



Westinghouse Electric Corporation
Medium Power Transformer Division
Sharon, Pa. 16146

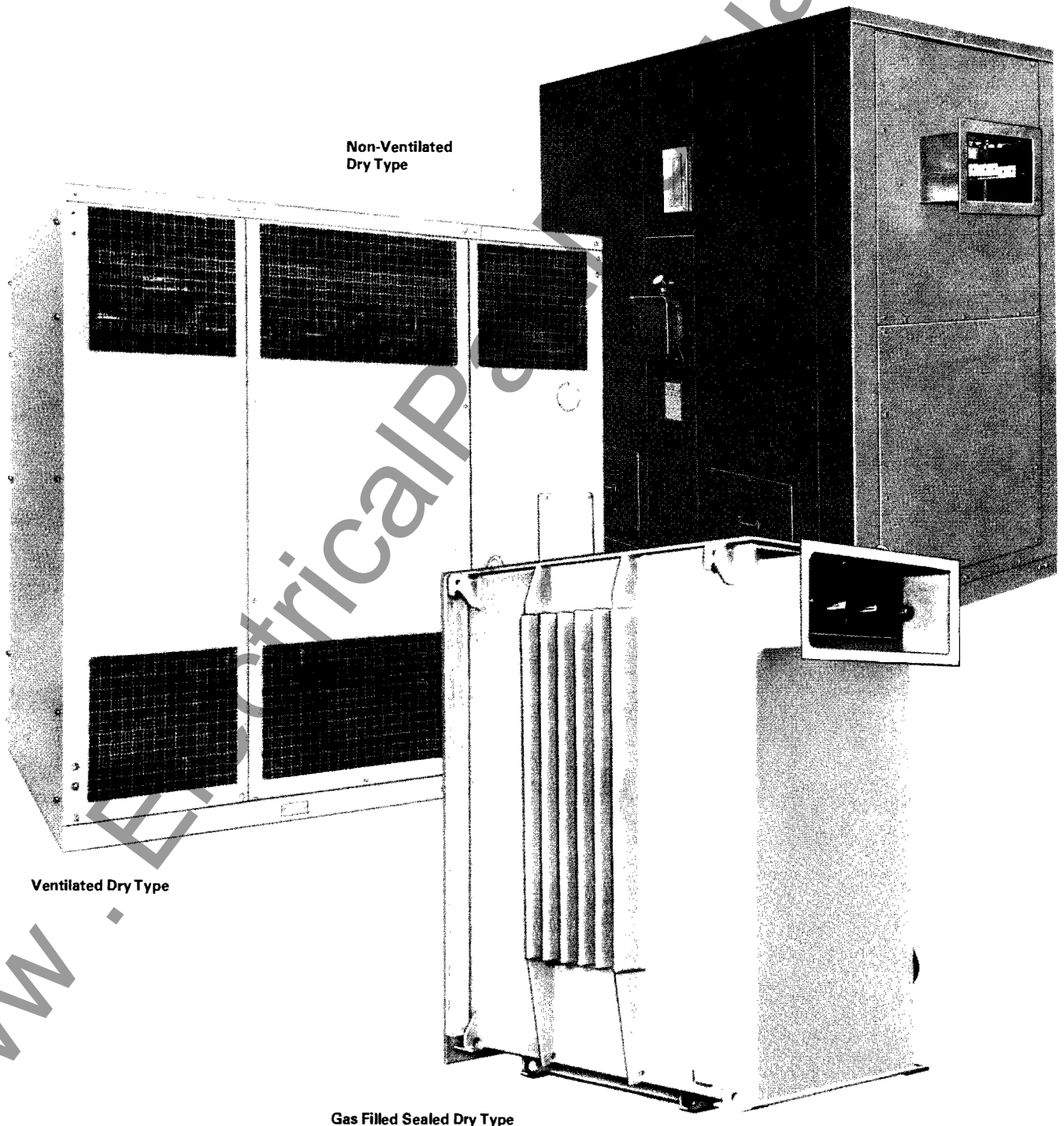
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For Unit Substation, Power Center,
Network and Pad Mounted Applications
Single and Three Phase
112 1/2 Through 10,000 Kva

Dry Type Transformers Type ASL



**Non-Ventilated
Dry Type**

Ventilated Dry Type

Gas Filled Sealed Dry Type

Dry Type Transformers

Application

Ventilated, non-ventilated and gas filled sealed dry type transformers are ideally suited for indoor and outdoor applications. Ventilated units may be installed in practically any indoor location not subject to submersion or to a high concentration of destructive fumes, or outdoor with a weather-resistant case. Non-ventilated units are recommended for dirty applications either indoor or outdoor. Gas filled sealed dry units offer the ultimate in safety and low maintenance with high impulse levels. They can be installed indoor or outdoor or completely submersed, when specified.

Benefits

Reliability and Long Life

- Windings are protected by Nomex® insulation having very high temperature and dielectric characteristics.
- A 220°C fully coordinated insulation system is used.
- Each prototype unit is subjected to a complete set of short circuit calculations which have been verified by full size testing.
- Westinghouse offers the widest range of coil types depending on voltage and current for optimum dielectric, mechanical and thermal characteristics, including: Layer Wound Cylindrical, Disc-Type, Random Wound – Slotted Spacer Type, Layer Sheet Wound
- The ventilation system is engineered to assure proper operating temperature in the coils.
- On FA units air is positively directed under pressure through the coil ducts at high speed to assure thermal operation under the 220°C allowable limit.

Low Environmental Cost

Safety and Versatility

- Dry type transformers are supplied with lightning arresters – when specified – allowing confident application to any exposed line regardless of line BIL.
- Air insulated and cooled by natural convection, these transformers release no toxic gases and cannot explode. Elimination of these principal liquid-filled transformer potential hazards makes them especially desirable for installation in schools, hospitals, hotels, theatres, factories, etc., where large groups of people are present.
- Where space limitations are a consideration, ventilated dry type transformers offer lower weight and absence of liquid allowing their mounting in such places as balconies to save floor space and yet provide safe operation.
- Gas filled sealed dry type transformers are the safest transformers available with a completely hermetically sealed heavy gauge steel tank – they can be installed anywhere.

Value

Proven Methods and Materials

- Westinghouse testing standards are the highest in the industry. New designs are given complete load, short circuit, and insulation tests to prove methods and materials used in manufacture. Verified production line models receive standard quality control inspections and tests by our most experienced personnel. Certified reports on routine tests can be obtained on all units, and special tests or reports can be obtained by special order.

Insulation Class

Dry type transformers are insulated with 220°C system materials with temperature ratings as follows:

Maximum Ambient	Average Rise	Hottest Spot Winding Temperature Rise
40°C	150°C	180°C
40°C	115°C	145°C
40°C	80°C	110°C

Maintenance

Dry type transformers are practically maintenance free, except for periodic inspection of the connections. On ventilated dry type transformers any accumulation of dust or dirt should be removed by brushing or vacuuming the unit. See IL 47-067-1. Gas filled sealed dry type transformers only require periodic checks of pressure and temperature. They require less maintenance than liquid filled or open ventilated dry type transformers. See IL 47-060-92.

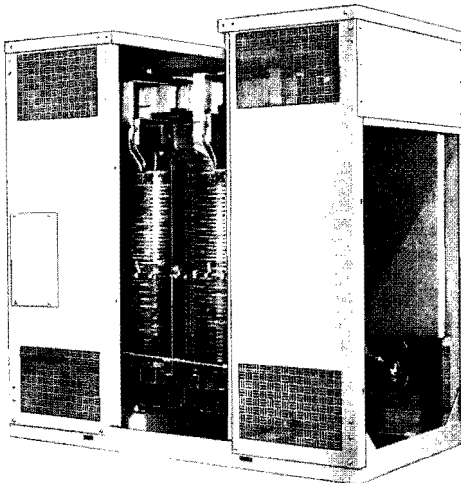
Further Information

Prices:
PL 47-330 DS 47-370 DB 32-850 DB 31-750

Design Features

Case – Ventilated Dry Type

The case has removable panels for access to the taps and core and coil inspection and the



Core and Coil in Ventilated Case with Access Panels Removed

complete case structure can be removed and knocked-down to reduce size and weight for rigging into tight locations. The case is constructed of 13 gauge steel and painted ANSI #61 light gray on indoor units and ANSI #24 on outdoor units.

Standard case accessories are: provision for jacking, ground pad, diagrammatic nameplate, provisions for rolling, and protective ventilation grille, provision for lifting, continuous ground between ground pads, and drip proof cover.

Case – Non-Ventilated

The knockdown case is designed for ease in fitting through limited openings and is formed of 13 gauge sheet steel construction, equipped with removable panels for access to the core and coils on the front and rear. The case totally encloses the core and coils and is so constructed as to provide no intentional circulation of external air through the transformer. A bolted cover section will be supplied for access to the core and coil lifting loops for lifting the complete assembly.

Gas Filled Sealed Dry Type

Sealed Tank

The transformer is of the sealed tank construction to prevent breathing. Tank is hermetically sealed and tested at 15 psi. pressure. It is provided with welded-on 1/4" thick Yukon coolers where required.

Shot Blast

The case and coolers are cleaned by shot blast and phosphatized before the paint is applied.

Finish

Paint finish is applied over a properly prepared surface. The color is light gray ANSI No. 61 (indoor) or dark gray ANSI No. 24 (outdoor).

The transformer is insulated and cooled with C₂F₆ fluorocarbon gas.

Bushings

The transformer tank is fitted with rolled flange, inert arc welded bushings for the high voltage and low voltage connections to insure that the tank is hermetically sealed.



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Design Features (Continued)

Core and Coil Assembly

Core and coil assemblies are rigidly braced to withstand mechanical forces under line fault conditions and to resist vibration and shock forces during shipment.

Coils are concentrically assembled on the core legs and rigidly positioned laterally by spacers between the inner-most insulating cylinder and the core. Horizontal and vertical stresses set up during faults do not exceed the inherent strength of the conductors and support system.

Core

Ventilated and Non-Ventilated Type and Gas Filled Sealed Dry Type

Material used to form the core is non-aging, cold rolled, high permeability silicon steel. Bulk material is cut to width and sheared to length by especially hardened and ground cutters to prevent edge damage and burrs that would short between laminations and reduce core efficiency.

Core laminations are firmly clamped by structural steel members for greater strength and lower noise levels. Core clamps and all structural parts are grounded to prevent an induced voltage buildup.

The resulting compact, rigidly clamped structure formed by the core and coil assembly provide a low loss, low sound level design with the strength to withstand repeated short circuit forces.

Coils

Ventilated and Non-Ventilated Dry Type and Gas Filled Sealed Dry Type

Conductor Material

Aluminum is the standard conductor material. Where design considerations require, copper may be substituted.

Insulation

The insulating structure of the coil is designed for operation at 220 degrees Centigrade hot spot temperature (150°C average rise). High voltage conductor insulation and layer insulation is DuPont Nomex®. This tough, long life Aramid material is especially resistant to humidity and repeated thermal cycling.

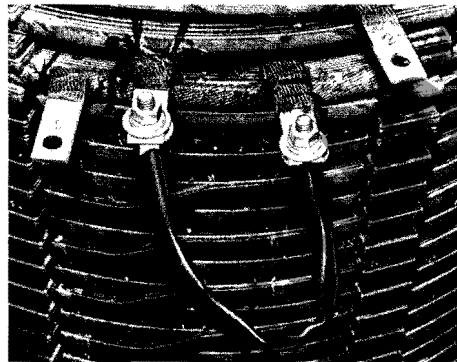
The low voltage coils are usually of cylindrical or strip construction and high voltage coils are usually of the continuous pancake or random wound disc type construction. Large air ducts provide insulation between windings and form vertical cylinders for natural ventilation. The free area in the pancake coils between porcelain spacers further facilitates the flow of cooling air.

Taps

Ventilated & Non-Ventilated Dry Type

The taps can be reached from the front or back by removing a panel which also protects tampering with the taps.

The taps are rigidly supported by brazing them on the central section of the HV coils. Taps are changed by moving the flexible bolted links from one connecting point to the other. To simplify these changes, the connections are clearly identified.

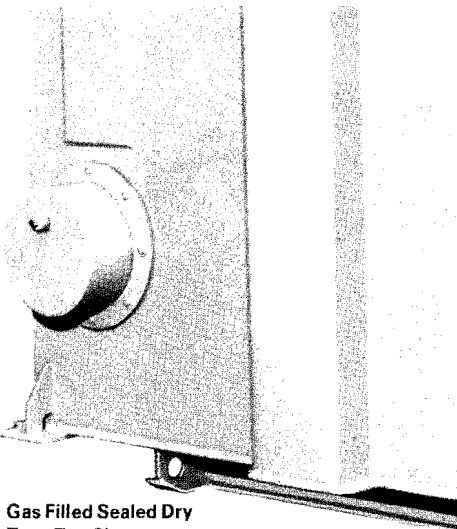


Tap Terminals – Ventilated and Non-Ventilated Dry Type

Double Sealed Gas Filled Sealed Dry Type Tap Changer

De-energized Tap Changer

A double sealed tap changer will be supplied to permit changing connections in the high voltage windings from outside the transformer case. The tap changer is designed for operation only when the transformer is de-energized. Provision will be made for padlocking in any position. A packing gland seals the operating shaft at the tank wall. The external housing prevents gas loss due to permeability through the gland packing material. The housing cover may be either gasketed or soldered.



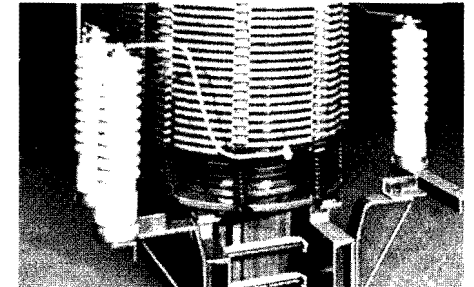
Gas Filled Sealed Dry Type Tap Changer

Arresters

Ventilated dry type power centers can be supplied with RM arresters when specified to provide maximum surge protection for the transformer and associated secondary equipment.

When located in the transformer section, the RM arresters protect against a possible double surge voltage at the transformer terminals even though arresters may be used on the incoming line. The possibility of exceeding BIL level due to reflected voltages is dependent on length and character of cable and steepness of surge.

In applying arresters, it should be remembered to use an arrester with a sparkover to operate below the BIL of the apparatus and to install the arresters close to the apparatus to be protected. If a high voltage air switch is close coupled to the transformer, this is a preferred location for these arresters.



Isomode Pad (Vibration Dampeners) On Ventilated and Non-Ventilated Dry Type Units

After removal of the shipping braces, the core and coil assembly rests on rubber Isomode pads to isolate normal core vibrations from the case, foundation or any conduit or bus duct connected to the case.

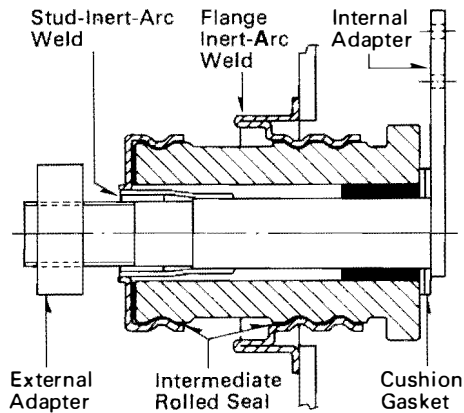
Coil Varnish Treatment

High temperature moisture and chemical resistant varnish maintains superior bond strength, high dielectric strength and good power factor at elevated temperatures associated with 220°C insulation systems. The thermal aging characteristics, thermal stability, high mechanical strength at high temperatures, and physical resistance to common solvents exceeds that of commonly used varnishes. The resistance to alkalis, acids, and moisture is excellent. High and low voltage coils are dipped in this varnish and baked before assembly, and after assembly the complete core and coil unit is dipped in this varnish and baked.

Design Features (Continued)

Bushings on Gas Filled Sealed Dry Type Transformers

Gas filled transformers are equipped with rolled flange, inert arc welded bushings, type RFW, for the HV and LV outlets. These bushings insure a hermetically sealed tank while allowing flexibility for conductor expansion and contraction.



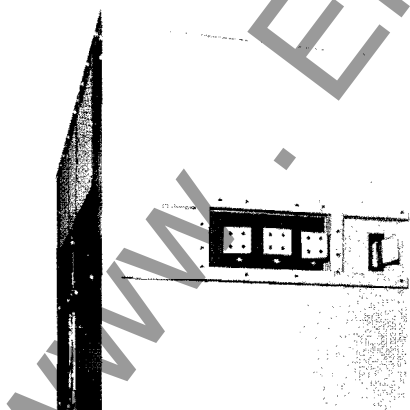
Rolled Flange Bushing

Network Transformers

Low Voltage Flange for Network Protector

Westinghouse ventilated (AA), non-ventilated or gas filled sealed dry type (GA) transformers are available for use on grid type horizontal or vertical secondary network systems. These systems are most common where a high load density exists. Since there is no explosion hazard due to the presence of liquids, no vaults are required.

These transformers can also be used in spot network systems. Network transformers are provided with an LV flange for connection in the field to a network protector. The above illustration is typical of ventilated dry type units. Gas filled sealed and non-ventilated dry type network transformers utilize a LV flange similar to that shown on page 1.



Low Voltage Flange For Network Protector

Accessories - Ventilated Dry Type

Outdoor Cases

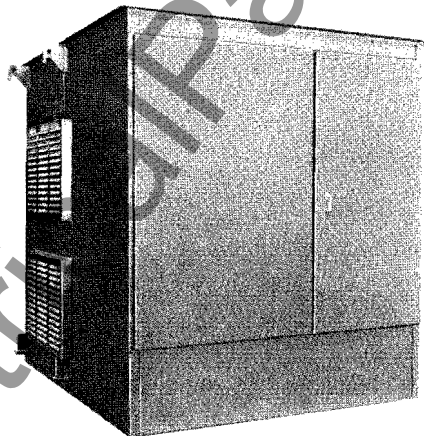
Ventilated and non-ventilated dry type units are available with either standard outdoor or outdoor tamper-resistant construction.

Special ventilating grills allow required cooling air flow in and out of the case and provide the degree of weather protection of a NEMA 3R enclosure.

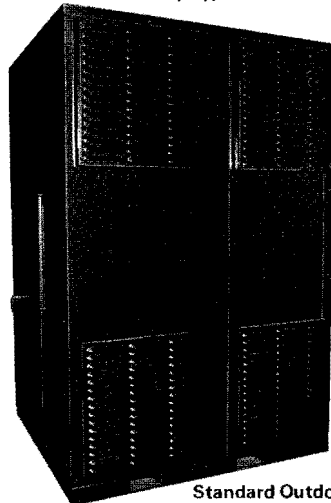
An extra dip and bake of varnish and appropriately located space heaters protect against damage to the core and coils from condensation during thermal cycling.



Space Heaters



Tamper-Resistant Outdoor Case Dry Type Pad Mount Configuration



Standard Outdoor Case

Temperature Devices

Ventilated & Non-Ventilated Dry Type Transformers



Opt-i-Therm Winding Temperature Indicator and Control

The Opt-i-Therm Temperature Indicator and Control is the most sophisticated instrument ever applied to ventilated dry type transformers for temperature indication and control of transformer protective devices. It is included on ventilated dry type Class AA/FA units and available as an optional accessory on ventilated dry type Class AA self-cooled units.

The Opt-i-Therm is a thermocouple actuated temperature indicator and control. The instrument directly measures hottest spot temperature in degrees centigrade and provides contacts for starting and stopping cooling fans, operating alarm signals and lights and actuating breaker trip coils or initiating other shut down or load reduction procedures.

The actuating thermocouple is wound into the transformer low voltage coil at the point of highest temperature. The instrument, therefore, indicates the actual hottest spot temperature of the transformer rather than a simulated hot spot temperature as conventional instruments do.

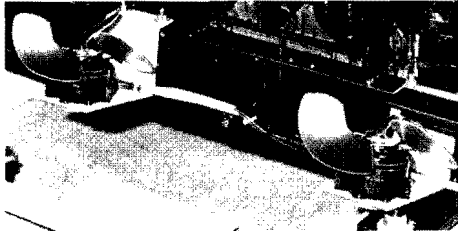
The ability of this relay to more accurately measure hot spot temperatures offers three benefits: 1. The ability to safely and reliably carry heavier overloads. 2. The ability to size a transformer more nearly to the actual load which means lower first cost. 3. More accurate fan control has the benefit of longer transformer life and fewer failures.



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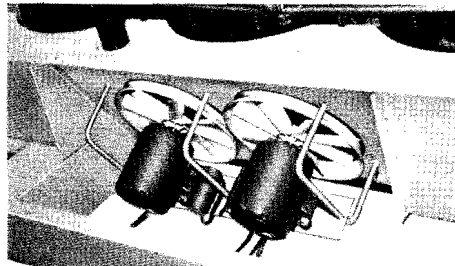
Cooling

Ventilated & Non-Ventilated



Small Units

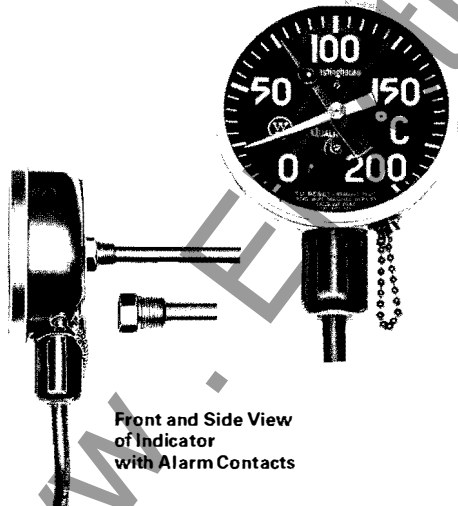
Forced air cooling is available on all ventilated units 300 KVA and above. With air blast equipment in operation the units have forced cooled ratings of 133 percent of the self-cooled rating. Single phase 230 volt fan motors are turned on or off by a winding temperature relay.



Large Units

Gas Filled Sealed Dry Type Transformers

Temperature Indicator Hot Gas, Two Switch, Dial Type, Submersible, Direct Mounted



Front and Side View of Indicator with Alarm Contacts

A dial-type thermometer with alarm contacts with maximum resettable indicating hand is provided. It indicates the temperature of the gas above the core and coils.

Transformer Standards

Dimensions and Weights as listed in the Tables are based on the following:

- Standard Base Kva Ratings: 300-500-750-1000-1500-2000-2500.
- 3 Phase, 60 Hertz, Two Windings.
- Standard 150°C Temperature Rise above ambient air temperature of 40°C (104°F) maximum and 30°C (86°F) average in any 24-hour period.
- Maximum Altitude of 1000 meters (3300 feet) above sea level for full rating.
- Standard High Voltages: 2400-4160-4800-6900-7200-12000-12470-13200-13800-23000-34500, delta connected only.
- Standard High Voltage Taps: two approximately 2½% full capacity above and two below rated voltage.
- Standard Low Voltages (notaps): 208y/120 (1000 Kva max.) 240 delta (1000 Kva max.) 480 delta (all ratings) 480y/277 (all ratings).
- Aluminum Winding Conductors.
- No Series-Parallel or Delta-Wye Terminal Boards.
- Standard Accessories.
- Standard Surface Preparation, Finish Processes, Materials and Colors.
- Standard Tests in accordance with ANSI Standard Test Code (see below).
- HV and LV Basic Impulse Levels, Impedance and Sound Levels in line with the following Tables.
- Indoor enclosure

Standard Insulation Levels – Kv BIL

High Voltage Rating	Vent. and Non-Vent. Dry Transformer		Gas Filled Transformer	
	HV	LV (600 Max.)	HV	LV (600 Max.)
2400	20	10	45	30
4160	25	10	60	30
4800	25	10	60	30
6900	35	10	75	30
7200	35	10	75	30
12000	50	10	95	30
12470	50	10	95	30
13200	50	10	95	30
13800	50	10	95	30
23000	110	10	..	..
34500	150	10	..	..

Impedances (±7½% Tolerance):

Kva	Ventilated Dry Type				Non-Ventilated Dry Type		Gas Filled
	5 kV Class and Below	8.6 and 15 kV Class 50 BIL	8.6 and 15 kV Class 95 BIL	25 and 34.5 kV Class	5 Kv Class and Below ^①	8.6 and 15 Kv Class ^②	
300	6.3%	5.0%	5.75%	6.5%	3.6%	3.0%	5.0%
500	5.75%	5.75%	5.75%	6.5%	3.1%	3.5%	5.0%
750	5.75%	5.75%	5.75%	6.5%	3.4%	3.5%	5.75%
1000	5.75% ^③	5.75% ^③	6.5% ^③	6.5%	3.5%	3.5%	5.75%
1500	5.75%	5.75%	6.5%	6.5%	3.5%	3.5%	5.75%
2000	5.75%	5.75%	6.5%	6.5%	3.5%	3.5%	5.75% ^③
2500	5.75%	5.75%	6.5%	6.5%	3.5%	3.5%	5.75% ^③

① 8.0% impedance is available as an alternate standard, if requested, at 480 volts low voltage.
 ② Alternate standard impedance of 6% for 2000 Kva and 6.2% for 2500 Kva is available at no price increase.
 ③ Transformers with impedance of 4% or less are designed to withstand 25 times normal current for two seconds.

Standard Guaranteed Sound Levels – Decibels

Maximum Base Kva (Self Cooled)	Vent. Dry Transformer		Non-Vent. Dry AA	Gas Filled Transformer GA
	AA	FA		
300	58	67	57	57
500	60	67	59	59
750	64	67	63	63
1000	64	68	63	63
1500	65	69	64	64
2000	66	71	65	65
2500	68	71	66	66

Transformer Kva Ratings, 3 Phase

In addition to their basic self-cooled (AA, 100%) Kva ratings, modern Westinghouse ventilated and non-ventilated dry type standard Secondary Unit Substation transformers are designed for continuous operation at the following supplementary fan-cooled (FA) 133% Kva ratings:

Ventilated Dry Type

150°C AA Rating	150°C FA Rating
300	400
500	667
750	1000
1000	1333
1500	2000
2000	2667
2500	3333

Gas filled sealed Dry Type Transformers are available as AA self cooled (100%) only.

ANSI Standard Tests

- Resistance measurements.
- Ratio tests.
- Polarity and phase relation.
- No-load loss.
- Existing current.
- Impedance and load loss.
- Applied potential test.
- Induced potential test.
- Temperature test or tests will be made on one unit of an order, covering one or more units of a given rating. Tests will be made only when there is no available record of a temperature test per ANSI Standards on a thermally duplicate or essentially duplicate unit.

Transformer Dimensions and Weights – Inches (Approximate)

Ventilated Dry Type, 150°C Temperature Rise, Low Voltage 600 Maximum, Indoor

Kva Self Cooled (AA)	Hv 2400Δ 20 Kv BIL, 4160 or 4800Δ 25 Kv BIL				Hv 6900, or 7200Δ – 35 Kv BIL, 12000, 12470, 13200 or 13800Δ – 50 Kv BIL				Hv 12000, 12470, 13200 or 13800Δ 95 Kv BIL				Hv 23000Δ (16400 – 25000) 110 Kv BIL				Hv 34500Δ (25001 – 36200) 150 Kv BIL			
	Dim. A	B	C	Wt. Lb.	Dim. A	B	C	Wt. Lb.	Dim. A	B	C	Wt. Lb.	Dim. A	B	C	Wt. Lb.	Dim. A	B	C	Wt. Lb.
300	90%	60	54	2500	90%	60	54	3350	90%	60	54	3800	110	110	70	6800	120	124	84	8700
500	90%	60	54	3150	90%	60	54	4100	90%	60	54	4650	110	110	70	7200	120	124	84	9200
750	90%	60	54	4050	90%	60	54	4700	90%	60	54	5500	110	110	70	7600	120	124	84	9700
1000	90%	60	54	5200	90%	70	60	5700	100	112	54	7800	110	110	70	8700	120	124	84	11100
1500	90%	70	60	5400	90%	70	60	6900	100	112	54	9900	120	115	72	10900	130	130	86	13900
2000	100	90	48	9500	100	100	54	10000	110	112	54	11700	120	120	73	12800	130	136	88	16400
2500	105	100	54	11100	105	100	54	11700	110	112	54	13700	120	125	75	14700	130	142	90	18800

Note: B dimension is for open-ended flange connection on the HV and LV and does not include a ground plane.

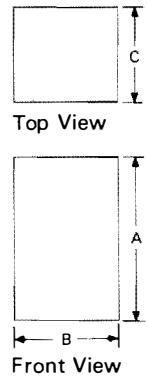
Refer to Westinghouse for outdoor applications, pad-mounted and other ratings.

Non-Ventilated Dry Type, 150°C Temperature Rise, Low Voltage 600 Volt Maximum, Indoor

Kva Self Cooled (AA)	Hv 2400Δ 20 Kv BIL, 4160 or 4800Δ 25 Kv BIL				Hv 6900, or 7200Δ – 35 Kv BIL 1200, 12470, 13200 or 13800Δ – 50 Kv BIL				Hv 12000, 12470, 13200 or 13800Δ 95 Kv BIL			
	Dimensions A	B	C	Weight Lb.	Dimensions A	B	C	Weight Lb.	Dimensions A	B	C	Weight Lb.
300	90%	60	54	3400	90%	60	54	4350	90%	70	60	5000
500	90%	70	60	5200	90%	70	60	5700	100	112	54	7800
750	100	90	48	8100	100	90	48	8600	100	112	54	9900
1000	100	90	48	9500	100	100	54	10000	110	112	54	11700
1500	110	100	54	12800	110	100	54	13200	110	124	60	15200
2000	110	112	54	14800	110	112	54	15300	130	130	70	17100
2500	...	...	...	...	125	112	54	18700	130	140	70	20200

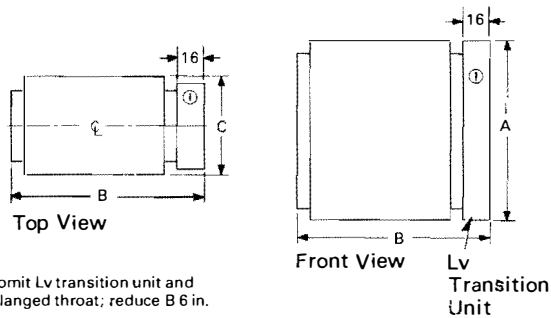
Note: B dimension is for open-ended flange connection on the HV and LV and does not include a ground plane.

Refer to Westinghouse for outdoor applications, pad-mounted and other ratings.



Gas Filled Dry Type, 150°C Temperature Rise, Low Voltage 600 Maximum, Indoor or Outdoor

Kva (AA)	Hv 2400Δ, 45 Kv BIL, or 4160 or 4800Δ, 60 Kv BIL				Hv 6900 or 7200Δ, 75 Kv BIL, or 12000, 12470, 13200 or 13800Δ, 95 Kv BIL			
	Dimensions A	B	C	Weight Lb.	Dimensions A	B	C	Weight Lb.
300	83	95	47	6800	...	...	...	...
500	86	98	50	7000	86	98	50	7000
750	91	103	54	8500	91	103	54	8500
1000	96	108	57	10000	96	108	57	10000
1500	102	114	63	13000	102	114	63	13000
2000	108	120	66	17000	108	120	66	17000
2500	112	122	70	21000	112	122	70	21000



① B dimension is for open ended flange connection on the HV and the LV and does not include a ground plane.

② For indoor only. For outdoor, omit Lv transition unit and Z-bar flanges, and substitute flanged throat; reduce B 6 in. for 15 Kv and 9 in. for 5 Kv Hv.

Table – Optional HV and LV Termination Dimensions

Add the following to the B dimension for the HV and LV Terminations:

Add to "B"	Termination
15"	HV Terminal Compartment
15"	LV Terminal Compartment
15"	LV Panelboard, End/Access
38"	LV Panelboard, Front/Access

Note: Refer to Westinghouse Switchgear Division for Add to "B" dimension for network protector if used.



Typical Specifications

Hv Sections Available

A. Terminal Compartment

The Hv section shall consist of a terminal compartment integral with the transformer case for cable entrance. The terminal connectors shall be located so as to give sufficient space for stress cones. Sufficient barriers shall be supplied between the Hv terminal compartment and the transformer to prevent the temperature surrounding the cable from exceeding NEMA Standards.

Optional Equipment Available With HV Terminal Compartments

Provide 3, _____ Kv RM (intermediate) (station type) arrestors in Hv compartment

RM arrestors provided in transformer section unless specified in Hv section.

Potheads

Provide 3-1/C (1-3/C) potheads for termination of Hv cables.

Loop Feed

Provide loop feed terminal connectors.

Interlock

Provide interlocked armored cable terminators for 1-3/C (3-1/C) cables.

Ground Bus

Provide a ground bus in the Hv terminal compartment to connect to incoming ground conductor.

B. High Voltage Lead Facilities

Provisions will be made for connecting the transformer case directly to a high voltage switch housing or other HV switchgear and the HV leads to this equipment.

Ventilated Dry Type Transformer

The indoor (outdoor), standard (temperature-resistant) transformer will be rated as follows:

_____ Kva, 3 phase, 60 hertz, ventilated dry type, 150°C (115°C) (80°C) rise, 220°C insulation system. (Complete with fans for increased rating to _____ Kva.)

HV _____ volts, 3 wire, _____ Kv BIL with plus two 2½%, and minus two 2½% no load full capacity taps delta connected.

LV _____ volts, 4 wire (3 wire) wye (delta) connected.

Accessories will include the following:

Diagram instruction plate
Provision for lifting and jacking
Removable case panel for access to high voltage taps
Drip proof cover
Two ground pads with continuous copper ground bus

High Voltage Taps

Tap leads will be terminated at the coils and equipped with provisions for changing taps.

Insulation

The transformer will be of the explosion resistant, fire-resistant, air insulated, dry type construction, cooled by the natural circulation of air through the windings. Solid insulation in the transformer will consist of inorganic materials such as porcelain, glass fiber, mica, electrical grade glass polyester or Nomex. All insulating materials must be rated for continuous 220°C Duty.

Coil Varnish Treatment

High voltage and low voltage coils will be dipped and baked after winding in a high temperature and chemical resistant varnish which maintains its mechanical strength at 220°C operating temperature. The complete core and coil assembly will also be dipped in this varnish after assembly to provide resistance to common solvents, alkalis, acids, and moisture.

Case

The knockdown case for ease in fitting through limited openings will be formed of 13 gauge sheet steel construction equipped with removable panels for access to the core and coils on the front and rear with ornamental ventilating grills. A bolted cover section will be supplied for access to the core and coil lifting loops for lifting the complete assembly.

Paint Finish

The case will be phosphatized. The color will be light gray ANSI No. 61 (Indoor) or dark gray ANSI No. 24 (Outdoor).

Lightning Arresters (Optional)

Three low ratio lightning arresters will be mounted in the transformer case and connected to the high voltage leads. They will be for use on a _____ Kv grounded (ungrounded) system.

Impedance

The impedance of the transformer at normal rating and frequency will be *% ± 7½% tolerance. (*Refer to Table on page 5.)

Sound Level

The transformer shall be designed to meet the Standard Nema Sound Levels.

Non-Ventilated Dry Type Transformer

The indoor (outdoor), standard or (temperature-resistant) transformer will be rated as follows:

_____ Kva, _____ phase, _____ Hertz, Non-ventilated dry type, 150°C, (115°C) (80°C) rise, 220°C insulation system (complete with internal fans for increased rating to _____ Kva.)

HV _____ volts, 3 wire, _____ Kv BIL with plus two 2½%, and minus two 2½% de-energized full capacity taps delta connected.

LV _____ volts, 4 wire (3 wire) wye (delta) connected. _____ BIL.

High Voltage Taps

Tap leads will be terminated at the coils and equipped with provisions for changing taps.

Insulation

The transformer will be of the explosion resistant, fire-resistant, air insulated, dry type construction, cooled by the natural circulation of air through the windings. Solid insulation in the transformer will consist of inorganic materials such as porcelain, glass fiber, mica, electrical grade glass polyester or Nomex. All insulating materials must be rated for continuous 220°C Duty.

Case

The knockdown case for ease in fitting through limited openings will be formed of 13 gauge sheet steel construction, equipped with removable panels for access to the core and coils on the front and rear. The case will totally enclose the core and coils and will be semi-dust tight. A bolted cover section will be supplied for access to the core and coil lifting loops for lifting the complete assembly.

Paint Finish

The case will be phosphatized. The color will be light gray ANSI No. 61 (Indoor) or dark gray ANSI No. 24 (Outdoor).

Lightning Arresters (Optional)

Three low ratio lightning arresters will be mounted in the transformer case and connected to the high voltage leads. They will be for use on a _____ Kv grounded (ungrounded) system.



Typical Specifications (Continued)

Impedance

The impedance of the transformer at normal rating and frequency will be $\pm 7\frac{1}{2}\%$ tolerance. (*Refer to Table on page 5.)

Sound Level

The transformer shall be designed to meet the Standard Nema Sound Levels.

Accessories will include the following:

- Diagram instruction plate
- Provision for lifting and jacking
- Removable case panel for access to high voltage taps
- Drip proof cover
- Ground pads with continuous ground bus

Gas Filled Sealed Dry Type Transformer Section

The indoor (outdoor) transformer will be rated as follows:

_____ Kva, 3 phase, 60 Hertz, gas filled sealed dry type, 150°C rise, with a 220°C insulation system.

H.V. _____ volts, 3 wire, _____ Kv BIL plus two 2½%, minus two 2½% no load full capacity taps, delta connected.

L.V. _____ volts, 4 wire (3 wire) wye (delta) connected.

Accessories will include the following:

- I-beam base for rolling in any direction.
- Cover welded to the tank flange.
- Yukon cooler ¼ inch thick where required.
- Lifting hooks – 4 total.
- Jack pads – 4 total.
- Vacuum pressure gauge.
- Dial-type gas thermometer with alarm contact.
- ¾ inch plug for purging
- ¾ inch packless valve for filling and test
- Diagram nameplate.
- De-energized tap changer, externally operated.
- Ground pad.
- Welded-on main tank cover.

Impedance

The impedance of the transformer at normal rating and frequency will be $\pm 7\frac{1}{2}\%$ tolerance. (*Refer to Table on page 5.)

Sealed Tank

The transformer will be of sealed tank construction to prevent breathing. Tank will be

hermetically sealed with metallic seals throughout and will be tested at 15 psi pressure. It will be provided with welded-on ¼" thick Yukon coolers where required.

Shot Blast

The case and coolers will be cleaned by shot blast and phosphatized before the paint is applied.

Finish

Paint finish will be manufacturer's standard, applied over a properly prepared surface. The color will be light gray ANSI No. 61 (indoor) or dark gray ANSI No. 24 (outdoor).

Insulation

The transformer will be of the explosion resistant, fire resistant, fluorocarbon insulated, dry type construction, cooled by the natural circulation of fluorocarbon through the windings. Solid insulation in the transformer will consist of inorganic materials such as porcelain, glass roving or Nomex in combination with a sufficient quantity of a high temperature binder to impart the necessary mechanical strength to the insulation structure. The transformer will be insulated and cooled with C₂F₆ fluorocarbon gas. It will be shipped filled with this C₂F₆ gas to a gauge pressure of approximately 1½ P.S.I. at 25°C ambient.

Bushings

The transformer will be equipped with rolled flange, inert arc welded bushings for the HV and LV connections to insure that the tank is hermetically sealed.

Sound Level

The transformer shall be designed to meet the Standard Nema Sound Levels.

Tests

The following tests shall be performed in accordance with NEMA TR-27.

1. Resistance measurements
2. Ratio tests
3. Polarity and phase relation tests
4. Excitation loss
5. Excitation current
6. Impedance and load loss
7. Temperature test shall be made on one unit only of an order covering one or more units of a given rating.

Tests will be made only where there is not available a record of a temperature test on a thermally duplicate or essentially duplicate unit if a unit is provided with forced air to give the unit two ratings the temperature test will be made at both ratings given on the nameplate.

8. Applied potential tests

9. Induced potential tests

Outgoing Line Section

The following paragraphs are a listing of the possible outgoing sections available.

A. Terminal Compartment

A low voltage terminal compartment for cable exit, integral with the transformer section shall be supplied for bottom (top) entrance of _____ /C, (size) _____ cables per phase and _____ for the neutral.

B. Panelboard

(Maximum of 1600 amp, 54X spaces)

A low voltage compartment with a _____ amp and _____ wire panelboard or equivalent shall be provided. The panelboard will consist of molded case circuit breakers as shown below (on the drawings) which will be manually operated with thermal-magnetic overcurrent protection. A door shall be provided with a key lock to cover the panelboard.

Quantity	Frame Size	Pole	Trip Rating, Amps	Interrupting Rating, Amps

C. Low Voltage Lead Facilities

Provisions will be made for connecting the transformer directly to the low voltage switchgear housing and low voltage leads to the switchgear bus.

D. Network Protector

Provisions will be made for connection in the field to a network protector.

Westinghouse



Ventilated Dry Type Power Centers

Self-Contained and Coordinated Type ASL, 1000-5000 Kva HV Through 15,000 Volts

Application

Ventilated dry type transformers are ideally suited for indoor and outdoor (see pg. 5) applications and offer many advantages over liquid-filled transformers. They may be installed in practically any indoor location not subject to submersion or to a high concentration of destructive fumes.

A self-contained power center incorporates a switch or terminal compartment while a coordinated power center is used close-coupled to switchgear.

Benefits

Reliability and Long Life

- Windings are protected by NOMEX® insulation and DORYL® varnish – a Westinghouse exclusive – having very high temperature and endurance characteristics.
- A 220°C fully coordinated insulation system is used instead of the more commonly used 180°C insulation.
- The insulation system is evaluated at full load in a full 40°C ambient for 100,000 hours – not the 20,000 hour theory proposed by some manufacturers. These insulation features provide an excellent 2.27×10^6 hrs. mean time between failures.
- Each unit is subjected to a complete set of short circuit calculations which have

been verified by full size prototype testing (results available on request).

- Coil types are coordinated with voltage application, i.e., Barrel type/cylindrical coils on 1.2 and 5 Kv class; Disc/pan-cake coils on 5, 8.6 and 15 Kv class and HISERCAP® coils – a Westinghouse exclusive – on 15, 25 and 34.5 Kv class.
- The ventilation system is engineered to assure proper operating temperature in the coils. Each design is verified to guarantee properly directed air movement of at least 100 cubic feet per minute per Kw loss.
- The plenum chamber positively directs cooling air under pressure through the coil ducts at high speed to assure thermal operation under the 220°C allowable limit.

Safety and Versatility

- Each transformer is supplied with lightning arresters – a Westinghouse exclusive – allowing confident application to any exposed line regardless of line BIL.
- Air insulated and cooled by natural convection, these transformers release no toxic gases and cannot explode. Elimination of these principal liquid-filled transformer potential hazards makes them especially desirable for installation in schools, hospitals, hotels, theatres,

factories, etc. where large groups of people are present.

- Where space limitations are a consideration and insurance regulations prohibit liquid-filled, dry type transformers offer lower weight and absence of liquid allowing their mounting in such places as balconies to save floor space and yet provide safe operation.

Proven Methods and Materials

- Westinghouse testing standards are the highest in the industry. New designs are given complete and exhaustive load, short circuit and insulation tests to prove methods and materials used in manufacture. Verified production line models receive standard quality control inspections and tests by our most experienced personnel. Certified reports on routine tests can be obtained on all units, and special tests or reports can be obtained by special orders.

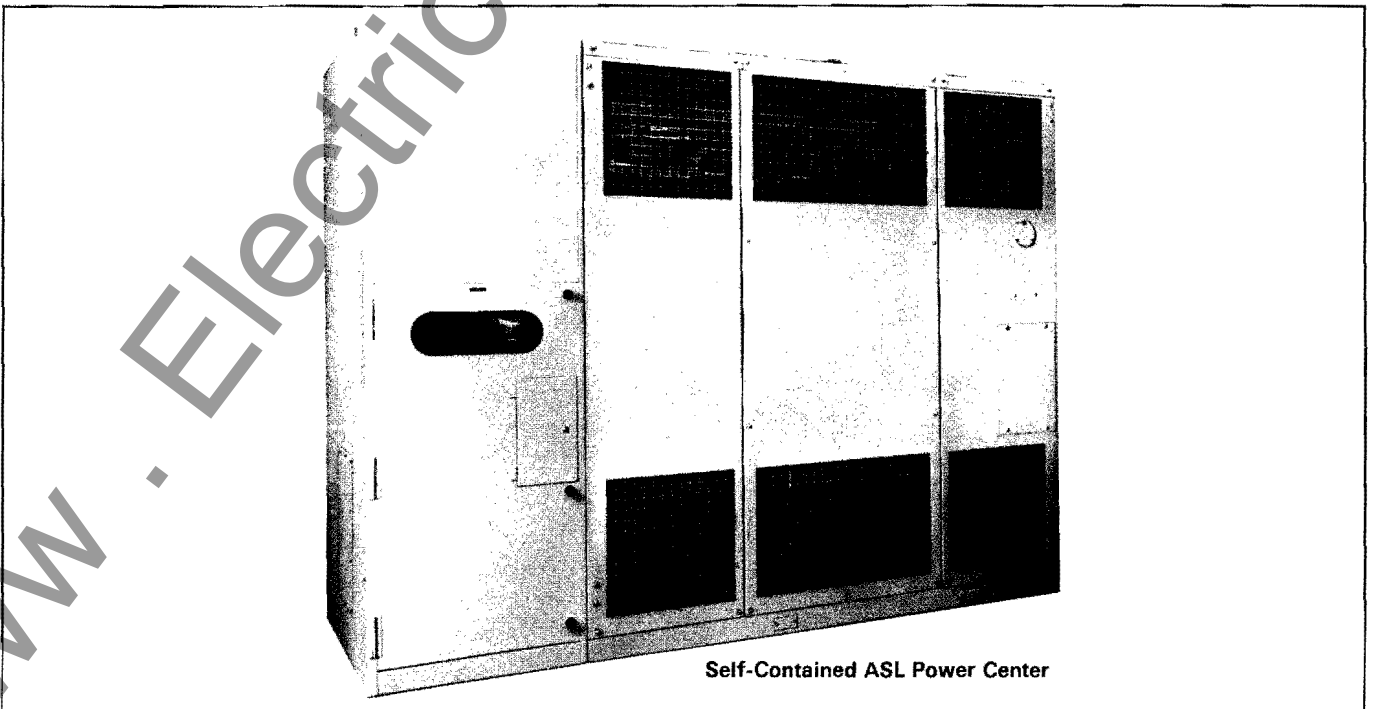
Further Information

Prices: PL 47-330, PL 48-121

Description: DB 47-352 (DT-3 Power Centers)
DB 47-353 (ASL-R Power Center)Ⓢ

Ordering Information and Dimensions: DS 47-370

Ⓢ Specification Data for Dry-Types – Pages 10-12



Self-Contained ASL Power Center

Westinghouse



Doryl® Final Coating

Doryl® high temperature varnish maintains superior bond strength, high dielectric strength and good power factor at elevated temperatures associated with Class H insulation systems. The thermal aging characteristics, thermal stability and physical resistance to common solvents exceeds that of commonly used silicone materials. The resistance to alkalis, acids, and moisture is excellent. High and low voltage coils are impregnated with this varnish and baked before assembly.

Figure 1 shows the bond strength of Doryl tested under both temperature and temperature/time conditions. Doryl is stronger at high temperatures than any other varnish in every thermal class tested. Silicone strength vs. temperature is illustrated for comparison and are published values. Maintenance of silicone bond strength with time is not shown because even initial strength at test temperature for silicone is too low to make such a study meaningful.

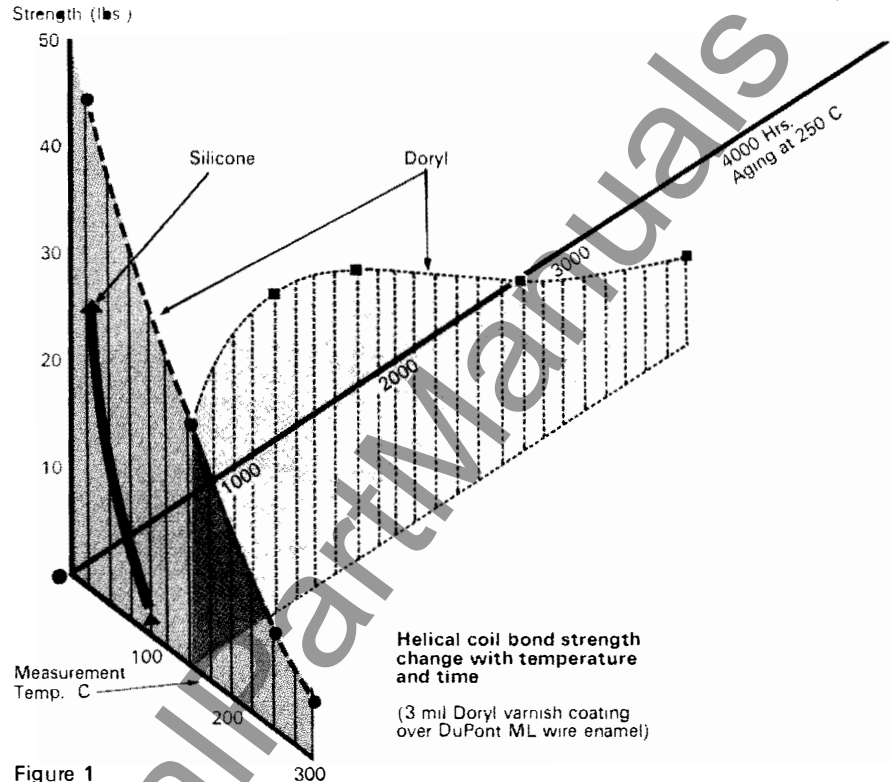


Figure 1

Helical coil bond strength change with temperature and time
(3 mil Doryl varnish coating over DuPont ML wire enamel)

Thermal Life

The curves in Figure 2 show the extra thermal life which is available with Doryl. These curves show extrapolated life/temperature test results for Doryl samples with the tests being more severe than the conditions of actual service at these time and temperatures. The comparison test merely defines the superiority of Doryl materials. Since silicones, in actual service, operate well at Class H, the improvement in insulation life by the use of Doryl is obvious.

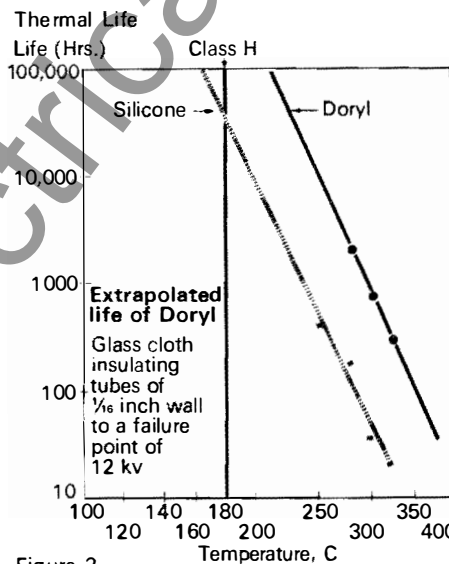


Figure 2

Solvent Resistance

Cured Doryl vs Cured Silicone

Air cooled dry-type transformers are not always operated in nice clean air. Figure 3 shows the relative resistance of silicone and Doryl to some of the more common contaminants which may be in contact with the insulation. It is again obvious that high solvent/chemical resistance is a major property of Doryl even at elevated temperatures. Silicones are water repellent at room temperatures but are relatively easily hydrolyzed at higher temperatures.

This chemical resistance property of Doryl means that a much longer time is required to deteriorate the Doryl and allow the insulation materials to be exposed to chemical reactions. Again Doryl helps to assure a long life insulation structure.

Solvent Resistance Cured Doryl vs Cured Silicone

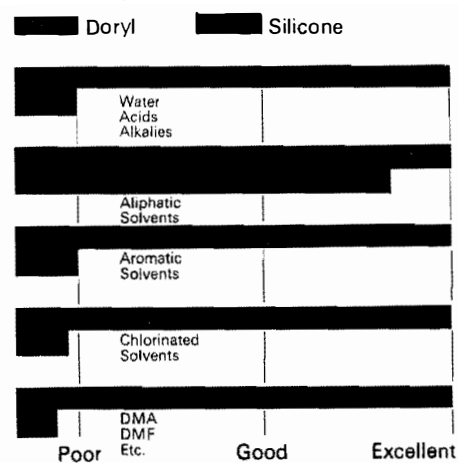
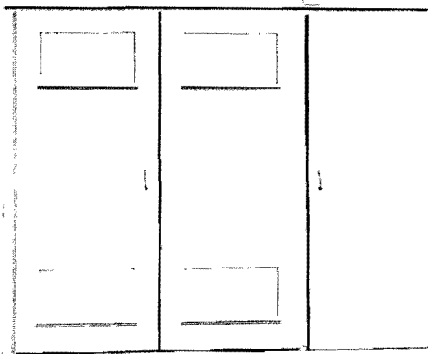


Figure 3

Ventilated Dry Type Power Centers

Self-Contained and Coordinated
Type ASL, 1000-5000 KVA
HV Through 15,000 Volts

Accessories

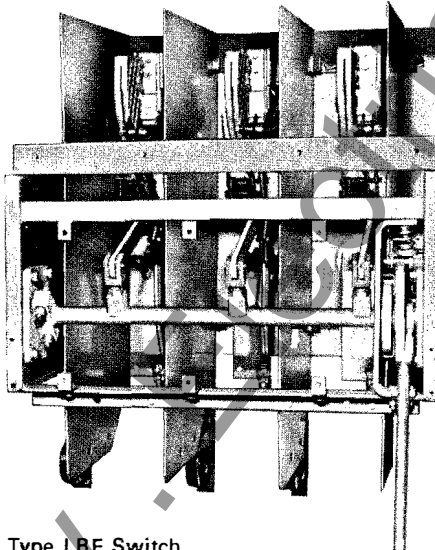


Outdoor Case

Ventilated dry type units are available with outdoor and outdoor tamperproof construction for use when codes prohibit use of liquid filled units and space is at a premium. Shown is an outdoor tamperproof transformer.

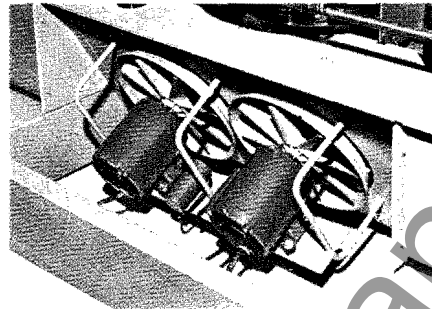
Special ventilating grills allow required cooling air to flow in and out of the case but block the passage of rain, fine spray or wind-driven snow.

An extra dip and bake of varnish and appropriately located space heater protect against damage to the core and coils from condensation during thermal cycling.



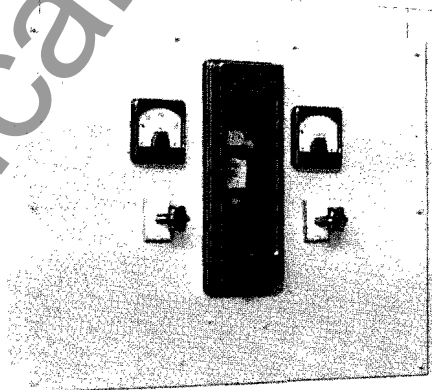
Type LBF Switch

The Type LBF switch is an air insulated, gang operated, three pole, two position, link type load interrupter switch. Rated 15 Kv and below, the switch will interrupt load currents to 600 amperes. The switch may be unfused or fused with Type RBA or CLE fuses.

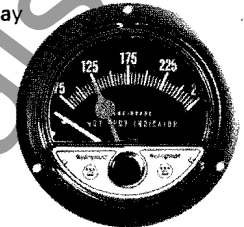


Cooling

Forced air cooling is available on all units. 1000 KVA units use 6 small fans, 3 on each side of the coils. With air blast equipment in operation the units have forced cooled ratings of 133 percent of the self-cooled rating. On units rated above 1000 KVA, fans mount near the bottom of the case and their output is uniformly distributed by an air chamber, upward through each phase group. Single phase 230 volt, capacitor start, Thermoguard® protected fan motors are turned on or off by a Type TRM winding temperature relay.



TRM Relay



Included on all AA/FA units and available as an optional accessory on AA units, the TRM relay indicates winding hot spot temperature.

The hot spot temperature is an indication of the load being carried by the transformer. Alarm contacts are furnished to signal overload conditions. On fan cooled units, a separate set of contacts turn the fans on when the AA rating is exceeded.



Forced Air Control Panel

Instruments and Metering

Low voltage metering and instruments and their required instrument transformers as permitted in Price List 47-330 can be furnished when specified.

Westinghouse



Transformer Dimensions and Weights

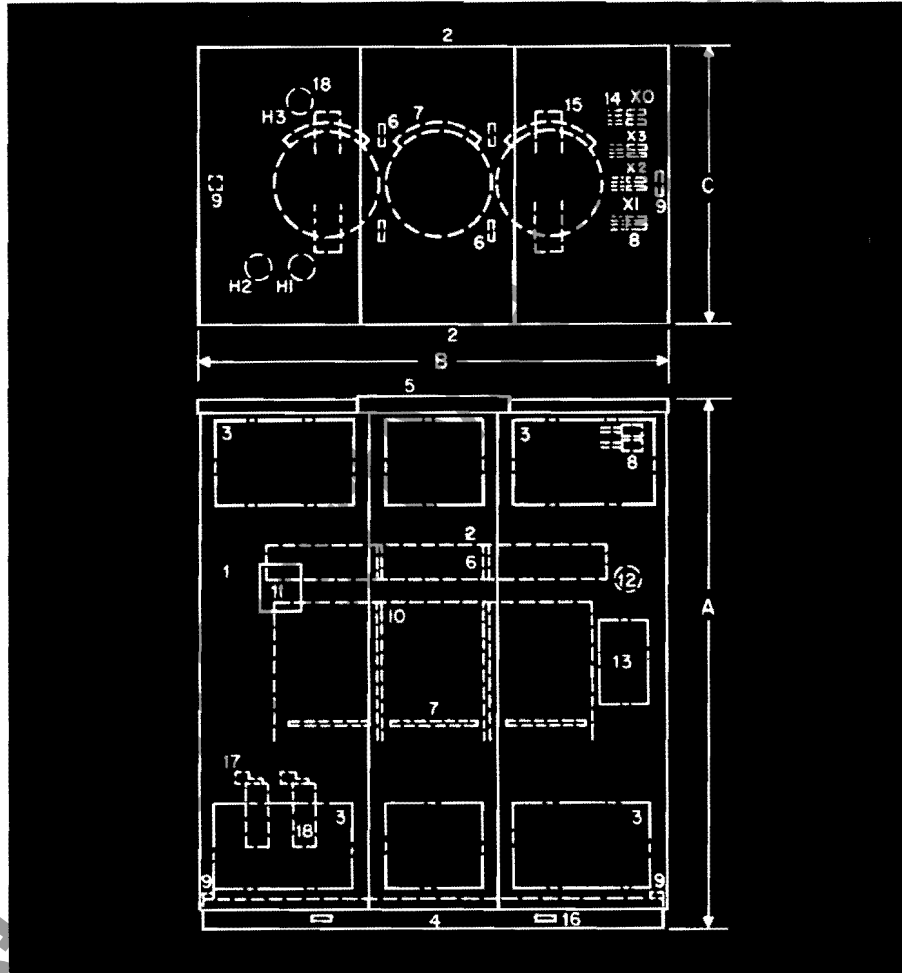
1. Case
2. Removable panels
3. Ventilation grille
4. Bar base
5. Removable cover for access to lifting lugs
6. Lifting lugs.
7. H.V. taps and connectors (In front for L.V. left)
8. L.V. flexible connector (provided when close coupling to switchgear)
9. Ground pads
10. Core and coils
11. Diagram instruction plate
12. Thermometer – when required
13. Air blast control panel – when required
14. L.V. neutral (always in rear)
15. Vibration dampener
16. Provision for jacking
17. H.V. Terminals
18. Lightning arresters

Note: Shown for L.V. Right. for L.V. Left turn 180°

Add 12 inches to the B dimension for HV and/or LV terminal compartments or CDP panelboards which are integral with the transformer case.

When coordinating with Westinghouse equipment on HV and/or LV, dimensions include transition space.

Other dimensions are available – refer to factory



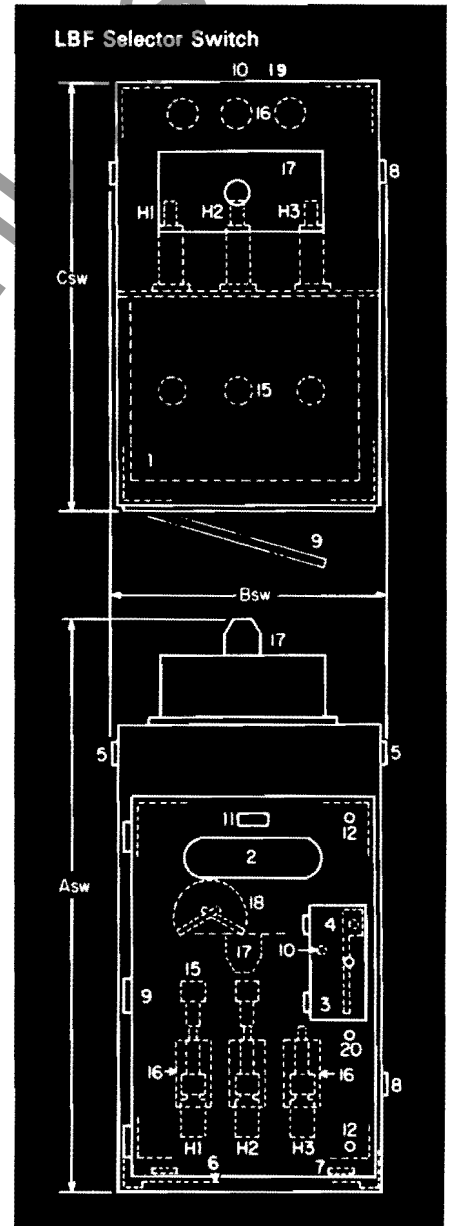
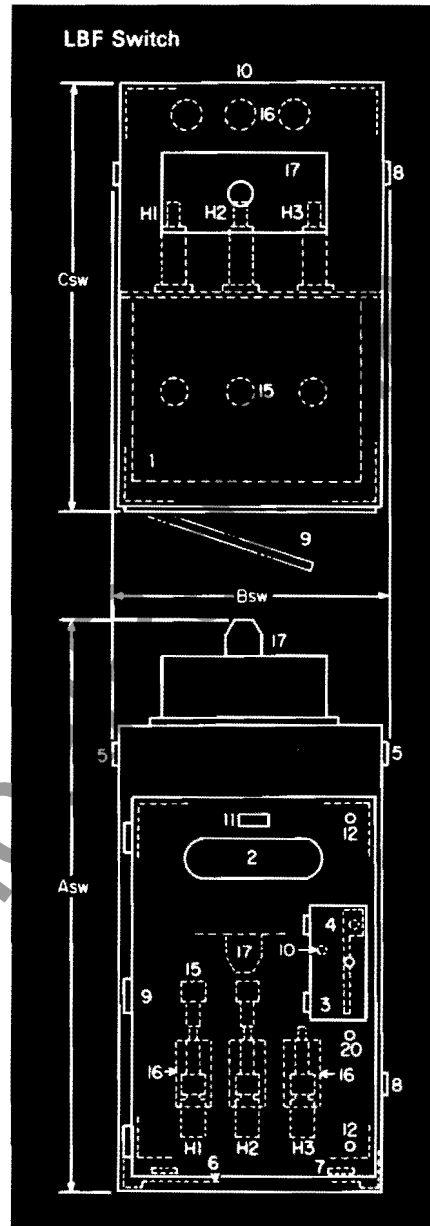
KVA	Dimensions In Inches																	
	HV 2400, 4160, or 4800 Delta			LV 208Y/120 or 240Δ			LV 480Δ			LV 480Y/277			LV 2400 or 4160					
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1000	6100 lbs. 90% 80 48	5800 lbs. 90% 80 48	5400 lbs. 90% 80 48	6300 lbs. 90% 85 48	6200 lbs. 90% 80 48	6100 lbs. 90% 80 48	8000 lbs. 90% 90 48	7100 lbs. 90% 90 48	6600 lbs. 90% 90 48	8600 lbs. 100 100 54								
1500	8100 lbs. 100 90 48	8000 lbs. 90% 85 48	6900 lbs. 90% 85 48	8200 lbs. 100 90 48	8100 lbs. 90% 85 48	7900 lbs. 100 90 48	9900 lbs. 100 90 48	8500 lbs. 90% 90 48	8600 lbs. 90% 90 48	10300 lbs. 100 100 54								
2000	Refer to Westinghouse	8400 lbs. 90% 90 48	9500 lbs. 90% 90 48	Refer to Westinghouse	8800 lbs. 100 90 48	9900 lbs. 100 90 48	Refer to Westinghouse	10100 lbs. 100 100 54	10000 lbs. 100 100 54	10700 lbs. 105 100 54								
2500		9700 lbs. 100 100 54	11100 lbs. 100 100 54		10500 lbs. 105 100 54	11300 lbs. 105 100 54		11600 lbs. 105 100 54	11700 lbs. 105 100 54	12000 lbs. 110 100 54								
3000		11200 lbs. 105 100 54	11400 lbs. 105 100 54		11800 lbs. 110 100 54	12000 lbs. 110 100 54		12200 lbs. 110 100 54	12400 lbs. 110 100 54	15000 lbs. 110 100 54								
3750										18000 lbs. 110 130 54								
5000										23000 lbs. 120 130 54								

Ventilated Dry Type Power Centers

Self Contained and Coordinated Type ASL, 1000-5000 KVA. HV Through 15000 Volts

High Voltage Equipment. Dimensions and Weights

1. Switch case
2. Sight window
3. Hinged door with key lock for access to operating handle
4. Operating handle
5. Lifting holes with cover plates – 4 total
6. Formed base
7. 1 x 3 inch jacking slots – 4 total
8. Ground pad – 2 total – ½ – 13 tap
9. Hinged door – mechanically interlocked with switch operating mechanism. Door cannot be opened unless switch is in the open position. Switch cannot be closed unless door is closed.
10. Bolted on back panel for access to cable entrance compartment
11. Identification Plate
12. Door knobs
15. Fuses (if specified)
16. Lightning arresters (if specified)
17. Pothead-bottom or top entrance (if specified)
18. Dead break feeder selector switch
19. Selector switch sight window



LBF Switch

Dimension in Inches			Wt.-Lbs.			
A _{sw} ③	Max.		B _{sw}	C _{sw}	Min.	Max.
	5 Kv	15 Kv				
63	81	97	34	48 54②	1200	1500

② Same as transformer, or 54 inches with loop feed potheads.

③ Top entrance with potheads add 15 inches for 5 Kv and 5 inches for 15 Kv.

LBF Selector Switch

Dimensions in Inches			Wt.-Lbs.			
A _{sw}	Max.		B _{sw}	C _{sw}	Min.	Max.
	5 Kv	15 Kv				
76	107	116	34	54 72④	1400	2000

④ With loop feed potheads.

www.Electric.com

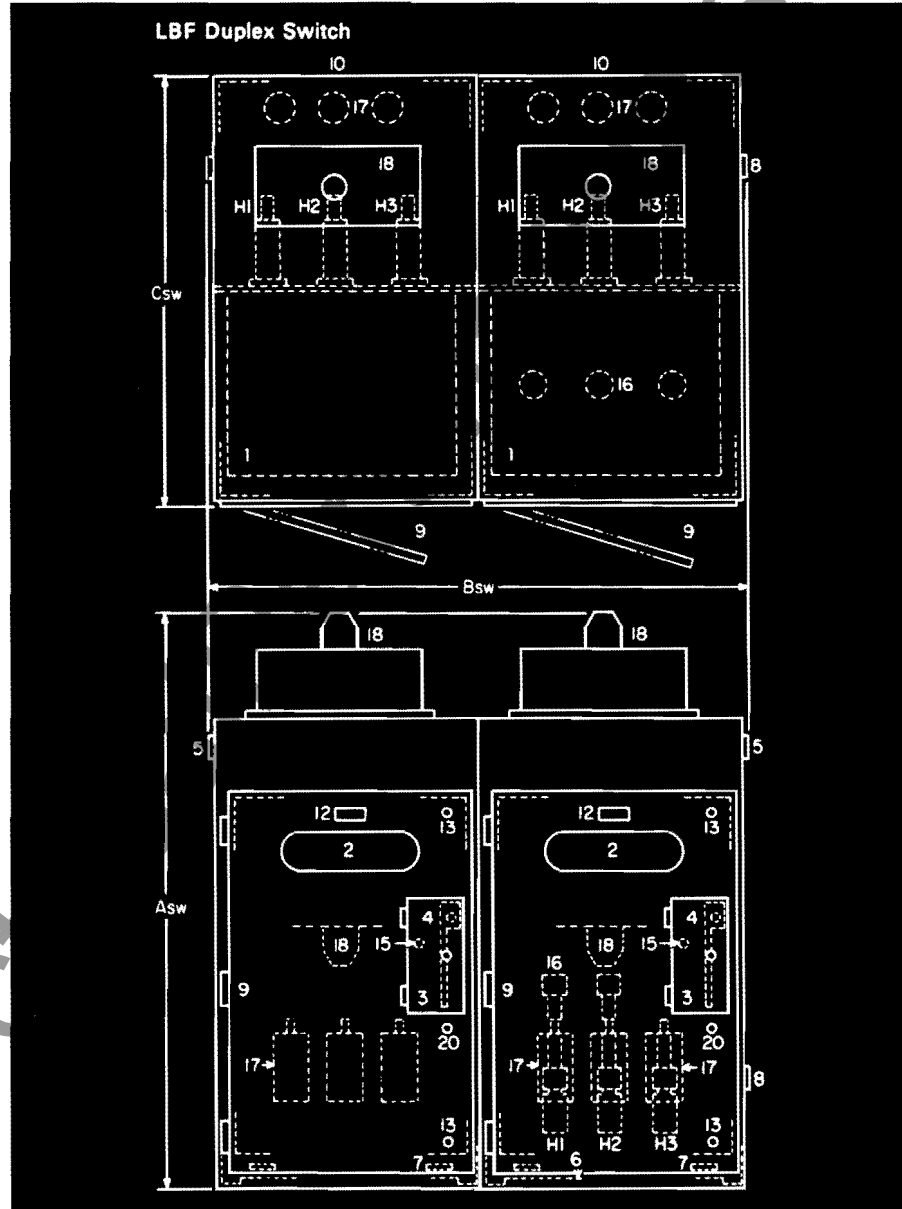
Ventilated Dry Type Power Centers

Self-Contained and Coordinated,
Type ASL, 1000-5000 KVA,
HV Through 15000 Volts

High Voltage Equipment. Dimensions and Weights, Continued

LBF Duplex Switch

1. Switch case
2. Sight window
3. Hinged door with key lock for access to operating handle
4. Operating handle
5. Lifting holes with cover plates - 4 total
6. Formed base
7. 1 x 3 inch jacking slots - 4 total
8. Ground pad - 2 total - 1/2 - 13 tap
9. Hinged door - mechanically interlocked with switch operating mechanism. Door cannot be opened unless switch is in the open position. Switch cannot be closed unless door is closed.
10. Bolted on back panel for access to cable entrance compartment
12. Identification plate
13. Door knobs
16. Fuses (if specified)
17. Lightning arresters (if specified)
18. Pothead - bottom or top entrance (if specified)



LBF Duplex Switch

Dimensions in Inches				Wt.-Lbs.		
A _{sw}			B _{sw}	C _{sw}	Min.	Max.
Min.	Max. ⑤	15 Kv				
65	91	106	68	54 72 ⑥	2800	4000

⑤ For top entrance with potheads add 15 inches to 5 kv or 5 inches to 15 kv dimensions.
⑥ With loop feed potheads.

The Westinghouse policy of continuous improvement of its products may result in changes of these specifications without notice.



Westinghouse Electric Corporation
Sharon Transformer Division
Sharon, Pa. 16146

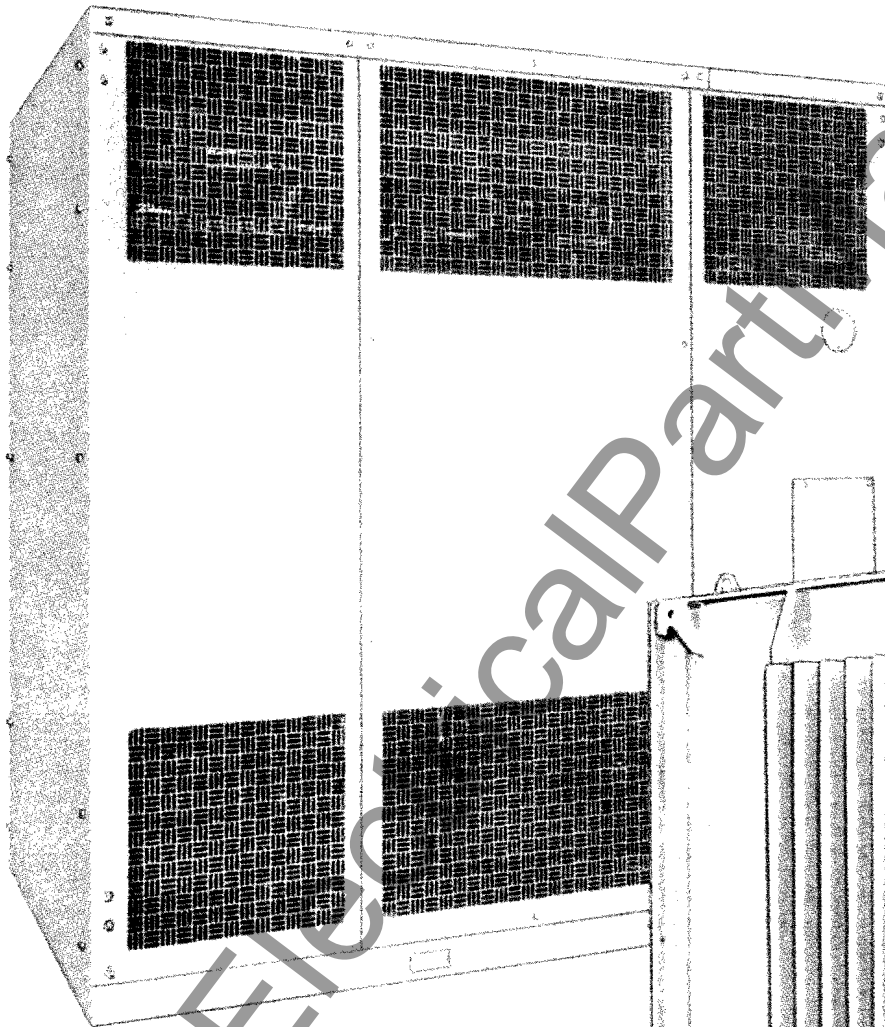
47-351 D WE A
Descriptive Bulletin

Page 1

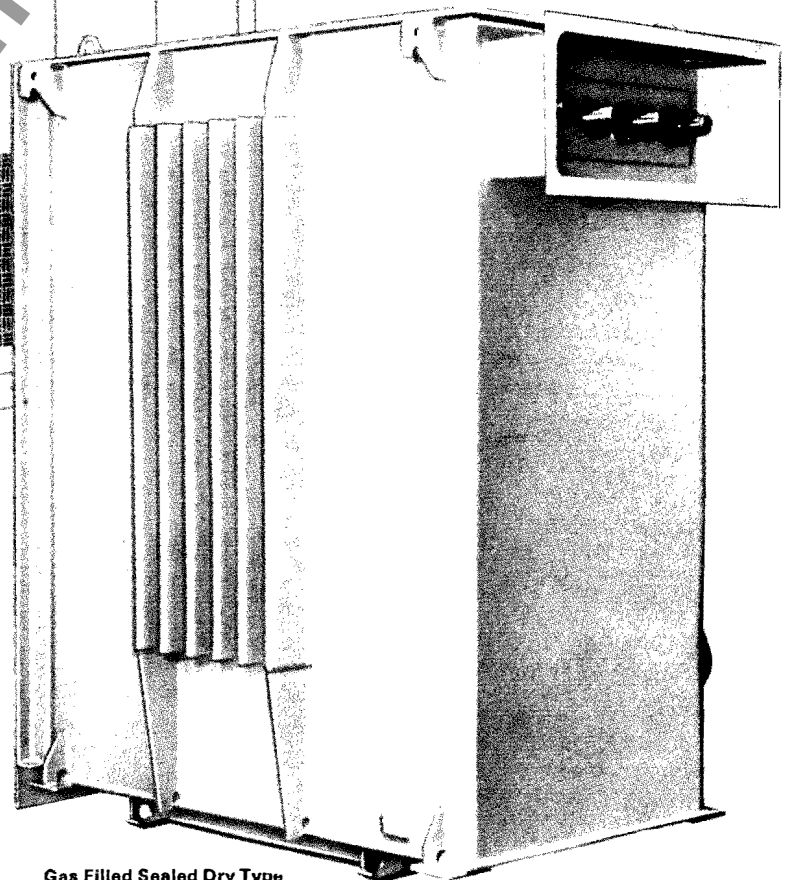
March, 1976
Supersedes DB 47-353, pages 1-12, dated
December, 1970, DB 47-351, pages 1-8,
dated September, 1972 and DB 47-151,
pages 1-8, dated December, 1972
Mailed to: E,D,C/2076, 2108, 2123, 2124/DB

For Unit Substations, Power Centers and
Networks
Single and Three Phase
11 $\frac{1}{2}$ Through 20,000 Kva

Dry Type Transformers Type ASL



Ventilated Dry Type



Gas Filled Sealed Dry Type

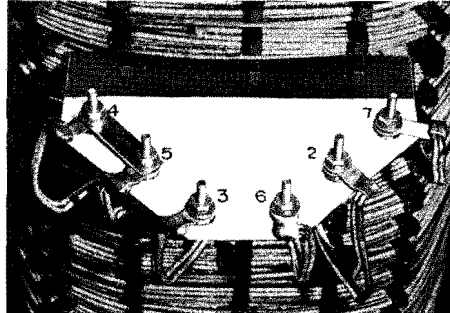
Design Features Continued

Taps

Ventilated Dry Type

The taps can be reached from the front or back by removing a panel which also protects tampering with the taps.

The taps are rigidly supported by brazing them on the central section of the HV coils. Taps are changed by moving the flexible bolted links from one connecting point to the other. To simplify these changes, the connections are clearly identified.

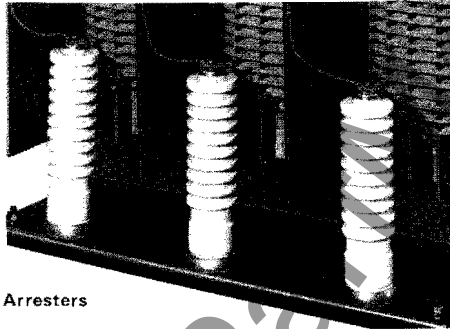


Tap Terminal Board

Gas Filled Sealed Dry Type

De-energized Tap Changer

A tap changer will be supplied to permit changing connections in the high voltage windings from outside the transformer case. The tap changer is designed for operation only when the transformer is de-energized. Provision will be made for padlocking in any position. A packing gland seals the operating shaft at the tank wall. The external housing prevents gas loss due to permeability through the gland packing material. The housing cover may be either gasketed or soldered.



Arresters

Arresters

Ventilated dry type power centers are supplied with RM arresters as standard equipment to provide maximum surge protection for the transformer and associated secondary equipment.

Located in the transformer section, the RM arresters protect against a possible double surge voltage at the transformer terminals even though arresters may be used on the incoming line. The possibility of exceeding BIL level due to reflected voltages is dependent on length and character of cable and steepness of surge.

This protection has added importance when LV apparatus or equipment in use has a lower BIL level than the LV transformer winding. Due to electrostatic coupling, a surge transmitted through a transformer could be as much as 1 1/2 to 2 times as great as would be anticipated on the basis of turns ratio alone and could damage this LV equipment. Therefore, RM arrester at HV terminals are desirable.

In applying arresters, it should be remembered to use an arrester with a sparkover to operate below the BIL of the apparatus and to install the arresters at the apparatus to be protected.

Isomode Pad (Vibration Dampeners) On Ventilated Dry Type Units

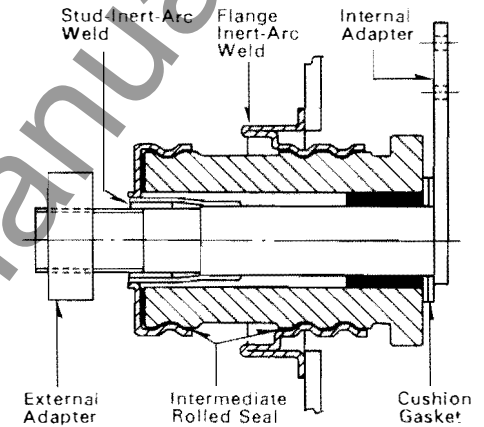
After removal of the shipping braces, the core and coil assembly rests on rubber Isomode pads to isolate normal core vibrations from the case, foundation or any conduit or bus duct connected to the case.

Coil Impregnation

High temperature moisture and chemical resistant varnish maintains superior bond strength, high dielectric strength and good power factor at elevated temperatures associated with 220°C insulation systems. The thermal aging characteristics, thermal stability and physical resistance to common solvents exceeds that of commonly used varnishes. The resistance to alkalis, acids, and moisture is excellent. High and low voltage coils are impregnated with this varnish and baked before assembly.

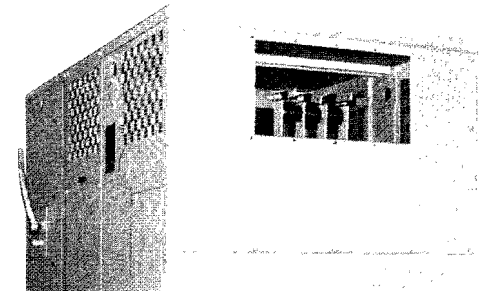
Bushings on Gas Filled Sealed Dry Type Transformers

Gas filled transformers are equipped with rolled flange, inert arc welded bushings, type RFW, for the HV and LV outlets. These bushings insure a hermetically sealed tank while allowing flexibility for conductor expansion and contraction.



Rollled Flange Bushing

Network Transformers



Low Voltage Flange for Network Protector

Westinghouse ventilated or gas filled sealed dry type (GFSDT) transformers are available for use on grid type horizontal or vertical secondary network systems. These systems are most common where a high load density exists. Since there is no explosion hazard due to the presence of liquids, no vaults are required.

These transformers can also be used in spot network systems. Network transformers are provided with an LV flange for connection in the field to a network protector. The above illustration is typical of ventilated dry type units. Gas filled sealed dry type network transformers utilize a LV flange similar to that shown on page 1.



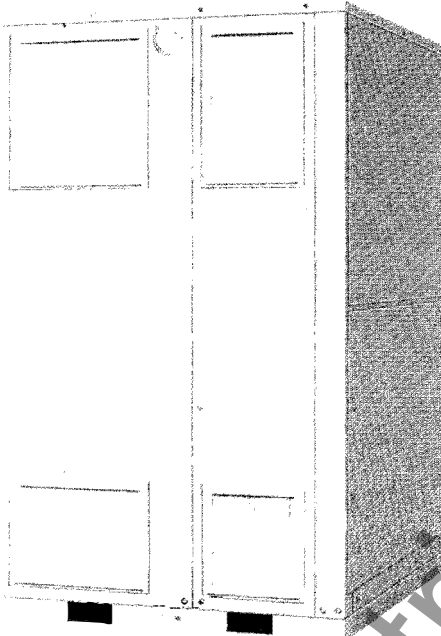
Accessories – Ventilated Dry Type

Outdoor Cases

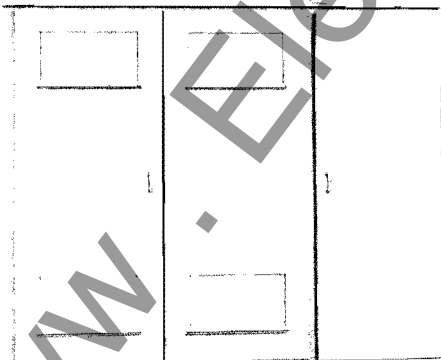
Ventilated dry type units are available with outdoor and outdoor tamper-resistant construction.

Special ventilating grills allow required cooling air flow in and out of the case but block the passage of rain, fine spray or wind-driven snow.

An extra dip and bake of varnish and appropriately located space heaters protect against damage to the core and coils from condensation during thermal cycling.



Standard Outdoor Case



Tamper-Resistant Outdoor Case

Temperature Devices Ventilated Dry Type Transformers



Type TRC,
Opt-i-Therm
Winding
Temperature
Indicator
and Control

Type TRC

The type TRC Opt-i-Therm Temperature Indicator and Control is the most sophisticated instrument ever applied to ventilated dry type transformers for temperature indication and control of transformer protective devices. It is included on all ventilated dry type AA/FA units and available as an optional accessory on ventilated dry type AA self-cooled units.

The type TRC Opt-i-Therm is a thermocouple actuated, optically isolated temperature indicator and control. The instrument indicates hottest spot temperature in degrees centigrade and provides contacts for starting and stopping cooling fans, operating alarm signals and lights and actuating breaker trip coils or initiating other shut down or load reduction procedures.

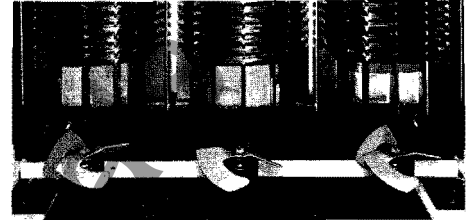
The actuating thermocouple is wound into the transformer low voltage coil at the point of highest temperature. The instrument, therefore, indicates the actual hottest spot temperature of the transformer rather than a simulated hot spot temperature from conventional instruments.

The ability of this type TRC relay to more accurately measure hot spot temperatures offers three benefits: 1. The ability to safely and reliably carry heavier overloads. 2. The ability to size a transformer more nearly to the actual load which means lower first cost. 3. More accurate fan control has the benefit of longer transformer life and fewer failures.

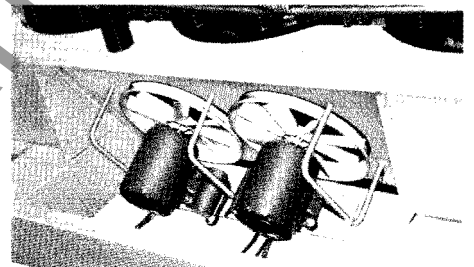
Type TRI

When only hot spot indication is required, the type TRI (indicator only) can be provided. Similar to the TRC, the type TRI utilizes the same thermocouple actuated sensing device, but provides no control functions for alarms, fans or shut down.

Cooling on Ventilated Dry Type Units



Small Units

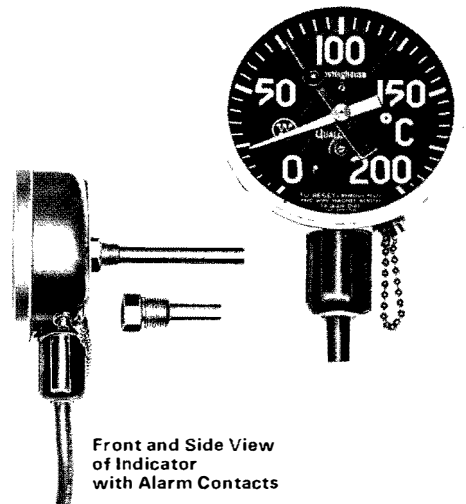


Large Units

Forced air cooling is available on all units 300 KVA and above. With air blast equipment in operation the units have forced cooled ratings of 133 percent of the self-cooled rating. Single phase 230 volt fan motors are turned on or off by a Type TRC winding temperature relay.

Gas Filled Sealed Dry Type Transformers

Temperature Indicator Hot Gas, Two Switch, Dial Type, Submersible, Direct Mounted



Front and Side View
of Indicator
with Alarm Contacts

A dial-type thermometer with alarm contacts with maximum resettable indicating hand will be provided. It will indicate the temperature of the gas above the core and coils.

Transformer Standards

Dimensions and Weights as listed in the Tables are based on the following:

1. Standard Base Kva Ratings: 300-500-750-1000-1500-2000-2500.
2. 3 Phase, 60 Hertz, Two Windings.
3. Standard Temperature Rise (See Tables) above ambient air temperature of 40°C (104°F) maximum and 30°C (86°F) average in any 24-hour period.
4. Maximum Altitude of 1000 meters above sea level for full rating (3300 feet).
5. Standard High Voltages: 2400-4160-4800-6900-7200-12000-12470-13200-13800, delta connected only.
6. Standard High Voltage Taps: two approximately 2½% full capacity above and two below rated voltage.
7. Standard Low Voltages (no taps):
208y/120 (1000 Kva max.)
240 delta (1000 Kva max.)
480 delta (all ratings)
480y/277 (all ratings)
8. Aluminum Winding Conductors.
9. No Series-Parallel or Delta-Wye Terminal Boards.
10. Standard Accessories.
11. Standard Surface Preparation, Finish Processes, Materials and Colors.
12. Standard Tests in accordance with ANSI Standard Test Code (see below).
13. HV and LV Basic Impulse Levels, Impedance and Sound Levels in line with the following Tables.

Standard Insulation Levels – Kv BIL

High Voltage Rating	Vent. Dry Transformer		Gas Filled Transformer	
	HV	LV (600 Max.)	HV	LV (600 Max.)
2400	25	10	45	30
4160	25	10	60	30
4800	25	10	60	30
6900	35	10	75	30
7200	35	10	75	30
12000	50	10	95	30
12470	50	10	95	30
13200	50	10	95	30
13800	50	10	95	30

Standard Guaranteed Sound Levels – Decibels

Maximum Base Kva (Self Cooled)	Vent. Dry Transformer		Gas Filled Transformer
	AA	FA	AA
300	58	67	57
500	60	67	59
750	64	67	63
1000	64	68	63
1500	65	69	64
2000	66	71	65
2500	68	71	66

Transformer Kva Ratings, 3 Phase

In addition to their basic self-cooled (AA, 100%) Kva ratings, modern Westinghouse ventilated dry type standard Secondary Unit Substation transformers are designed for continuous operation at the following supplementary fan-cooled (FA) Kva ratings:

Ventilated Dry Type

150°C AA Rating	150°C FA Rating
300	400
500	667
750	1000
1000	1333
1500	2000
2000	2667
2500	3333

Gas filled sealed Dry Type Transformers are available as AA self cooled (100%) only.

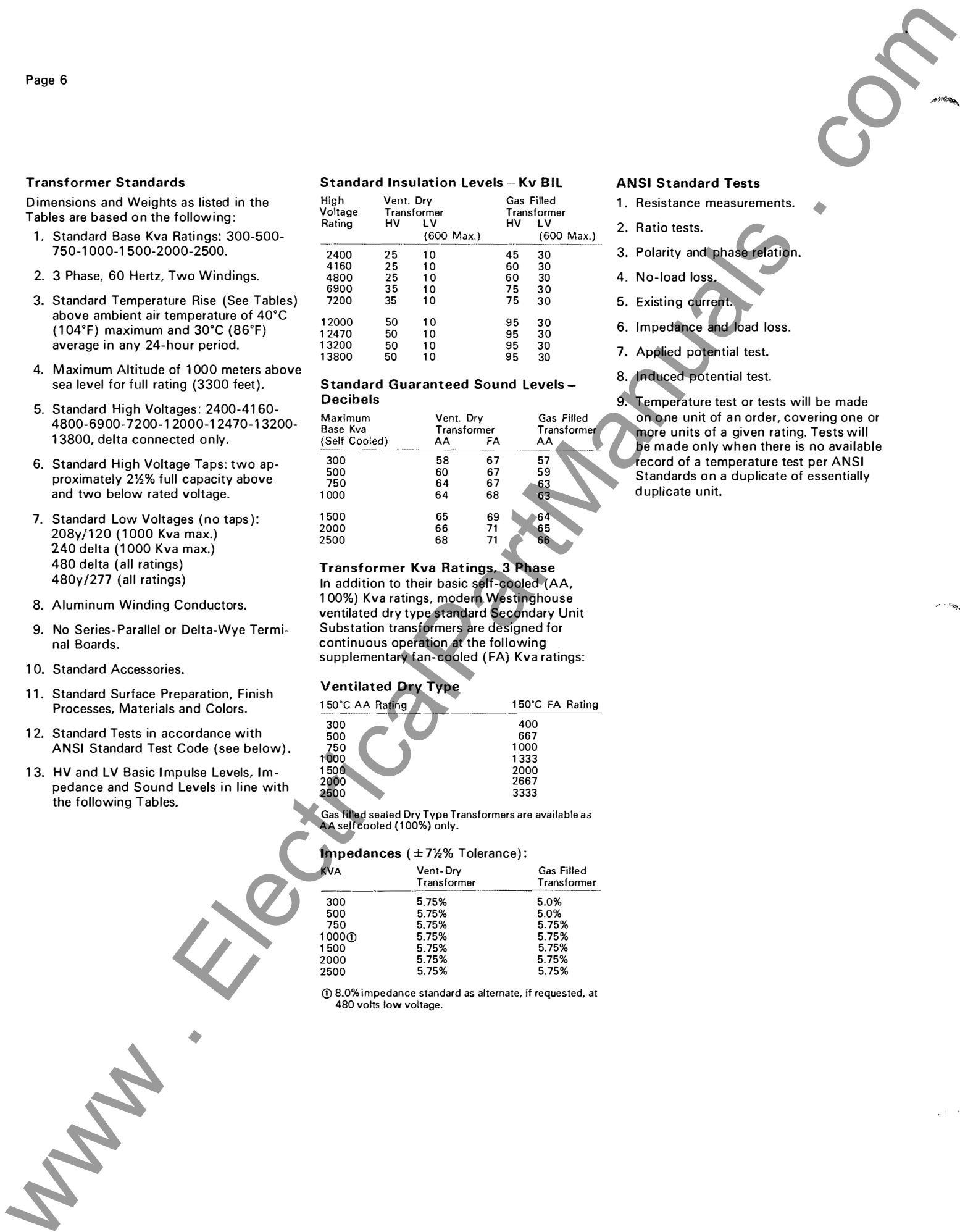
Impedances (± 7½% Tolerance):

KVA	Vent-Dry Transformer	Gas Filled Transformer
300	5.75%	5.0%
500	5.75%	5.0%
750	5.75%	5.75%
1000①	5.75%	5.75%
1500	5.75%	5.75%
2000	5.75%	5.75%
2500	5.75%	5.75%

① 8.0% impedance standard as alternate, if requested, at 480 volts low voltage.

ANSI Standard Tests

1. Resistance measurements.
2. Ratio tests.
3. Polarity and phase relation.
4. No-load loss.
5. Existing current.
6. Impedance and load loss.
7. Applied potential test.
8. Induced potential test.
9. Temperature test or tests will be made on one unit of an order, covering one or more units of a given rating. Tests will be made only when there is no available record of a temperature test per ANSI Standards on a duplicate of essentially duplicate unit.



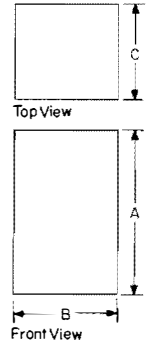


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Transformer Dimensions and Weights – Inches (Approximate)

Ventilated Dry Type, 150°C Temperature Rise, Low Voltage 600 Maximum, Indoor

Kva Self Cooled (AA)	Hv 2400, 4160 or 4300Δ 25 Kv BIL				Hv 6900 or 7200Δ 35 Kv BIL				Hv 12000, 12470, 13200 or 13800Δ 50 Kv BIL			
	Dimensions			Weight Lb.	Dimensions			Weight Lb.	Dimensions			Weight Lb.
A	B	C	A		B	C	A		B	C		
300	90%	60	54	2500	90%	60	54	2800	90%	60	54	3100
500	90%	60	54	3100	90%	60	54	3600	90%	60	54	3900
750	90%	60	54	4000	90%	60	54	4300	90%	60	54	4600
1000	90%	60	54	5300	90%	90	54	6100	90%	90	54	6800
1500	90%	90	54	6000	90%	90	54	7700	90%	90	54	9100
2000	90%	90	54	9300	90%	90	54	9300	90%	90	54	10400
2500	90%	90	54	9500	90%	90	54	9500	90%	90	54	10600



Note: B dimension is for open-ended flange connection on the HV and LV and does not include a ground plane.

Refer to Westinghouse for outdoor applications and other ratings.

Gas Filled Dry Type, 150°C Temperature Rise, Low Voltage 600 Maximum, Indoor or Outdoor

Kva (AA)	Hv 2400Δ, 45 Kv BIL, or 4160 or 4500Δ, 60 Kv BIL				Hv 6900 or 7200Δ, 75 Kv BIL, or 12000, 12470, 13200 or 13800Δ, 95 Kv BIL			
	Dimensions			Weight Lb.	Dimensions			Weight Lb.
A	B	C	A		B	C		
300	83	95	47	6800	86	98	50	7000
500	86	98	50	7000	91	103	54	8500
750	91	103	54	8500	96	108	57	10000
1000	96	108	57	10000	102	114	63	13000
1500	102	114	63	13000	108	120	66	17000
2000	108	120	66	17000	112	122	70	21000
2500	112	122	70	21000				

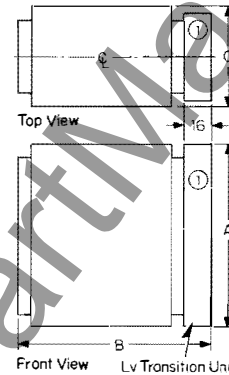


Table – Optional HV and LV Termination Dimensions

Add the following to the B dimension for the HV and LV Terminations:

Add to "B"	Termination
15"	HV Terminal Compartment
36"	HV Cutouts, Front Access
15"	LV Terminal Compartment
15"	LV Panelboard, End/Access
38"	LV Panelboard, Front/Access

Note: Refer to Westinghouse Switchgear Division for Add to "B" dimension for network protector if used.

① B dimension is for open ended flange connection on the HV and the LV and does not include a ground plane.

② For indoor only. For outdoor, omit LV transition unit and Z-bar flanges, and substitute flanged throat; reduce B 6 in. for 15 Kv and 9 in. for 5 Kv Hv.

Typical Specifications

Hv Sections Available

A. Cutouts

The Hv section shall consist of 3-single pole _____ amp gang operated oil fused cutouts.

Optional Equipment Available

1. Provide _____ spare fuse links for oil fused cutouts.
2. Provide _____ key interlock(s) to interlock with _____.

B. Terminal Compartment

The Hv section shall consist of a terminal compartment integral with the transformer case for cable entrance. The terminal connectors shall be located so as to give sufficient space for stress cones. Sufficient barriers shall be supplied between the Hv terminal compartment and the transformer to prevent the temperature surrounding the cable from exceeding NEMA Standards.

Optional Equipment Available With HV Terminal Compartments

Provide 3, _____ Kv (RM) (intermediate) (station type) arrestors in Hv compartment
RM arrestors provided in transformer section unless specified in Hv section.

Potheads

Provide (3-1/C) (1-3/C) potheads for termination of Hv cables.

Loop Feed

Provide loop feed terminal connectors.

Interlock

Provide interlocked armored cable terminators for (1-3/C) (3-1/C) cables.

Ground Bus

Provide a ground bus in the Hv terminal compartment to connect to incoming ground wire.

C. High Voltage Lead Facilities

Provisions will be made for connecting the transformer case directly to a high voltage switch housing or other HV switchgear and the HV leads to this equipment.

Ventilated Dry Type Transformer

The indoor (outdoor), standard or (temperature-resistant) transformer will be rated as follows:

_____ Kva, 3 phase, 60 hertz, ventilated dry type, 150°C rise, 220°C insulation system. (Complete with fans for increased rating to _____ Kva.)
HV _____ volts, 3 wire, with plus two 2½%, and minus two 2½% no load full capacity taps delta connected.
LV _____ volts, 4 wire (3 wire) wye (delta) connected.

Accessories will include the following:

- Diagram instruction plate
- Provision for lifting and jacking
- Removable case panel for access to high voltage taps
- Drip proof cover
- Ground pad

High Voltage Taps

Tap leads will be terminated at the coils and equipped with provisions for changing taps.

Insulation

The transformer will be of the non-explosive, fire-resistant, air insulated, dry type construction, cooled by the natural circulation of air through the windings. Solid insulation in the transformer will consist of inorganic materials such as porcelain, glass roving or Nomex in combination with a sufficient quantity of a high temperature binder to impart the necessary mechanical strength to the insulation structure.

Case

The knockdown case for ease in fitting through limited openings will be formed of 13 gauge sheet steel construction equipped with removable panels for access to the core and coils on the front and rear with ornamental ventilating grills. A bolted corner section will be supplied for access to the core and coil lifting loops for lifting the complete assembly.



Typical Specifications Continued

Paint Finish

The case will be phosphatized and finished in manufacturer's standard light gray.

Lightning Arresters

Three low ratio lightning arresters will be mounted in the transformer case and connected to the high voltage leads. They will be for use on a _____ Kv grounded (ungrounded) system.

Impedance

The impedance of the transformer at normal rating and frequency will be manufacturer's standard $\pm 7\frac{1}{2}\%$ tolerance.

Gas Filled Sealed Dry Type Transformer Section

The indoor (outdoor) transformer will be rated as follows:

_____ Kva, 3 phase, 60 Hertz, gas filled sealed dry type, 150°C rise, with a 220°C insulation system.

H.V. _____ volts, 3 wire, plus two $2\frac{1}{2}\%$, minus two $2\frac{1}{2}\%$ no load full capacity taps, delta connected.

L.V. _____ volts, 4 wire (3 wire) wye (delta) connected.

Accessories will include the following:

- I-beam base for rolling in any direction.
- Cover will be welded to the tank flange.
- Yukon cooler $\frac{1}{4}$ inch thick.
- Lifting hooks – 4 total.
- Jack pads – 4 total.
- Vacuum pressure gauge.
- Dial-type gas thermometer with alarm contact.
- $\frac{3}{8}$ inch filling plug – 2 total.
- Diagram nameplate.
- Welded handhole cover for access to high voltage and low voltage bushings.
- De-energized tap changer, externally operated
- Ground pad.
- Welded-on main tank cover.

Impedance

The impedance of the transformer at normal rating and frequency will be $*\% \pm 7\frac{1}{2}\%$ tolerance.

(*5.0% for 500 Kva and below, 5.75% for 750 Kva through 2500 Kva).

Sealed Tank

The transformer will be of sealed tank construction to prevent breathing. Tank will be hermetically sealed with metallic seals throughout and will be tested at 15 psi pressure. It will be provided with welded-on $\frac{1}{4}$ " thick Yukon coolers.

Shot Blast

The case and coolers will be cleaned by shot blast and phosphatized before the paint is applied.

Finish

Paint finish will be manufacturer's standard, applied over a properly prepared surface. The color will be light gray ANSI No. 61 (indoor) or dark gray ANSI No. 24 (outdoor).

Insulation

The transformer will be of the nonexplosive, fire resistant, fluorocarbon insulated, dry type construction, cooled by the natural circulation of fluorocarbon through the windings. Solid insulation in the transformer will consist of inorganic materials such as porcelain, glass roving or Nomex in combination with a sufficient quantity of a high temperature binder to impart the necessary mechanical strength to the insulation structure. The transformer will be insulated and cooled with C₂F₆ fluorocarbon gas. It will be shipped filled with this C₂F₆ gas to a gauge pressure of approximately $1\frac{1}{2}$ P.S.I. at 25°C ambient.

Bushings

The transformer will be equipped with rolled flange, inert arc welded bushings for the HV and LV connections to insure that the tank is hermetically sealed.

The following tests shall be performed in accordance with NEMA TR-27.

1. Resistance measurements
2. Ratio tests

3. Polarity and phase relation tests

4. Excitation loss

5. Excitation current

6. Impedance and load loss

7. Temperature test shall be made on one unit only of an order covering one or more units of a given rating.

Tests will be made only where there is not available a record of a temperature test on a duplicate or essentially duplicate unit. If a unit is provided with forced air to give the unit two ratings the temperature test will be made at both ratings given on the nameplate.

8. Applied potential tests

9. Induced potential tests

Outgoing Line Section

The following paragraphs are a listing of the possible outgoing sections available.

A. Terminal Compartment

A low voltage terminal compartment for cable exit, integral with the transformer section shall be supplied for (top) (bottom) entrance of _____ - _____ /C, (size) _____ cables per phase and _____ for the neutral.

B. Panelboard

(Maximum of 1600 amp, 54X spaces)
A low voltage compartment with a _____ amp and _____ wire panelboard or equivalent shall be provided. The panelboard will consist of molded case circuit breakers as shown (below) (on the drawings) which will be manually operated with thermal-magnetic overcurrent protection. A door shall be provided with a key lock to cover the panelboard.

Quantity	Frame Size	Pole	Trip Rating, Amps	Interrupting Rating, Amps

C. Low Voltage Lead Facilities

Provisions will be made for connecting the transformer directly to the low voltage switchgear housing and low voltage leads to the switchgear bus.

D. Network Protector

Provisions will be made for connection in the field to a network protector.