Mining Duty Transformers

- ***Standard Mine Duty Transformers***
- ***VPI and Epoxy Shielded***
- ***Mitered Core or Butt Lap Construction***
- ***Impulse Testing***

Line Power Manufacturing is the leading specialist in design and manufacturing of mine duty transformers. Our people, knowledge and experience can provide a reliable, cost-effective transformer that will provide years of trouble free service.

Line Power vacuum pressure impregnated (VPI) transformers combine a performance proven dry-type transformer design with the environmental protection of a polyester coil encapsulation process. This combination ensures reliable transformer operation in hostile environments containing moisture, dust, dirt, chemicals and other contaminants.

The VPI process fully penetrates and seals the coils into a high strength composite unit for complete environmental protection. Since the coil protection is created using vacuum pressure impregnation rather than molding, maximum design flexibility is achieved to allow conformance to the most stringent application requirements.

The vacuum impregnation of the varnish eliminates winding voids to reduce corona generation due to insulation voids.

Benefits

Line Power vs. Cast Coil

- Lower initial cost
- Flexibility of design
- Elimination of cracking concerns
- Higher thermal overload available
  Cast = 17% @ 80 / 115° C rise
  VPI = 30% @ 80 / 150° C rise
- Less weight for easier handling and installation
- Smaller dimensions to save valuable floor space
- Outstanding environmental protection

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The Material

Line Power uses a polyester solvent varnish class H 220° C. The transformer is first baked to remove any traces of water, dipped in the varnish, baked, dipped and baked again.

Coil Construction

Coil construction is used to assure proper ventilation and maximum strength. Coils are constructed using a 220° C Nomex® insulation system that for many years has had proven performance in dielectric strength, temperature stability and long life. The high voltage coils are wound directly over the low voltage coils to form a complete assembly. The coil assembly is completely insulated and mechanically braced to pass all ANSI standard tests.

Epoxy Shielded Transformer

Take one high quality Line Power VPI transformer, add 1-2 mils or more of modified epoxy varnish and the result is a premium transformer ready to handle the really tough environments. The Line Power Epoxy Shielded transformer is ideal for environments polluted with refrigerants, askarel, mineral oil, acids, alkalies, salt water and high humidity. Even greater dielectric strength, mechanical integrity, and thermal endurance than VPI is now achievable.

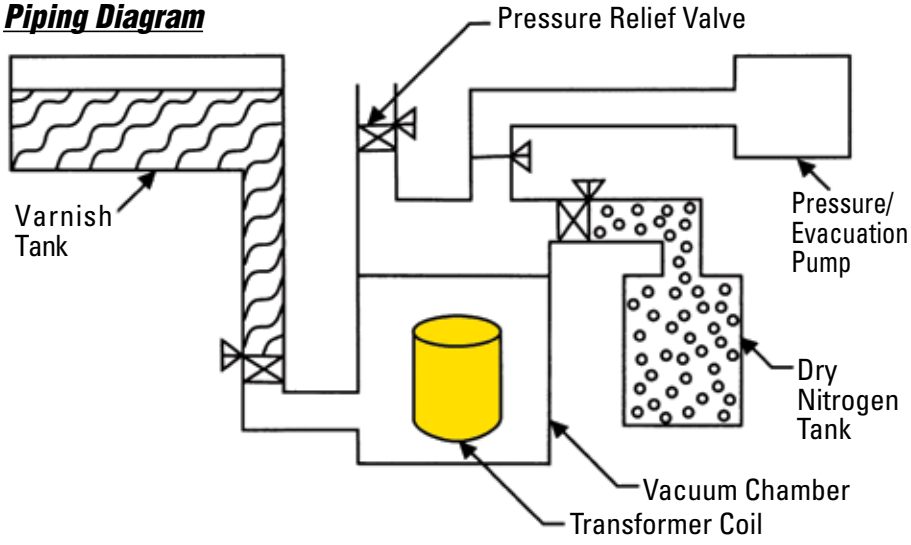
Line Power uses high viscosity (40 - 60 sec. #4 Ford cup) insulating epoxy. This specially formulated epoxy is designed for greater film dry thickness than most epoxies in use today. The epoxy used has a high percentage of solids, 50% by weight, yet has a relatively low cure weight. This unique combination allows high mechanical bond strength (7 lbs. helical coil) and a low overall unit weight.

Where your environmental concerns are the greatest, specify the best epoxy transformer on the market today - Line Power's Epoxy Shielded Transformer.

Vacuum Pressure Impregnated Process

1. Transformer coils preheated for improved resin penetration into coils
2. Coils placed into special pressure vessel
3. Apply dry vacuum to remove trapped moisture from coils
4. Polyester resin is pumped into pressure vessel to completely submerge coils
5. Vacuum broken followed by application of high pressure forcing the resin to penetrate into the transformer coils thereby removing air voids
6. Resin evacuated from pressure vessel and returned to storage tank
7. Coils allowed to drain
8. Coils baked in oven to cure resin forming a barrier to airborne contaminants and enhancing the dielectric strength of the insulation system

Piping Diagram



Specification Guide

The transformer(s) shall be dry-type with both primary and secondary coils encapsulated with polyester resin using a vacuum pressure impregnation (VPI) process (optional VPI with epoxy shield). The transformer shall be fire resistant, and cooled by the natural circulation of air through the windings.

The transformer will be designed, manufactured and tested in accordance with applicable ANSI, NEMA and IEEE standards.

Conductor Material

The conductor shall be electrical grade copper.

Insulation Material

All insulation materials for the primary and secondary coils shall be rated for continuous 220°C operation.

Coil Assembly

The high and low voltage coils shall be concentrically wound as an integral assembly. The insulated coil assembly shall be capable of passing all standard ANSI and NEMA tests, including impulse test, before the coils are encapsulated.

High Voltage Taps

Taps shall be terminated at the coils and equipped with provisions for changing taps under de-energized conditions.

Encapsulation System

The coil assembly shall be encapsulated utilizing a vacuum pressure impregnation process to completely seal and bind the windings. The encapsulating material shall be solventless polyester (optional VPI with epoxy shield).

Core Structure

The core structure shall be of nonaging, cold rolled, grain oriented, high permeability silicon steel. All core laminations shall be free of burrs and stacked without gaps. The core framing structure shall be of rigid construction to provide full clamping pressure upon the core and provide support points for the coils.

Enclosure

The enclosure and/or skid shall be designed for maximum safety protection against electrical shock hazard and to assure proper cooling for long transformer life.

Sound Level

The transformer shall be designed to meet or exceed the standards for dry-type transformers per NEMA ST20.

Test

Each transformer shall be tested in accordance with ANSI C57.12.91.

Definition

A mitered core is similar to a butt lap core arrangement made from cold rolled, grain-oriented silicon steel laminations with joints configured at 45° angles for purposes of reducing core losses and sound levels. (See diagram below.)

Purpose

To better control flow of magnetic flux and reduce eddy currents.

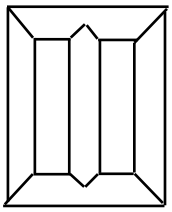
Benefits

- Eliminate flux in cross grain directions which reduces core loss and exciting current values.
- Permits larger KVA rating for a given constrained size.

Types

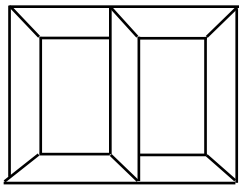
- Hybrid Miter - Achieves better losses than butt-lap construction, however v-notching core machine not required. Some 90° angle configurations still exist. (See diagram below).
- Full Miter - All angles at 45° for maximum reduction of flux. "V-notcher" required to achieve center cut. (See diagram below).

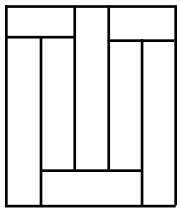
Line Power, the only manufacturer of mining electrical equipment that can offer this exclusive feature.



Full Miter Cut Construction

Hybrid Miter Cut Construction





Butt & Lap Construction

Mining Transformer BIL's

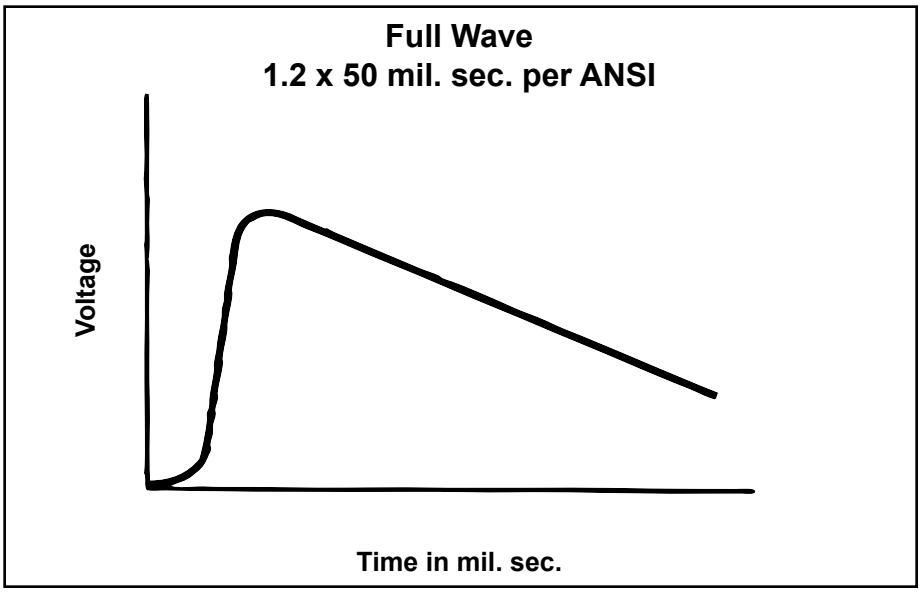
Line Power's experience with the electrical system requirements associated with power center transformers, indicates a strong emphasis by the coal companies toward lower height, lower impedance, and higher KVA's. We are confident that suitable surge protection (arrestor plus surge capacitor) is available to fully protect these transformers which are designed in accordance with ANSI C57.12.01 and C57.12.91.

Where the coal company is particularly concerned with having the highest possible BIL withstand, we encourage the specifications to include a production line impulse test from which the manufacturer is required to furnish the oscillograms. If the transformer is designed properly, the production line impulse test is not a destructive test, nor a design limit test, but rather another quality assurance activity performed at the factory to enhance the reliability of the transformer in the field.

Impulse Tests

Impulse test are dielectric tests that consist of the application of a high-frequency voltage wave of a specified shape applied between windings and between winding and ground.

The primary purpose of production-line impulse test is to weed out transformers with "weak links" in their impulse dielectric make-up, a deficiency not discovered by any other standard test.



Manufacturer reserves the right to make changes or modifications without notification.

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