

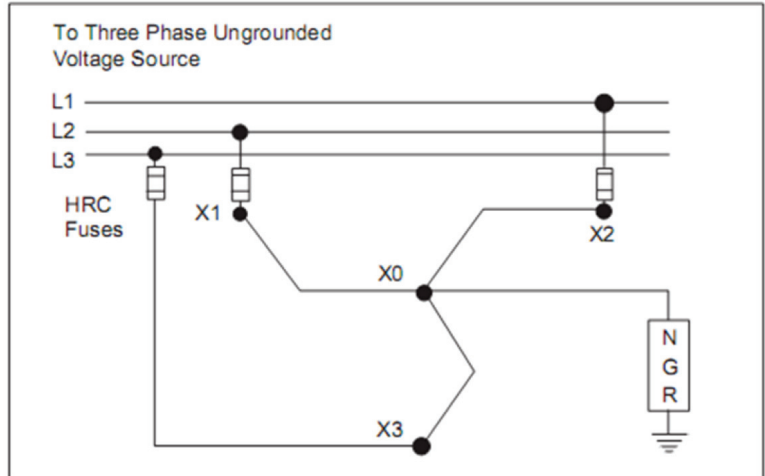
# Zigzag Grounding Transformers

In older 600V and lower systems, and in many existing volt and higher systems, the system neutral may not be available. To be able to ground these systems, grounding transformers can be used to create a neutral, which in turn can be connected to ground either directly, or more commonly, through a Neutral Grounding Resistor (NGR). These combinations are known as artificial neutrals.

The Zigzag grounding transformer is a commonly used option. It is a three-phase, dry-type, air-cooled auto-transformer with no secondary winding. Each phase has two identical windings, which are wound in opposite directions to give the high impedance to normal phase currents. The windings are connected in a Wye configuration. The neutral point is then connected either directly or through a neutral grounding resistor (NGR) to ground.

When a ground fault occurs downstream of the Zigzag transformer, ground fault current flows through the fault, back through ground and the NGR to the Zigzag where the current is divided equally in each leg of the Zigzag. Since these three currents are all equal and in time phase with each other (zero sequence), and because of the special Zigzag winding connections, they see a very low impedance. This allows the ground fault current to flow back into the system. It can be seen that the ground fault current is only limited by the resistance of the ground fault, the NGR, and the small reactance of the Zigzag.

The Zigzag should be connected to the system on the line side of the main breaker, as close as possible to the power transformer secondary terminals. When more than one power transformer is involved, one Zigzag is required for each. Care should be taken not to have more than one Zigzag connected to the same section of the system at the same time. Short circuit protection should be provided on each of the three line connections of the Zigzag.



## Features

- Stainless steel grid or edgewound resistor banks (application dependent)
- Continuously rated Dry Type Transformer
- Mill Galvanized Type 3R enclosure with options for painted and stainless steel
- Extra heavy duty mounting channels for transformer
- Junction box / Terminal block for easy addition of protective relaying equipment Specification for Zigzag Grounding Transformers



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# Zigzag Grounding Transformers

## Scope

This specification covers design, manufacture and testing of low- or medium-voltage Zigzag grounding transformers for use with Neutral Grounding Resistors (NGR) for installation indoors or outdoors onto a concrete pad or power transformer.

## Applicable Standards

The transformer shall be designed, manufactured and tested as per the latest revisions of IEEE-32.

## Transformer

The transformer shall be a three-phase, dry-type, air-cooled auto-transformer with each phase having two windings connected in a Zigzag configuration. It shall have class "B" insulation up to 2400 volts line to neutral or class "H" insulation above 2400 volts.

The transformer shall be continuously rated for the charging current of the system on which it is being applied; it shall also have the same current and "on" time rating as that of the NGR with which it is being applied. Insulation class maximum temperature rise shall not be exceeded at these currents and "on" times. It shall be rated at the system voltage.

## Enclosures

Low Voltage (600 volts or less)

The Zigzag transformer may be combined with the NGR and mounted in one enclosure where the continuous rating does not exceed 5 amps. The enclosure shall be of heavy gauge galvanized steel with baked enamel finish. All mounting hardware shall be stainless-steel. Indoor enclosure shall have a screened cover with maximum openings of 1/2". Outdoor enclosure shall have a solid heavy gauge top cover, slightly overhung.

### **Medium Voltage (above 600 volts to 5,000 volts)**

The frame of the enclosure shall be made from structural steel angles made from heavy gauge steel, welded together, or bolted together with stainless-steel hardware. The top of the enclosure shall be solid, slightly overhung and sloped. It shall be embossed with stiffening ribs. The enclosure shall have forged eyebolts in each corner for lifting purposes.

The bottom of the enclosure shall be screened with expanded or perforated metal with openings of 1/2" or less. This screening shall be permanently installed. It shall be elevated 4 to 6 inches above the base of the unit.

Bolt-on side covers on all four sides shall be used. Screened covers may be furnished for certain applications. Stainless-steel hardware shall be used. Louvered or screened openings shall not exceed 1/2".

A durable nameplate, permanently attached to one side cover shall show the manufacturer and the complete rating.

Painted enclosures shall be suitably sanded, cleaned, primed and painted. Stainless-steel and galvanized enclosures shall be protected from scratching during manufacture, assembly and shipment.