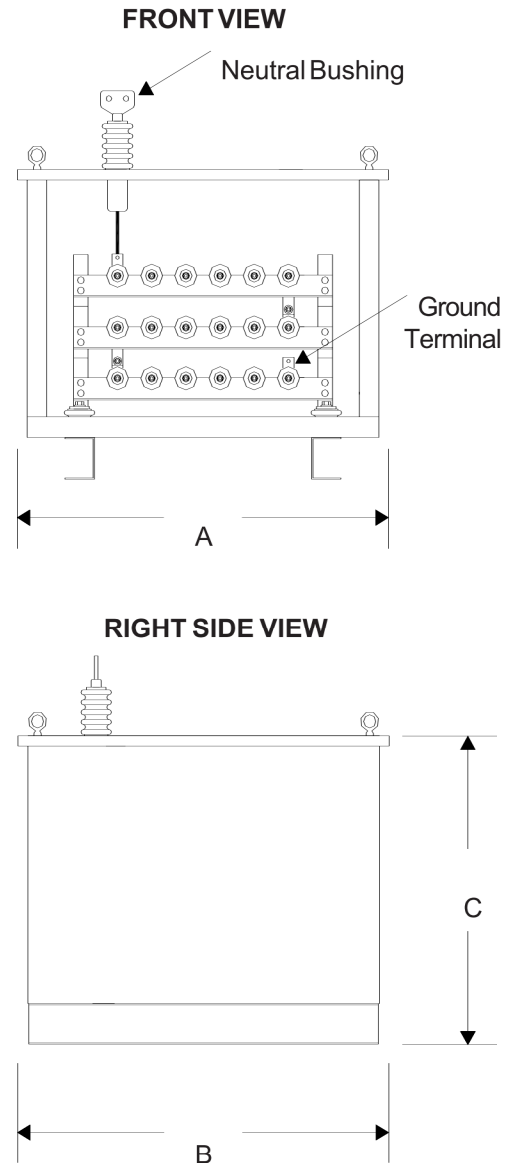
NR1390-15-E	15	92.7	38	38	30	320
NR1390-25-E	25	55.6	38	38	30	370
NR1390-50-E	50	27.8	38	38	36	420

2400 VOLTS LINE-TO-NEUTRAL (4160 VOLT SYSTEM)

NR2400-15-E	15	160.0	38	38	36	450
NR2400-25-E	25	96.0	38	38	36	550
NR2400-50-E	50	48.0	44	54	54	850

4160 VOLTS LINE-TO-NEUTRAL (7200 VOLT SYSTEM)

NR4160-15-E	15	227.3	44	54	54	900
NR4160-25-E	25	166.4	44	54	54	950
NR4160-50-E	50	83.2	84	54	54	1400



The above drawing details a typical neutral grounding resistor with enclosure. Units are available with screened or louvered covers on front and back. All units normally have solid tops and sides and a perforated bottom.

TO ORDER A NEUTRAL GROUNDING RESISTOR NOT LISTED IN THE TABLE, SPECIFY THE FOLLOWING:

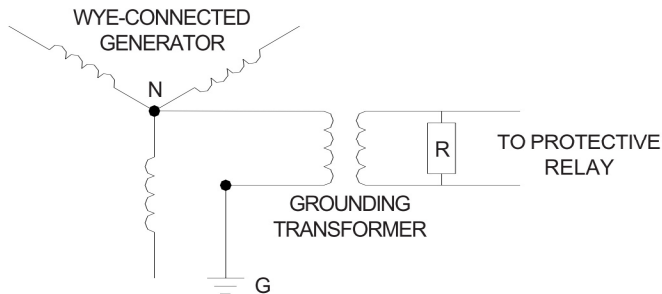
1. Line-to-neutral voltage.
2. Initial fault current.
3. Maximum time on.
4. Special requirements or options.

Generator Neutral Grounding Resistors

APPLICATION

Powerohm offers high resistance grounding equipment for wye connected generators. Our equipment is normally designed to limit the line-to-ground fault current to below 15 amps for generators rated up to 14,400 volts. These units will provide a high resistance neutral during a fault condition, while allowing the system to operate as an ungrounded system during normal operating conditions. The configuration basically consists of a dry-type single-phase transformer with a resistor connected across the secondary. The primary of the transformer is then connected between the wye point of the generator and ground.

Powerohm generator grounding equipment is normally supplied with the transformer and resistor installed in a common enclosure. Continuous rated units are usually compartmentalized to separate the resistor assembly from the transformer which is subject to overheating. Units do not normally include any relaying or control circuitry, but do offer the transformer secondary wired to a terminal block installed in an external junction box.



BASIC CONSTRUCTION

Transformer: For continuous time ratings, the transformer must be capable of withstanding rated current for an indefinite period of time; therefore, the KVA rating of the grounding transformer is equal to the rated line-to-neutral voltage times the desired neutral current. For a short-time rating, the KVA rating of a grounding transformer will be smaller because the unit is designed to carry its rated current for a limited time.

Resistor Assembly: The resistance value is calculated by dividing the secondary voltage by the rated current necessary to obtain the desired fault current on the primary. Resistor elements are selected to best meet the current and voltage requirements of the system. A typical assembly includes all stainless steel elements, bus bars and terminals.



Safety Enclosure: Our grounding assemblies are available in grounded NEMA 1 or NEMA 3R safety enclosures, complete with nearly any finish including mill galvanized, power coated, hot dipped galvanized after fabrication, aluminum or stainless steel.

Options: A number of additional options are available, including entrance bushings, current transformers, elevating stands, and disconnect switches.

ELECTRICAL TESTS

All units are factory tested in accordance with IEEE Standard 32-1972, specifically Sections 10.1.4 and 10.3.2. The procedure includes a resistance measurement test to verify that the tolerance is within + 10%, and an applied potential test. A copy of the test report is included with each shipped unit.

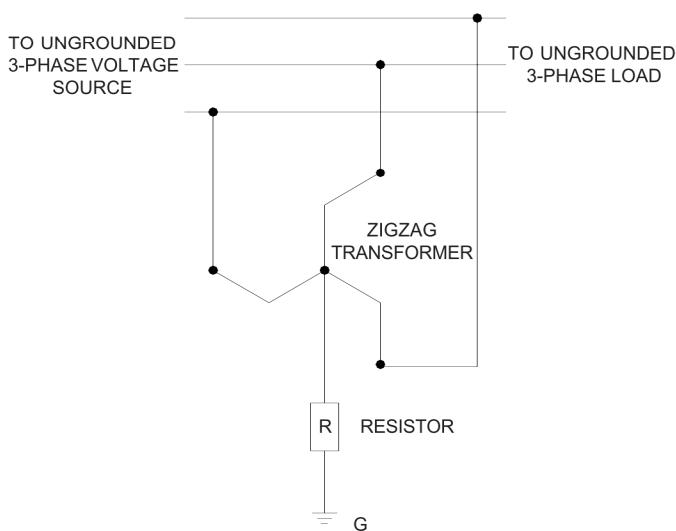
Resistance Grounding with a Zigzag Transformer

APPLICATION

The best way to resistance ground a power system is to obtain the system neutral through a generator or transformer with a wye-connected winding. However, a system neutral may not be available, particularly in many older low voltage systems and a significant number of existing medium voltage systems. To avoid the high cost of replacing a source transformer, an existing delta-connected system can be grounded using a zigzag transformer to form an artificial neutral, then connecting a resistor between the newly created wye-point and ground.

A zigzag transformer has no secondary winding, and is designed to provide a low-impedance path for the zero-sequence currents to flow. During a line-to-ground fault condition, the zero sequence currents can flow into the ground at the point of the fault, and back through the neutral of the grounding transformer. The impedance of the zigzag transformer to balanced three-phase voltages is relatively high, therefore, when there is no fault on the system, only a small magnetizing current flows in the windings. A zigzag grounding transformer provides a stable neutral point which makes possible its use for grounding an otherwise isolated neutral system.

A zigzag transformer with a resistance ground is normally designed for a short time rating of 10 to 60 seconds. Consequently, the grounding transformer is much smaller in size than an ordinary continuously rated transformer with the same rating. For short time ratings, the short time temperature rise for the resistive element is 760°C.



Zigzag Grounding Transformer with Resistor



BASIC CONSTRUCTION

Transformer: For a short time rating, the grounding transformer is designed to carry its rated current for a limited time, consequently the unit is ordinarily much smaller, physically, than an ordinary three-phase transformer for the same rated kVA.

Resistor Assembly: The resistance value is calculated by dividing the line-to-neutral voltage by the rated neutral current. Resistor elements are selected to best meet the short time current rating and voltage requirements of the system. A typical assembly includes all stainless steel elements, bus bars and terminals.

Safety Enclosure: Our grounding assemblies are available in grounded NEMA 1 or NEMA 3R safety enclosures, complete with nearly any finish, including mill galvanized, power coated, hot dipped galvanized after fabrication, aluminum, or stainless steel.

Options: A number of additional options are available including entrance bushings, current transformers, elevating stands and disconnect switches.

ELECTRICAL TESTS

All units are factory tested in accordance with IEEE Standard 32-1972, specifically Sections 10.1.4 and 10.3.2. The procedure includes a resistance measurement test to verify that the tolerance is within + 10%, and an applied potential test. A copy of the test report is included with each shipped unit.