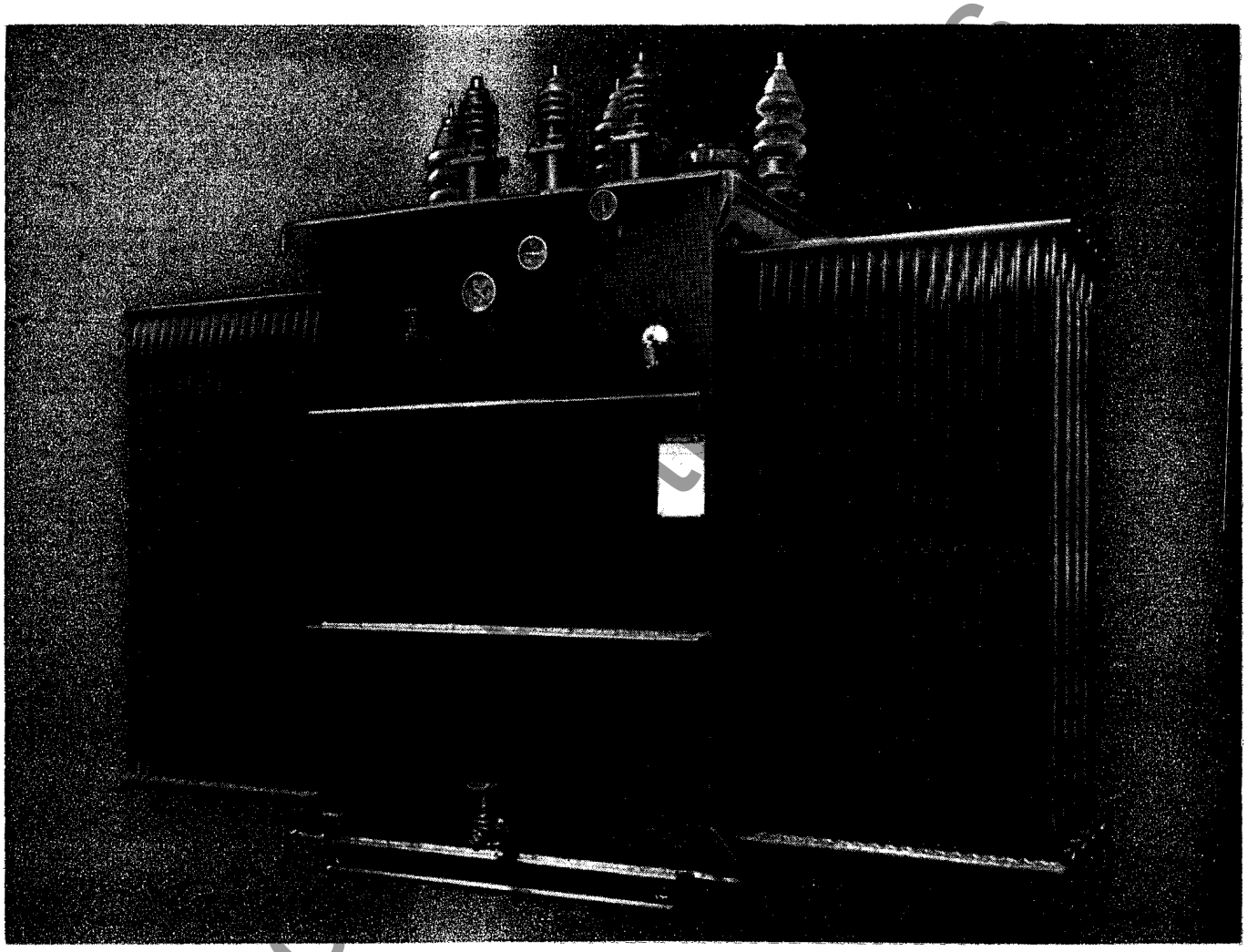
Westinghouse

Type RSL Rectangular Coil Core Form Liquid Immersed Substation Transformers

OA/Future FA, or OA/FA
Single and Three Phase, 60 Hertz



Application

Type RSL transformers are designed in accordance with USA standard C57.12.10 and NEMA publication No. TR-11-1967 to meet the need for an economical and reliable line of substation transformers to serve a variety of lighting and power loads.

Advantages

Easier to Specify

Standardization through USASI standards results in proven designs with complete accessory equipment and necessary features to free the purchaser of necessity of having to prepare detailed, lengthy specifications.

Modern Design and Construction

Application of advanced engineering techniques and optimized design computer program results in better proportioned more compact designs. A continuing plant modernization program applying the latest in automated equipment and modern manufacturing processes assures uniform quality and reliability.

Highest Short Circuit Strength

Research developed and thoroughly tested designs provide the short circuit strength necessary to repeatedly withstand the increasingly large short circuit currents available in modern systems.

Highest Thermal Capacity

The improved Insuldur insulation system and WEMCO C insulating oil are the result of an extensive program of research and development in the chemistry of insulating materials carried on by Westinghouse.

Easier Handling and Reduced Maintenance

Compact designs reduce cost of rigging and hauling and require smaller installation space. Clean design and simplified accessories reduce maintenance costs.

Ratings

Kva-Three Phase:
34.5 Kv and below – 750 through 5000 Kva.

Kva – Single Phase:
46 Kv and below – 833 through 3333 Kva.

Frequency: 60 Hertz.

Voltages
Three Phase: 34.5 Kv (200 Kv BIL) and below.
Single Phase: 46 Kv (250 Kv BIL) and below.

May, 1969
Supersedes DB 48-150, Pages 1-20, dated September, 1967
E, D, C/2091/DB

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Design Features (Standard)

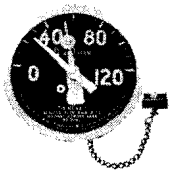
Lifting Lugs and Eyes

Total of four lifting lugs on corners of tank for lifting entire unit.

Upper Valve for Filter Press Connection

Dial Type Thermometer

Mounted in well on tank wall. Indicates temperature of top liquid. Has magnetically resettable red peak temperature pointer. Supplied with alarm contacts, if specified.



Magnetic Liquid Level Gauge

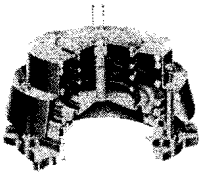
Float position transmitted magnetically through tank wall to gauge pointer preserving tank seal. Supplied with alarm contacts, if specified.

Pressure Vacuum Gauge

Indicates pressure inside tank gas space.

Sealedaire Oil Preservation System
(Relief valve and gas sampler located behind pressure vacuum gauge)
Westinghouse Sealedaire system of oil preservation excludes oxygen and moisture, thus preventing deterioration of the liquid and insulation. The transformer tank (when specified by standards) is filled with oil under vacuum. A relief valve assembly keeps the transformer sealed throughout an oil temperature range of 100 degrees C. Pressure and vacuum-limiting valves are set to open at plus or minus 6.5 pounds per square inch. Gas samples for purging or for analysis may be taken.

Mechanical Relief Device

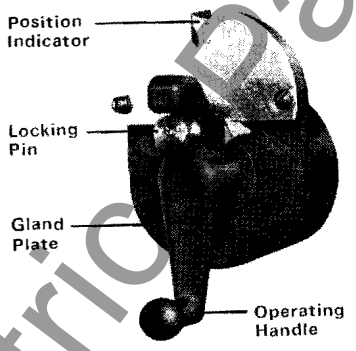


Relieves abnormally high internal pressure. Factory calibrated to operate at 10 psi. Easily visible operation pointer. After operation, positively reseals and continues to give protection against the elements.

Cover Mounted Bushings
(Refer to Page 7)

No Load Tap Changer Control Handle:

(See page 6 for tap changer detail.)



Operating handle is brought out through side of tank at a height convenient to the transformer design and includes provision for padlocking.

Instruction Nameplate

Stainless steel nameplate mounted on tank wall at convenient height.

Cooling

Cooling systems for power transformers are designed to fit individual requirements. Self-cooled systems usually consist of flattened external tubes welded into headers that are in turn welded into the tank wall.

Self-cooled forced air cooled systems employ fans to circulate masses of air. Fans are optional with either tubes or radiator systems and operate from customer's 230 volt, single phase supply.

Jack Pads

Welded pads at bottom corners provide bearing surfaces for jacks.

Base

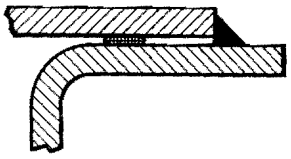
The structural members, which strengthen the transformer tank, are designed for ease in skidding of rolling. Holes are provided in the base for pulling, tie-down and ventilation.

Lower Drain Valve, Filter Press Connection and Sampling Valve

Assures bottom sampling and complete oil drainage from tank sump.

Tank

All tanks are made of high-quality sheet steel with a minimum of seams. Tanks are rectangular with rounded corners. For added strength to withstand test and operating pressures, steel reinforcing members are welded to the outside walls. Such bracing also protects the tank against distortion which may occur during shipment or installation. All seams and joints are electrically welded.



The tank walls are flanged outward at the top to form a platform for the cover plate which is welded on. A handhole is provided in the cover for internal inspection and maintenance.

Tank Grounding Provision

Two copper faced steel pads with standard holes for bolting on connection located on back and front tank walls near base.

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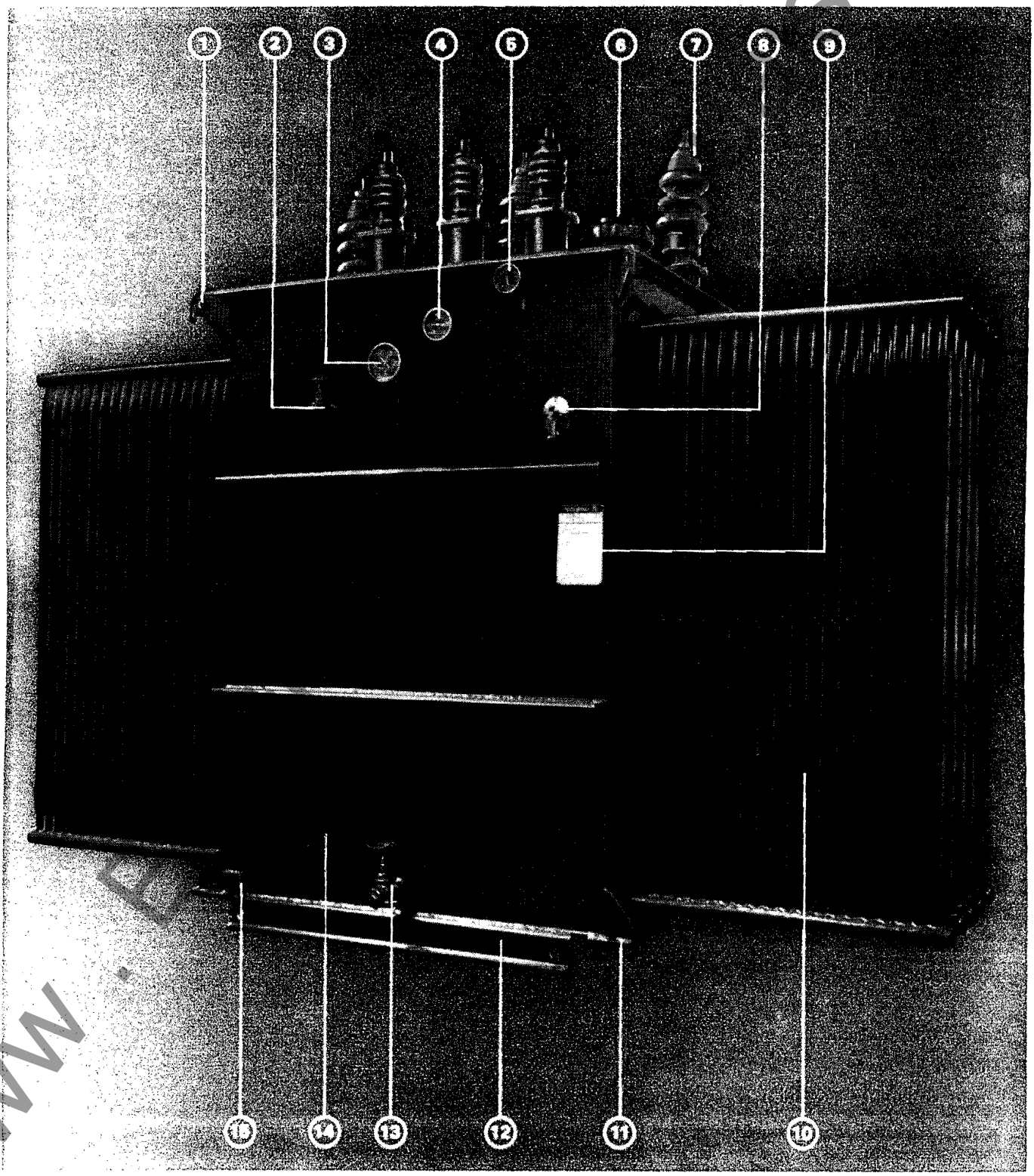

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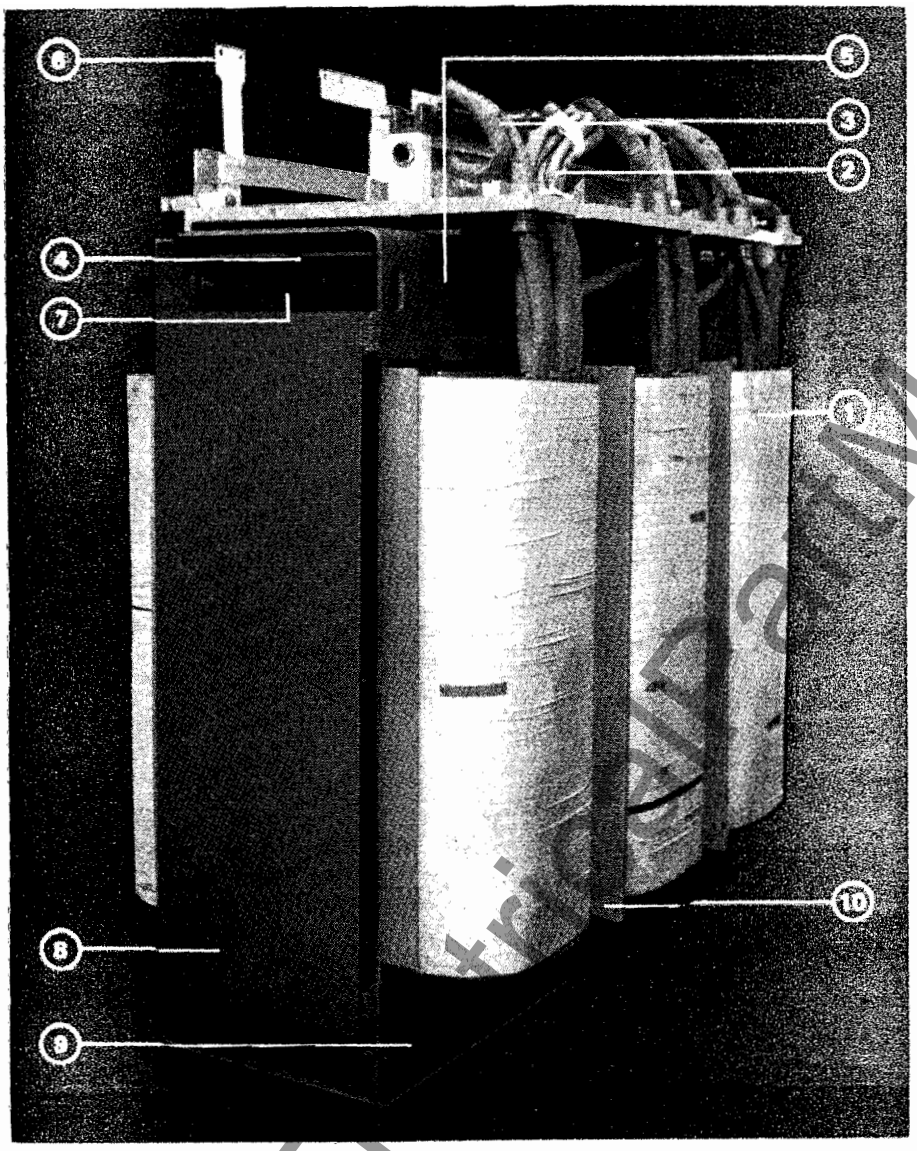

Core and Coil Assembly

1. Phase Coil
2. Tap Leads
3. High Voltage Lead
4. Core Ground (Removable)
5. Top Support
6. Low Voltage Lead
7. Step Lap Core
8. Side Braces and Support Tie
9. Bottom Support
10. Inner Phase Barrier Insulation

Coils

All low voltage windings 1.2 class and many 2.4 class will be wound with sheet aluminum with the width of the sheet extending the full height of the coil. Layer insulation between the sheet conductor is Insuldur paper covered with thermosetting epoxy diamond shaped areas that harden during processing to form a high strength bond between layers. Pressboard high to low insulation is placed over the low voltage winding and the strap wound high voltage is wound directly over the low voltage to form a rigid high strength coil assembly.

Some low voltage coils in the 2.4 KV class and most above 2.4 KV are wound with strap conductor in the same manner at the high voltage winding.

The completed coil assembly is covered on the outside surface with strong tape to protect conductor insulation during assembly. Taps can be accurately located and this accuracy together with the large cross section of winding reduces unbalanced ampere turns to a minimum. Unbalanced ampere turns create forces during short circuit that will displace the HV and LV coils vertically with respect to each other. By reducing unbalance, vertical forces are correspondingly reduced. Thus the rectangular design is stronger under short circuit due to: (A) Solid bonded construction, (B) Accurate tap locations, reducing unbalance and (C) Self balancing tendency of large coil areas.

The large areas presented by the layer type winding results in a low ground capacitance which gives a nearly straight line surge distribution throughout the winding. This enables the design engineer to add insulation in predictably higher stress areas and does not require padding throughout the winding. A compact, high impulse strength coil is the result.

Generous oil ducts extend the height of the coil to provide cooling in the winding. The elimination of restrictive blocking at the top and bottom of the coils, made possible by the staggered diamond epoxy layer restraint, improves the flow of oil to and from the coils.

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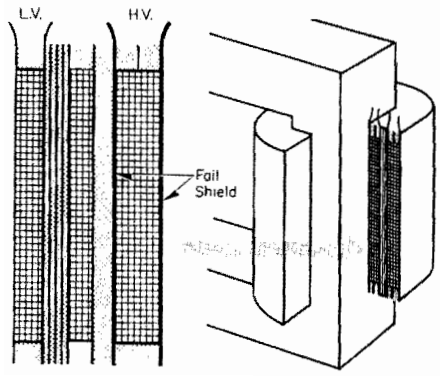
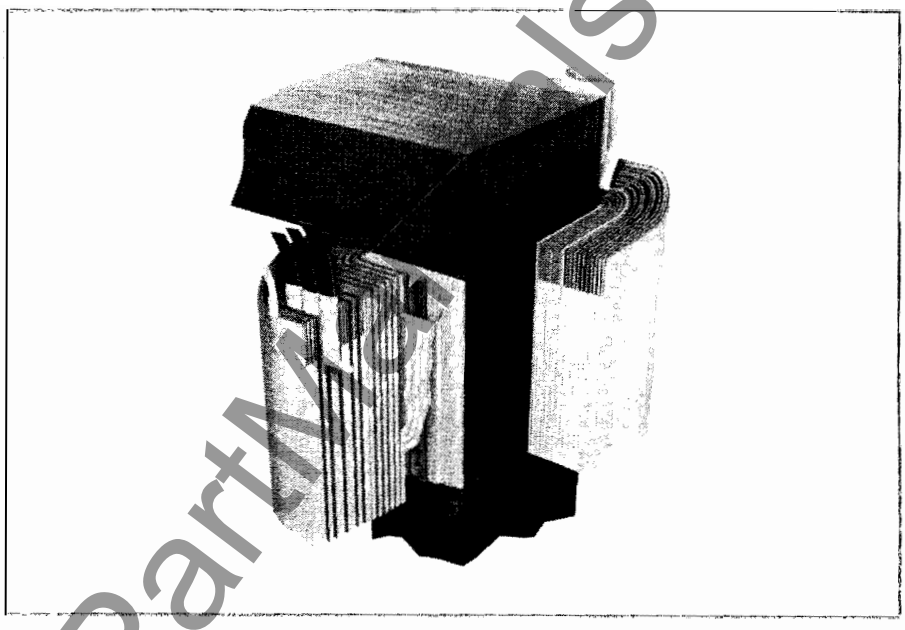
For units with 110 kv BIL and up a low alpha is achieved with shields or static plates which are used to introduce capacitances from winding to line in such a manner as to effectively cancel the ground capacitances. This construction is the exclusive Logrocap® winding which achieves practically a straight line initial impulse voltage distribution.

Logrocap (Shielding)
Cg Reduced by Shielding Coil from Ground



This type of construction was developed in 1955 to meet the strenuous short circuit requirements of underground secondary network service and has proven superior with over 5,000 units in service without a single short circuit failure. In network service, repeated short circuits are common operating practices sometimes occuring hundreds of times during the life of an average network transformer. This construction has proven so mechanically strong that it is now also used on rectifier transformers which are also subjected to severe short circuit duty.

Units of this type of construction up to 5000 kva successfully passed full short circuit tests in the Westinghouse High Power Laboratory.



Core

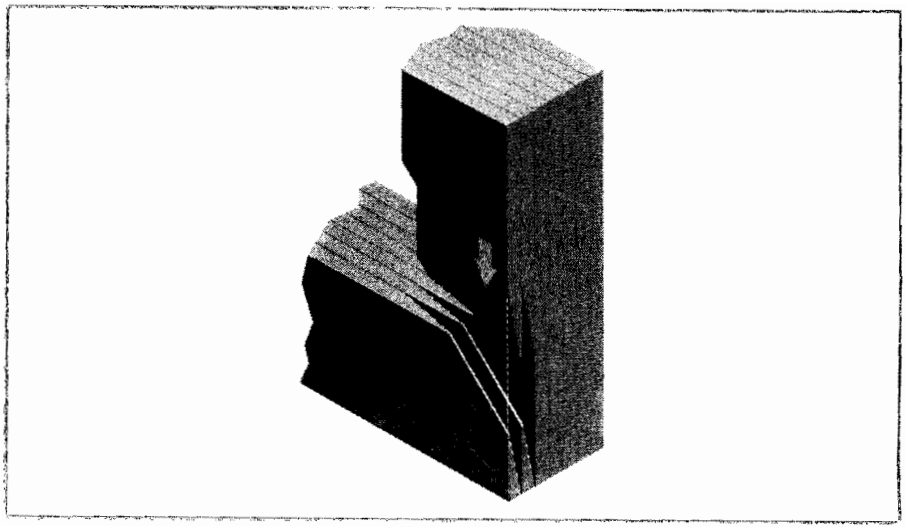
The rectangular shaped core efficiently fills the correspondingly shaped opening in the coil with a minimum of unused space.

The very short yoke between core legs cuts down the external path of the flux between active core leg material with resulting increase in efficiency. The rectangular shape of the core can be more uniformly and rigidly supported to prevent shifting of laminations and to improve sound level characteristics.

The manner in which the yoke of the core joins the legs of the core is very important to core efficiency and the patented step-lap joint (see illustration below) developed by Westinghouse has resulted in decreases in exciting current, sound levels and iron loss.

The effective way in which the core is supported and the efficient step-lap joint have resulted in decreases in exciting current up to 40%, reductions in sound levels up to 3 db and reductions in iron loss up to 10%.

Hipersil — a highest quality grain oriented silicon steel is used for laminations. Interlaminar insulation is provided by a thin but effective Carlite chemically etched coating that withstands furnace annealing and repeated handling.



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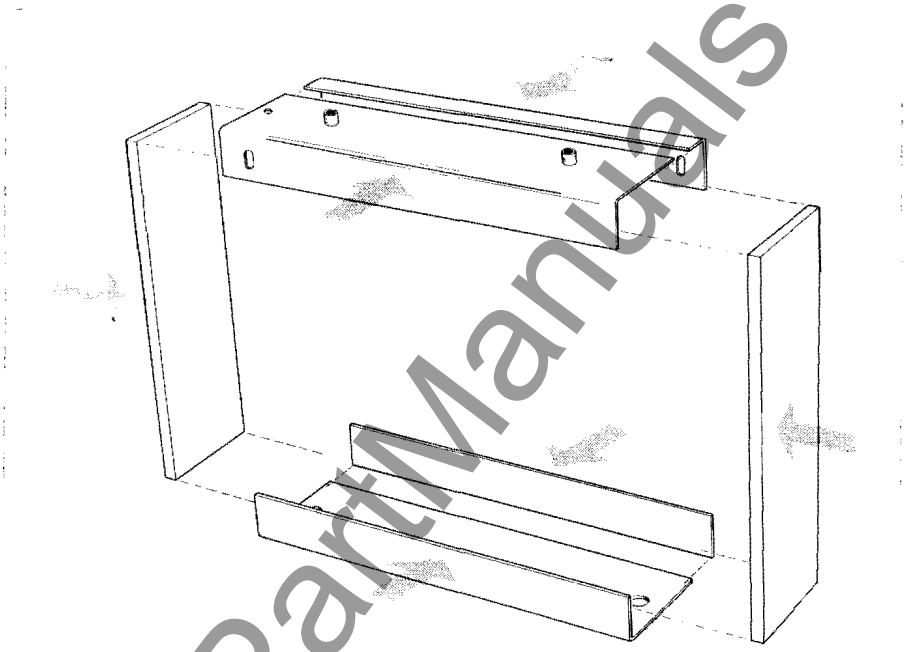
Core and Coil Supporting Structures

The functional design six piece supporting structure for the core and coils is assembled in a pressure jig around the core and coils and arc welded to form a rigid structure that will not loosen during assembly, shipment or in service.

The top and bottom pieces exert a clamping action on the yokes of the core which is important not only to hold the laminations firmly in place but also by using a pre-calculated pressure, optimum sound attenuation is achieved. Welding holds this preload for a permanently quiet core.

End plates are thick steel slabs pressed into position on the pressure jig and welded to the top and bottom pieces to form a permanent framing. The thickness of the plate is calculated for each order to provide the beam strength required to prevent the wide flat part of the outside coils from tending to "round out" during short circuit.

The supporting structure holds the assembly in place in the transformer tank and also supports the high and low voltage leads and the tap changer assembly.

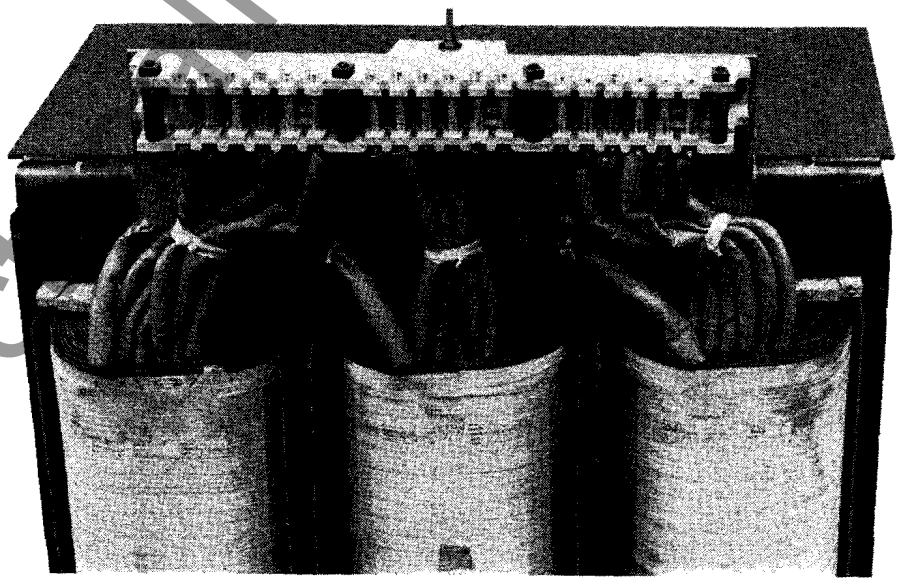


Type WSS Tap Changer

Externally operated tap changers make matching of line voltage quick and convenient when the transformer is de-energized. One complete revolution of the readily accessible operating crank is required for each tap change.

The type WSS tap changer is used on all units 34.5 kv and below and 150 amps and below. The stationary contacts are through-type studs which are supported by a molded channel and have provisions on one end for connecting the tap leads.

A silver plated copper bridging contact in each phase moves along a straight line of fixed contacts to provide a connection between two adjacent stationary contacts on each position. The bridging contacts are spring loaded and supported by a sliding channel. This assembly is moved forward or backward by the rack and pinion at one end of the stationary channel.



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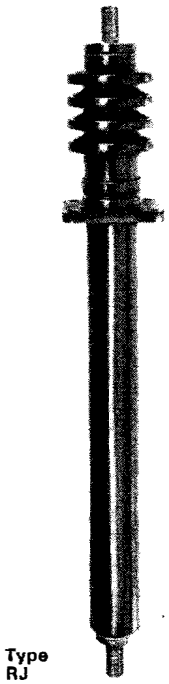
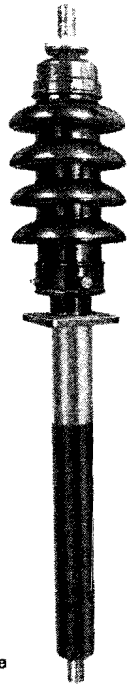
Bushings



Type RJ



Type OS

Two types of bushings are furnished: Solid type for voltages 15 kv and below and condenser type for higher voltages. Both types are cover mounted and comply with all industry standards pertaining to electrical and mechanical characteristics.

RJ Bushings
RJ bushings feature a flange with silicone rubber seals rolled into grooves cut in the porcelain. So supported, bushings cannot crack due to uneven tightening in assembly or from stresses of normal operation.

Condenser-Type Bushings
Used for voltages above 15 kv, type OS meet all USA Standards. The condenser surrounds a central metal tube or bar. At specified diameters, metal foil layers are inserted to form the condensers. Thus, a series of equal capacity condensers is arranged between the central conductor and the outermost foil layer which is connected to a grounded flange. Voltage is, therefore, uniformly distributed to prevent concentration of stress at any one point.

Type OS bushings are used for voltages 23 through 46 kv. The resin bonded condenser is protected on its outer end by a porcelain weather casing and on its inner end by varnish and oil. The space between the porcelain and condenser is filled with oil. The top end of the porcelain is soldered to the cap, and the bottom of the porcelain is soldered to the mounting flange. No gaskets, packing or cement are used in the construction.

All bushings will be furnished with standard brown porcelains.

USA No. 70 grey porcelains can be furnished instead of brown, if specified on the order.

Insuldur® Insulation

The Insuldur insulation system effectively upgrades cellulose insulation materials thermally for increased load and overload capability. Ask for SA 9025 for a complete description of the Insuldur system.

Westinghouse Insulating Oil WEMCO "C"

Concurrent with the Insuldur development, Westinghouse was working with the various petroleum companies to develop a higher flash-point oil for additional margin of safety. Westinghouse Research, developed and provided to all of the oil suppliers the required information needed to refine a new higher flash-point oil and made it available to all the industry. The flash-point was raised from 273°F to 283°F while equalling or bettering the remaining characteristics including lower pour point.

Inerteen (Optional on limited ratings)
Inerteen® is an ASKAREL especially prepared by Monsanto Company to rigid Westinghouse specifications. Inerteen contains a hydrogen chloride scavenging agent specified by Westinghouse for maximum transformer life. Inerteen is non-corrosive. and it possesses the high dielectric strength required for an insulating and heat transfer liquid.

Standard Finish

The Westinghouse standard finish is a three-coat system applied as follows:

A. All surfaces are grit blasted to white metal to form a completely clean surface.

B. A caustic wash and phosphatized coating to inhibit corrosion and give a base for high mechanical strength of paint bonding.

C. An epoxy primer coat cured in a baking oven at 150°C.

D. Westinghouse top coat, composed of an alkyd-amine (Melamine) paint containing special pigments selected to give long outdoor service in varying climatic exposures and maintain attractive appearance, are applied and given a baked finish at 150°C.

Standard tank finish is USA standard dark grey No. 24 (Munsell No. 10B2.40/1 18) or USA standard sky grey No. 70 (Munsell No. 5.0BG7.0/0.4) can be supplied but must be specified at the time the order is placed.

Accessories

Standard
Included with each core-form transformer are:

1. Cover-mounted bushings
2. Tap changer for de-energized operation
3. Liquid-level gauge
4. Drain valve, bottom filter press connection and liquid-sampling valve
5. Valve for top filter press connection
6. Dial-type liquid thermometer
7. Lifting hooks on tank
8. Lifting eyes on cover
9. Provision for jacking
10. Sealedaire oil preservation device
11. Vacuum pressure gauge
12. Tank pressure-relief device
13. Tank grounding provision
14. Welded cover on main tank
15. Instruction nameplate

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Accessories

Optional

The following optional accessories can be supplied for use with core-form transformers:
(For complete listing, see PL 48-120).

Forced-Air Cooling

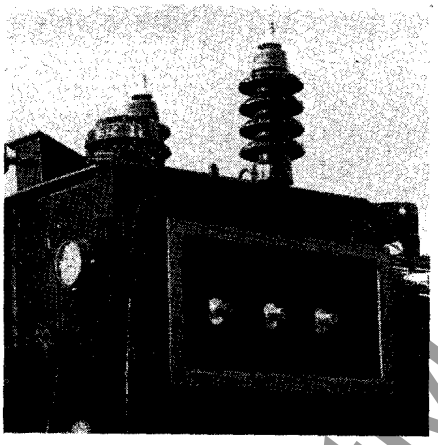
These substation transformers are supplied as standard with provision for future fan cooling. Provision consists of designing the transformer current carrying parts including internal parts for the greater capacity and having space available to receive the required external equipment. When fans are added in the future, an output increase of 15-percent is available on units up to 2500 kva and a 25-percent increase on units 2500 kva and above. The fans are located on the top of the tubular coolers for maximum efficiency. Research has shown that the air moving over the hottest part of the coolers provides greater cooling efficiency. This location reduces accidental damage, blows cleaner air, and reduces maintenance, by locating the fans above accumulation of leaves and snow. Automatic control is normally actuated from a top-liquid temperature thermometer.

Lightning Arresters

Maximum surge protection is provided by installation of lightning arresters mounted directly on transformer tank brackets.

Westinghouse intermediate or station type arresters may be specified and furnished with the transformer or the transformer furnished with arrester brackets only for mounting customers' arresters.

Throat Connections

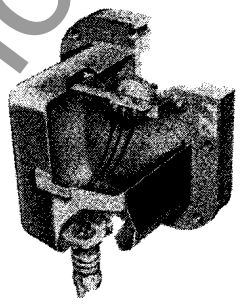


Bushing groups may be enclosed in a flanged throat USA Standard C57.12.10 par. 10.2.4. Segregated or isolated phase throat assemblies are also available.

Terminal Chambers

1. High voltage and/or low voltage terminal chambers for cable entrance, with or without potheads, for voltages of 46 kv and below. Air-insulated chambers are usually used for all voltages 15 kv and below; oil chambers for all voltages above 15 kv.

Sudden Pressure Relay

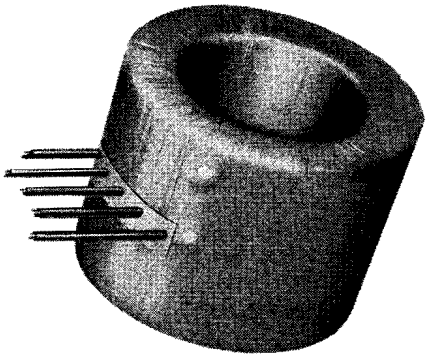


Protection against damage due to internal can fault be provided by a sudden pressure relay. This device operates on rate of pressure change; that is, the higher the rate of rise, the faster it operates. It will not operate on pressure changes due to changes in transformer temperature or loading, but it will protect against small arcs which would not cause a relief device to operate. On major troubles causing high rate of rise, it will operate within a half-cycle on a 60-cycle circuit.

Dial Hot Spot

Dial hot spot winding temperature equipment including a current transformer may be specified. Energy from a current transformer added to the temperature of the top oil in the tank operate a bimetallic element to indicate the simulated hot spot temperature of one phase of the transformer winding. A pointer on the large weatherproof indicator dial gives visual indication, and switches are provided to actuate cooling equipment and to control alarm circuits.

Bushing-Type Current Transformers



Multi-ratio current transformers are applied for general application involving protective relays and indicating instruments. These can be included in the power transformer case on the bushing flange, or provision can be made for future installation by the user. Tap ratios, current ratings and accuracy are according to USASI standards.

Further Information:

Prices: See Price List 48-120

Data contained in this publication is subject to change without notice.

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