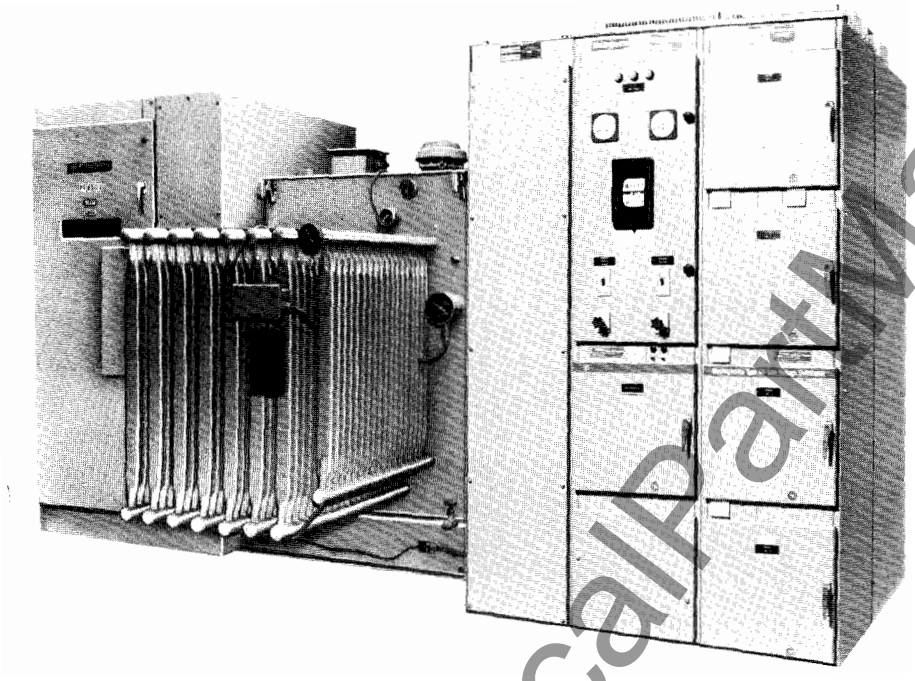
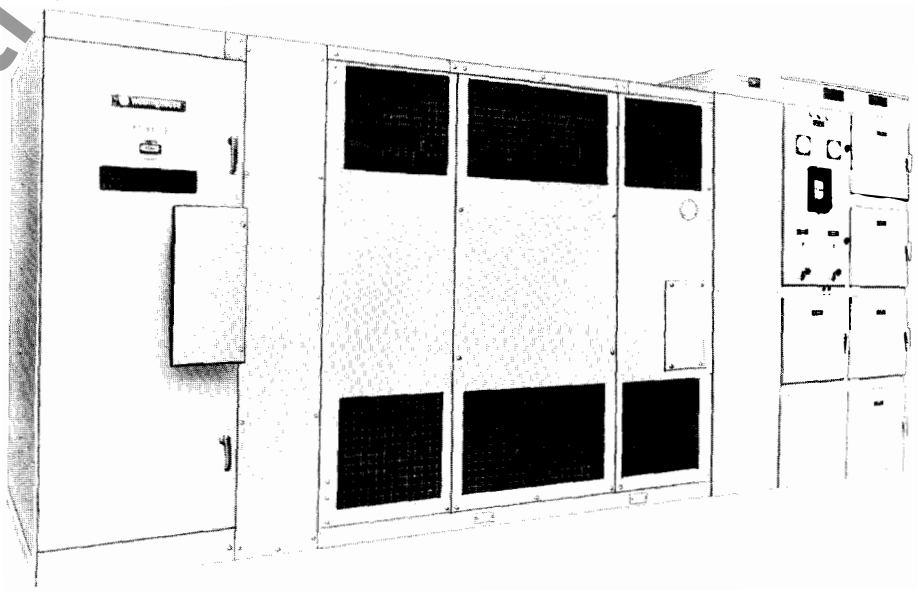
Westinghouse Electric Corporation
Distribution and Control Business Unit
Pittsburgh, Pennsylvania, U.S.A. 15220

July, 1985
Supersedes DB 32-850
dated November, 1978
E,D,C/31-700A, 32-000B

112.5 to 2500 Kva
Primary—2400-13800 Volts Ac
Secondary—208Y/120-600 Volts Ac

Power Centers With Type DS Secondary Switchgear.





Power Centers With Type DS Secondary Switchgear

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Definition

A Power Center as referred to in this publication is defined as a coordinated assembly consisting of 3 phase transformers with high voltage incoming line sections and an assembly of Low Voltage Distribution Sections, with the following parameters:

Transformer Kva—112.5 thru 2500
High Voltage—2400 V thru 13,800 V
Low Voltage—208, 240, 480 or 600 V

Power centers described in this publication may be indoor or outdoor, with a selection of high voltage incoming sections and a choice of transformer types as shown under "components," and an arrangement of Type DS Switchgear to suit the application.

Power centers as defined herein come within the category of "Secondary Unit Substations" as defined in NEMA Standards.

Why Power Centers?

Power centers follow the modern system concept of locating transformers as close as practicable to areas of load concentration at utilization voltages, thus minimizing the lengths of secondary distribution cables and buses. This concept provides several basic advantages over older methods, such as:

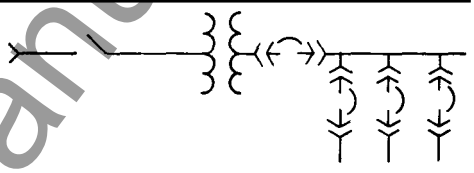
- Reduced power losses.
- Improved voltage regulation.
- Improved service continuity.
- Reduced likelihood of faults.
- Increased flexibility.
- Minimized installation expense.
- Availiability of non-flammable types of transformers eliminates necessity of vaults.
- Efficient space utilization.

Advantages of Westinghouse Power Centers

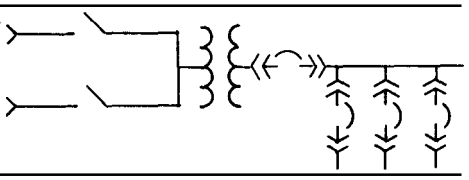
- Single source responsibility.
- Complete coordination, both mechanical and electrical.
- Extreme flexibility, with wide choice of components and ratings to meet exact application requirements.
- Optimum safety to operators.
- Modern design.
- Meets all applicable ANSI, IEEE, NEMA and UL Standards.

Types of Systems

A. Simple Radial
- Simplest and least costly.
- Easy to coordinate.
- No idle parts.



B. Primary Selective Radial
Similar to simple radial, with added advantage of spare primary incoming cable circuit. By switching to spare circuit, duration of outage from cable failure is limited.

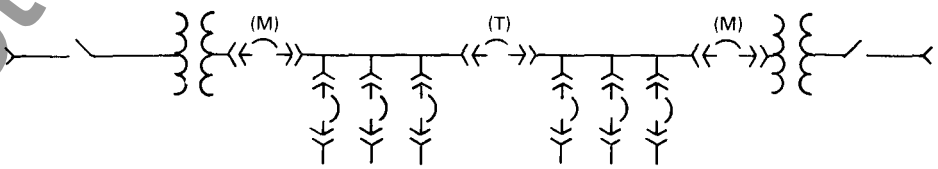


C. Secondary Selective
Normally operates as two electrically independent unit substations, with bus tie breaker (T) open, and with approximately half of total load on each bus. In case of failure of either primary incoming circuit, only one bus is affected, and service can be promptly restored by opening main breaker (M) on dead bus and closing tie breaker (T). This operation can be made automatic, with duration of outage on either bus limited to a few seconds.

Since the transformers are not continuously paralleled, secondary fault currents and breaker application are similar to those on radial unit substations.

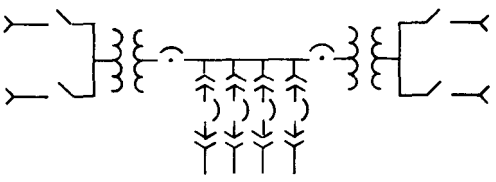
Either transformer can be removed from service and isolated with no interruption of service on either bus, by first closing the tie breaker and then opening the associated main breaker.

Service continuity and substation capacity can be further improved by substituting selector type primary switches, as in B.



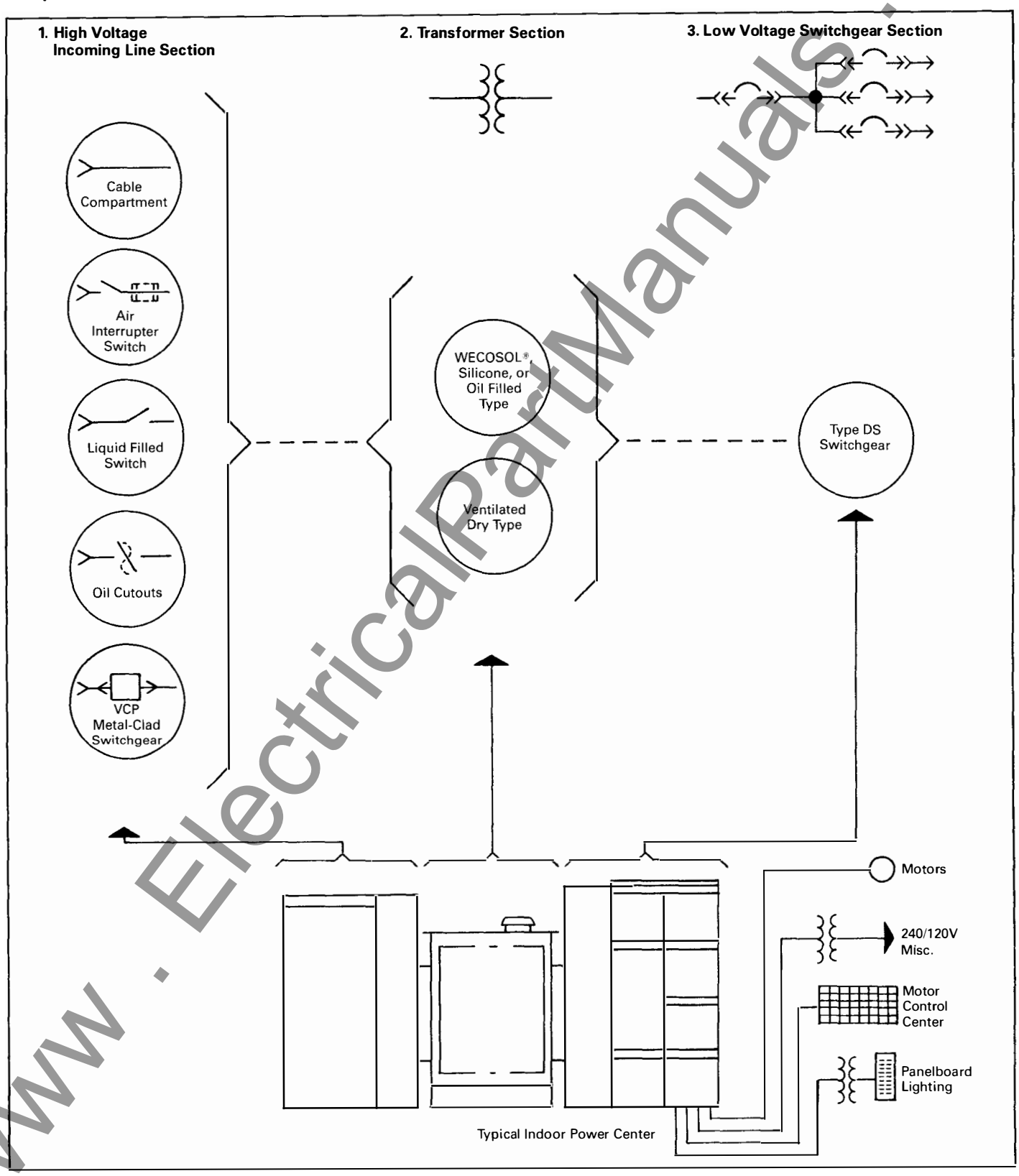
D. Spot Network
The transformers are paralleled through network protectors. In case of primary voltage failure, the associated protector automatically opens. The other protector remains closed, and there is no "dead time" on the bus, even momentarily. When primary voltage is restored, the protector automatically checks for synchronism and recloses.

- Secondary voltage regulation is improved by paralleled transformers.
- Secondary fault capability is increased by paralleled transformers, and the feeder breakers must be selected accordingly.
- Primary switches are usually selector or duplex type, so that transformers can be transferred to alternate live sources, thus shortening duration of overloads.



Power Centers With Type DS Secondary Switchgear

Components of Power Centers

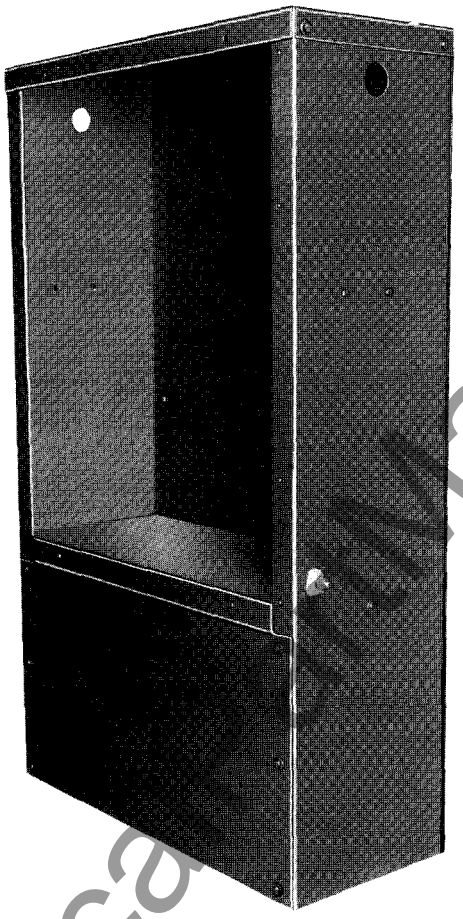


Power Centers With Type DS Secondary Switchgear

Incoming Line Section

A. Cable Terminal Compartment Only, Air Filled

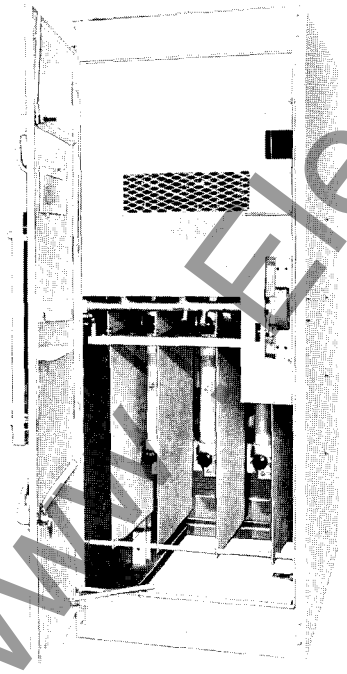
Available with all transformer types. Extends to floor and completely encloses cables and terminals. Arranged for either bottom or top cable entrance.



C. Miscellaneous Types of High Voltage Incoming Equipment

1. Type VCP VAC-CLAD® metal clad switchgear, 5 kV to 15 kV, 250 to 1000 mVA interrupting rating, indoor or outdoor.
2. Liquid filled switch.
3. Oil fused cutouts.
4. Oil-filled cable terminal compartment.

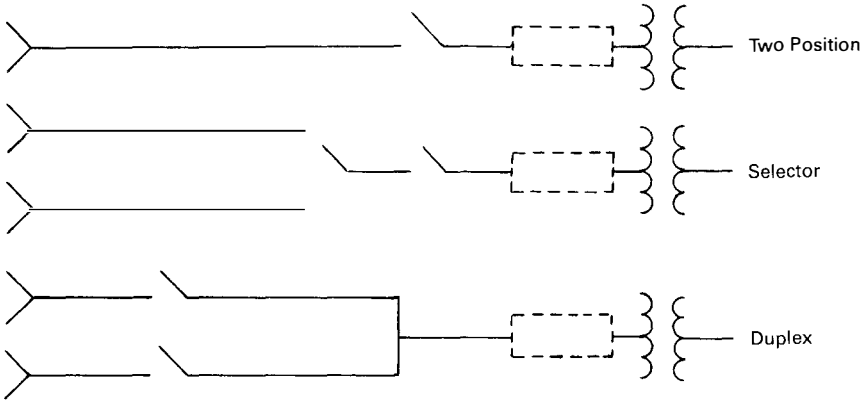
B. Load Interrupter Switch, Type WLI



Features

- Quick-make, quick-break stored energy spring mechanism, manual or motor drive.
- De-ion arc interruption in air.
- Positive switch position indication by operating mechanism.
- Safety interlock between access door and mechanism.
- Adequate insulated cable connections to transformer terminals; bare or insulated bus connections optional.
- Furnished unfused or fused with either expulsion or current limiting type fuses.
- Proven reliability.

Configurations Available



Further Information
DB 31-935

Power Centers With Type DS Secondary Switchgear

Fuses

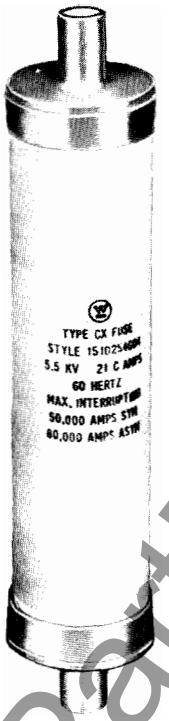
Current Limiting Type
Westinghouse CX and CXN

The CX and CXN general purpose current limiting fuses were designed specifically to provide complete fault protection on high capacity indoor and underground distribution systems. They provide excellent protection for all types of transformers.

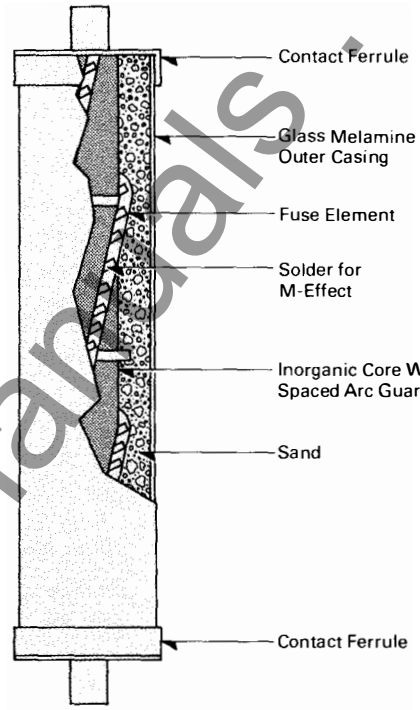
Type CX and CXN are constructed with pure silver fuse elements, a high-purity silica sand filler, an inorganic core with spaced arc guards, and a glass melamine outer casing.

During a high fault current the silver element melts almost instantly losing energy to the surrounding sand. The energy melts the sand forming a glass-like substance called fulgurite. The arc voltage rapidly increases to about three times the fuse voltage rating forcing the current to zero. The fault is interrupted in one-half cycle or less without noise or expulsion of gases.

Low level currents are cleared by the melting of a solder drop on the fuse element which melts the silver element.

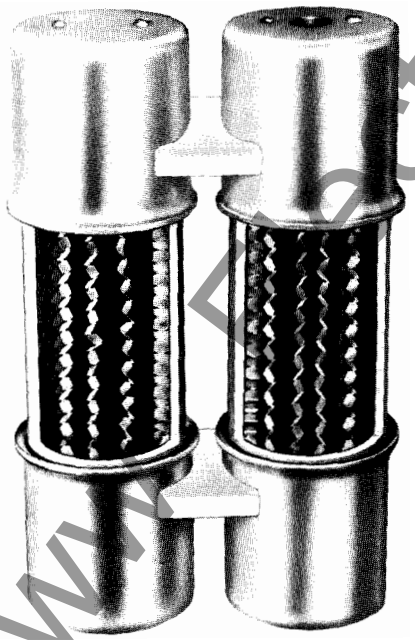


CX Fuse



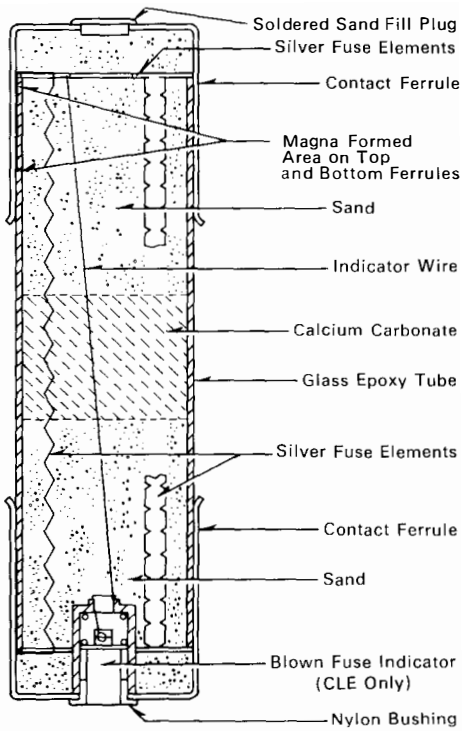
Cross Section Showing Component Parts of a CX Fuse

Type CLE Current Limiting Non-Expulsion, Non-Refillable Fuses



Cutaway view of type CLE-2 fuse showing pure silver elements.

Type CLE power fuses are basically of inorganic construction, the only organic material used being the glass-resin outer casing and the plastic indicator. The fuse elements are pure silver designed to combine maximum load carrying ability with the most favorable short circuit interruption characteristics, plus being "fatigue proof." This added feature is made possible by bending or spiralling the element prior to assembly, making the element structurally stronger and distributing expansion uniformly to withstand the most severe type of duty cycling without failure. These fuses are filled with a high purity silica sand of controlled grain size, and sandwiched between the sand filling is an additional layer of pulverant arc quenching material. The addition of this band of filler to the fuse changes its melting characteristics and facilitates low current interruption making it more suitable for transformer protection. Type CLE fuses are equipped with plunger for blown fuse indication.



Cross-section drawing showing component parts of a type CLE-1 fuse unit.

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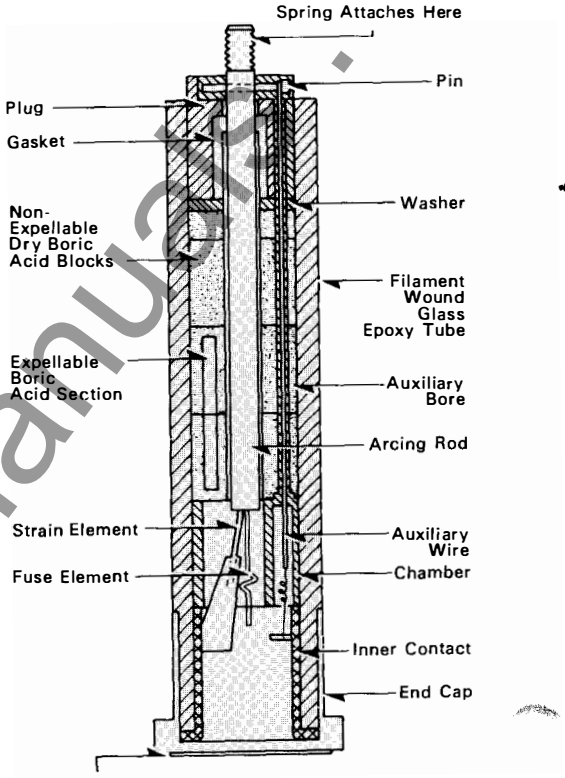
Type RBA Non-Current Limiting, Refillable, Expulsion Type Fuses

The boric acid refill is probably the most important component of the RBA fuse. It is designed to interrupt currents of short circuit magnitude within ½ cycle, and through its two de-ionizing chambers in parallel, have selective operation and interruption for both low-current and high-current faults. This is achieved by movement of the arc through the boric acid cylinder by a helical spring and rod. Intense heat from the arc, as it strikes, decomposes the dry boric acid. On decomposition the boric acid forms water vapor and inert boric oxide. The electrical interruption is caused by the steam de-ionizing the arc as it is drawn through the cylinder by the action of the spring and rod. The high particle turbulence of boric acid causes the rate of de-ionization in the cylinder to exceed the ionization rate of the electrical arc. This action prevents the arc from restriking.

After operation of the fuse, the fuse holder is taken from its mountings, the fuse refill removed and replaced with a new refill. Blown Fuse Indication is available as an option.

RBA-400 Fuse With Discharge Filter



RBA-400 Fuse Refill

Power Centers With Type DS Secondary Switchgear

Transformer Section

Fluid Filled Transformers

Advantages
A proven rectangular core and coil design, pioneered by Westinghouse in 1954, is used in conjunction with a computer program to provide rugged, dependable service and an optimized design.

The Insuldur system of thermally stabilized insulating material allows the user 12% additional Kva capacity of 55/65°C rated units or maximum 55°C Kva capacity at 40°C average ambient.

A semi-automated plant, designed specifically for the production of rectangular core form transformers, assures uniform quality and shipping expediency.

General Design Features
These transformers are designed for indoor or outdoor use. The core-coil assembly is immersed in WEMCO®-oil, silicone fluid, or WECOSOL® and has a standard temperature rise of 65°C. Either a flange or throat can be furnished on the high and low voltage side for connections to primary and secondary equipment.

High and low voltage terminals are located on opposite sides of the unit for a "straight-thru" line-up. Bushing height is standardized at 55 inches to permit ease of coordination with other equipment and later uprating at minimum costs.

Cooling is accomplished through flat, tubular coolers welded to the tank wall. A welded-on tank cover/handhole provides sealed tank oil preservation. Standard tank pressure is 5 psi for oil-filled units, 8 psi for silicone-filled units and 15 psi for WECOSOL®-filled units.

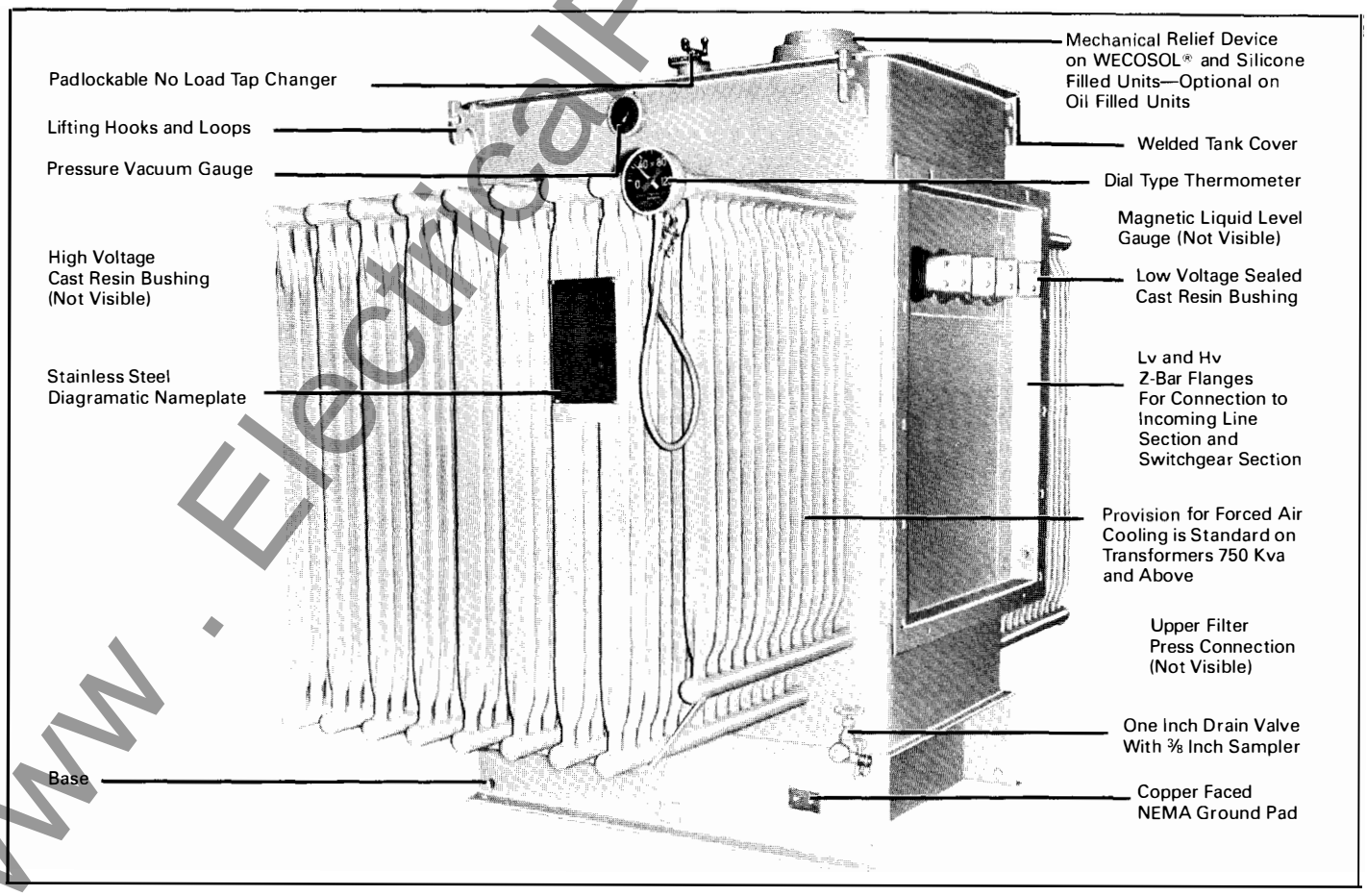
Lifting hooks are provided for lifting the entire unit and lifting loops for lifting the tank cover. The base is designed for skidding in any direction.

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

A. All surfaces are shot blasted or pickled to a semi-white metal to form a completely clean surface.
B. A caustic wash and phosphatized coating inhibit corrosion and furnish a base for high mechanical strength of paint bonding.
C. Prime coat to inhibit rust.
One coat of Primer Intermediate water-borne alkyd flow coat paint. High temperature bake at 110°C.
D. Intermediate coat of finish color.
One coat of Primer Intermediate water-borne alkyd flow coat paint. High temperature bake at 110°C.
E. Finish coat for attractive appearance. Air spray touch-up with air-dry alkyd enamel.

Standard indoor and outdoor tank color is ANSI No. 61. ANSI No. 70 and 24 can be supplied but must be specified. Other colors or other paints may be available on special request.

Standard Features and Accessories



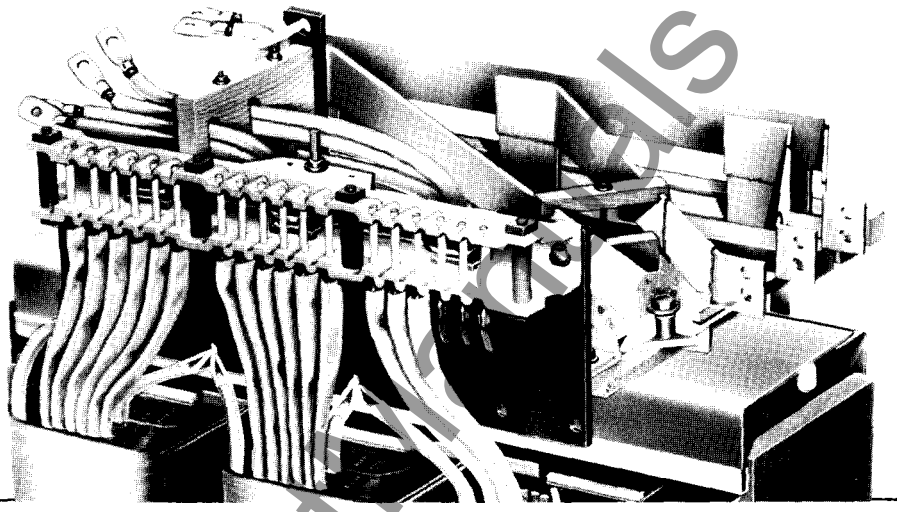
Power Centers With Type DS Secondary Switchgear

Rectangular Core and Coils

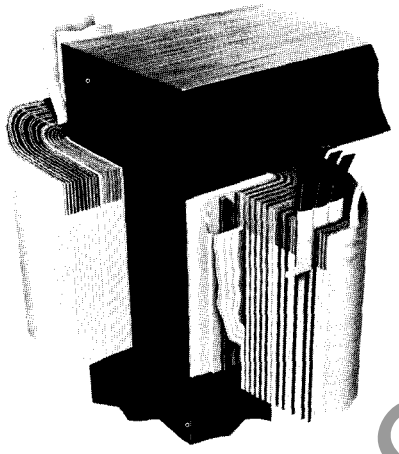
WSS Tap Changer
The Westinghouse externally operated WSS tap changer provides positive sequence line voltage changes under de-energized conditions. An in-line assembly, the WSS features through-type stationary contact studs rigidly supported by a molded plastic channel. Moving contacts are spring loaded, silver plated copper which move along the stationary line by means of a rack and pinion.

This design has no rivets, bolts or nuts, thus assuring the proper contact of current carrying parts when taps are changed. The WSS benefits the user through a reduction of repair or replacement costs by eliminating faulty tap changer operation—the cause of failure in 20% of all power transformers.

WSS Tap Changer



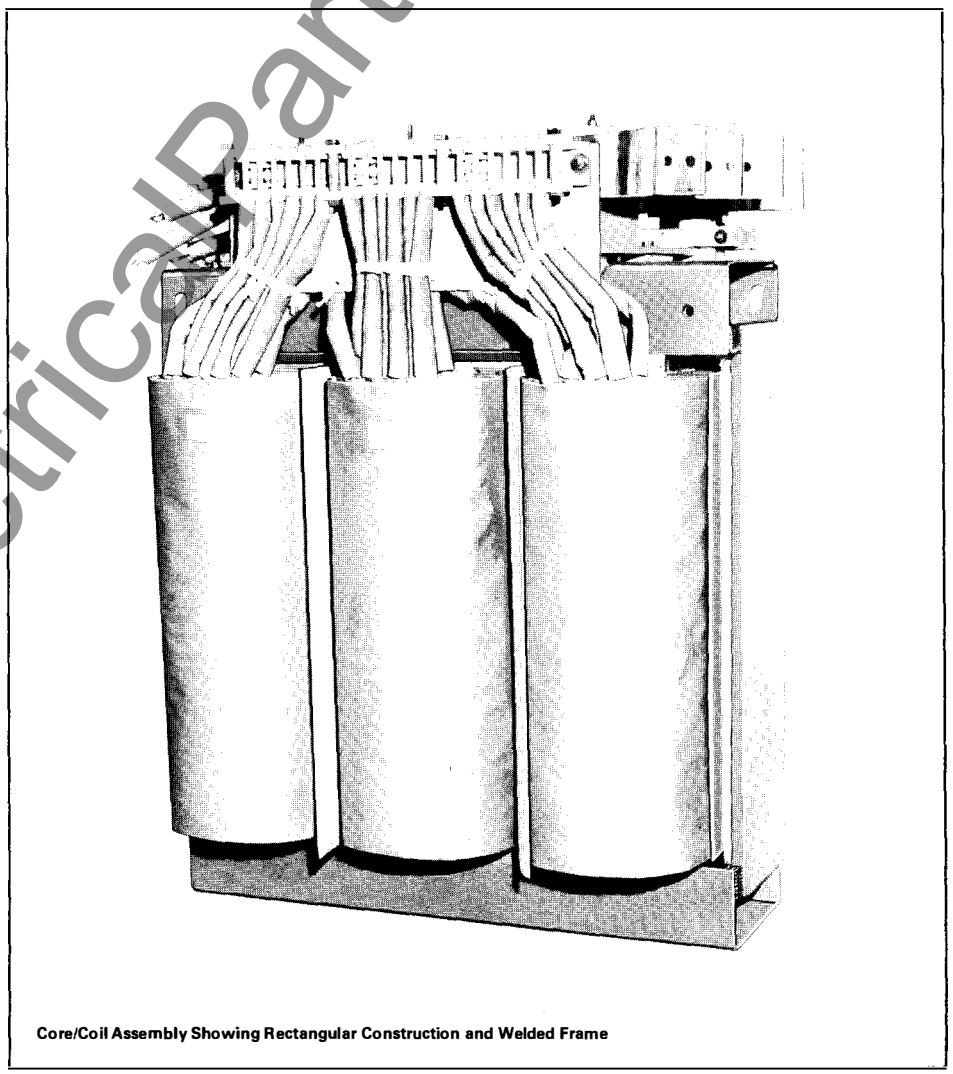
Rectangular Aluminum Wound Coils



Cutaway View of Rectangular Coils

The Westinghouse rectangular wound coil features aluminum conductor in both high and low voltage windings. The low voltage winding is accomplished on a constant tension machine and consists of full width sheet aluminum extending the full height of the coil. High voltage strap aluminum is wound directly over the low voltage winding on a constant tension traversing machine. Layer to layer and high to low insulation is diamond epoxy paper which when heat treated bonds the complete coil into a solid configuration.

The advantage of low voltage sheet aluminum is a continuous cross section of conductor that allows the electrical centers of high and low voltage windings to easily align themselves, virtually eliminating the vertical component of short circuit force.

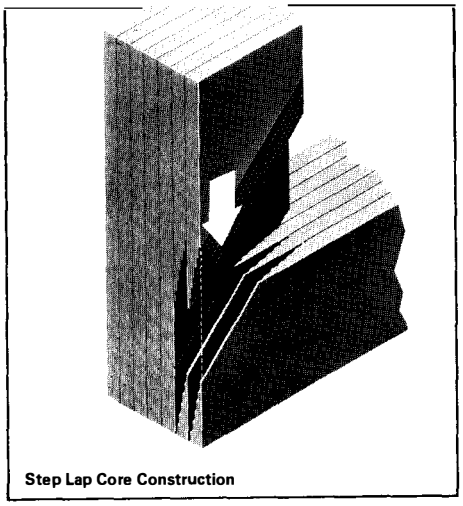


Core/Coil Assembly Showing Rectangular Construction and Welded Frame

Power Centers With Type DS Secondary Switchgear

The result is a coil so uniform and compact that the chance of windings overlapping during short circuit is minimized, reducing failure rate, repair and/or replacement cost.

Step-Lap Core



Step Lap Core Construction

The Westinghouse exclusive stacked core provides a superior flux path by utilizing the patented step-lap joining of core legs to top and bottom yokes. Hand stacked Hypersil steel punchings with interlocking laminations can be more uniformly and rigidly braced to prevent shifting during service.

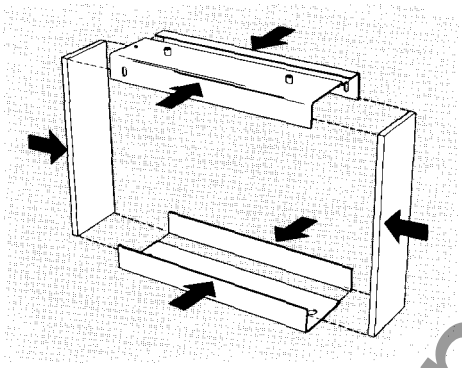
The user can benefit through reduced sound levels, lowered iron and total losses, and decreased exciting current to lower total operating cost.

On wye-wye units, a fourth leg is added to provide a path for circulating third harmonic flux during an unbalance condition.

Welded Frame
The Westinghouse exclusive welded frame provides a superior six piece supporting structure for the core and coils. End plates are thick steel slabs that are assembled in a mechanical and pressure jig around the core and coils, then welded to top and bottom plates to form a rigid structure that will not loosen during assembly, shipment, or in service. To determine the thickness of members used (even the thickness of welds), a short circuit calculation is made for each unit to determine the forces of short circuit.

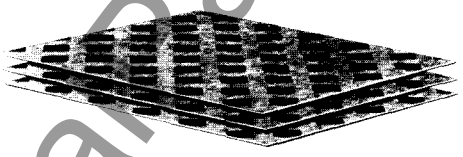
The result is an assembly that restrains vertical and horizontal forces, thus decreasing the probability of failure during severe short circuits.

This benefits the user by a reduction in repair or replacement costs and a reduction in downtime that means loss of service or lost production.



Welded Frame

Super Insuldur Insulation
The Westinghouse Super Insuldur Insulation effectively upgrades cellulose insulating materials for increased load and overload capability. Chemical stabilizers in the Insuldur process retard insulation breakdown under severe temperature conditions. Dimensional changes in the insulating materials are minimized to insure a tighter structure. The result is greater strength and coil integrity throughout the life of the transformer.



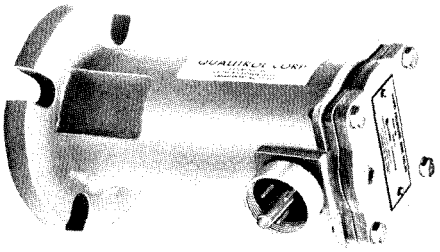
Super Insuldur Insulation

The Insuldur system allows operation at 10°C higher temperature on a 55°C rated unit with a 12% increase in Kva capacity.

Optional Accessories

Many optional accessories are available for use with Westinghouse fluid-filled transformers. Some of these are:

- 55°C Rise
- Rapid pressure rise relay (See photo)
- Dial hot spot indicator (See photo)
- Internally mounted current transformers
- Bolted manhole on cover
- Forced air system
- Thermal overload relay
- Removable cooling radiators
- Key interlock on tap changer
- Undercoating on tank
- Alarm contacts on devices
- Special tests



Rapid Pressure Rise Relay

Dial Hot Spot Indicator

Special Designs

Westinghouse transformers can be custom designed to meet specific customer requirements including:

- Low losses
- Special sound levels
- High altitude
- High ambient
- Special taps and range

Power Centers With Type DS Secondary Switchgear

Dry Type Transformers

Application

The Westinghouse VPI Transformer is a custom-designed dry type power transformer which gives complete environmental protection for both indoor and outdoor applications. The Westinghouse VPI Transformer is explosion-resistant, fire-resistant, non-polluting to the environment, and is ideally suitable for use in coordinated unit substations. Since it is a power transformer design with inherent protection against environmental contaminants, the Westinghouse VPI Transformer can be used in applications such as:

- Steel mill drives
- Schools, hospitals, shopping centers substations
- Pulp and paper driver
- High-rise building substations
- Cement mills and mining processes
- Power generating stations

Benefits

Westinghouse VPI Transformers offer the advantages of the proven Westinghouse conventional dry type design and the environmental protection offered with the vacuum pressure impregnation (VPI) encapsulation system with either polyester or epoxy. The primary benefits include:

- Custom-design flexibility for special customer needs and applications
- Computerized loss-evaluated designs for specific customer evaluation criteria
- Complete environmental protection
- Practically maintenance free
- High short circuit strength
- ANSI short time overload capability
- Aluminum or copper windings
- Available in NEMA 1, 2, 3R, totally enclosed non-ventilated, and other special enclosures
- Economical

Westinghouse Dry Type Experience

Westinghouse invented the dry type transformer in 1885 and has continued to improve and develop the dry type design. From the first 35KV class dry type produced in 1903 to the numerous units built for the nuclear industry, Westinghouse had led the way in dry type technology and experience. No other dry type manufacturer has provided dry type transformers for as many special applications including offshore drilling rigs, rectifiers, underground mining, transportation, networks, captive motor loads, and many more.

Proven Design and Technology

The Westinghouse VPI Transformer incorporates the Westinghouse proven, conventional dry type design with the vacuum-pressure-impregnation (VPI) process using polyester or epoxy to encapsulate the coils. The result: a custom-designed dry type transformer with complete environmental protection.

The Westinghouse VPI Transformer is similar to the conventional Westinghouse dry type transformer. That is, it is custom designed and manufactured with the coils insulated with 220°C class H Nomex® insulation system. However, instead of placing the coil assembly in a "dip and bake" tank to enclose the windings as with the conventional design, the coil assemblies of the VPI Transformer are impregnated with a solventless polyester or epoxy resin (choice is dependent on environmental condition) using the VPI process Westinghouse has used with motors since 1960. During the VPI encapsulation, the resin penetrates and seals the insulation materials and is polymerized through heat to form a composite mass. The result is a transformer which incorporates the advantages of the 220°C class H Nomex® insulation system and the environmental protection and strength of the resin.

Special Applications

Because of the design flexibility of the Westinghouse VPI Transformer, it can be custom-designed to meet special application requirements, including:

- Low losses (based upon evaluation criteria)
- Special impedances
- High ambients and altitudes
- Special sound levels
- Network designs

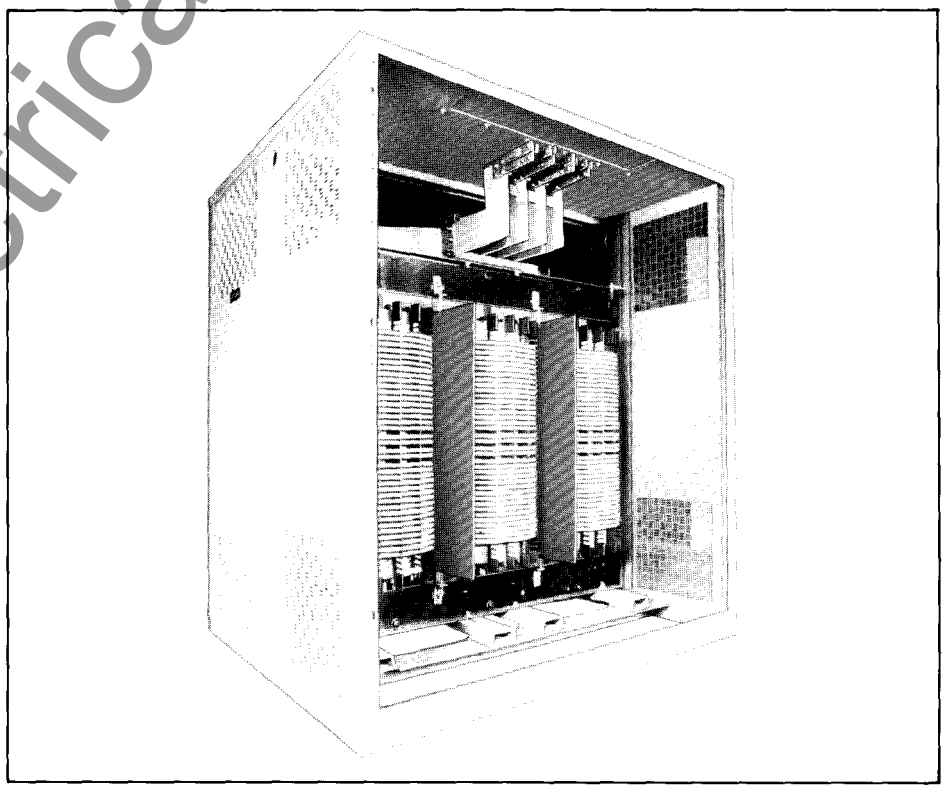
Vacuum Pressure Impregnated (VPI) Encapsulation

Westinghouse introduced the VPI process into the manufacturing of its large motors in 1960. Since that time, the VPI process has been expanded to include the encapsulation of a wide range of motors and now dry type transformers. The VPI process is used with either polyester or epoxy resins and offers the following advantages as compared to the conventional dip and bake process:

- Enhancement of the Nomex insulation system by minimizing air pockets in the insulating materials and on the conductors
- Increased mechanical strength by complete penetration into all porus areas
- Complete protection against moisture and atmospheric contaminants

Reliability

The Westinghouse encapsulation process reduces the possibility and concern of the resin cracking due to thermocycling. The thickness of the resin coating is thick enough for environmental protection, but thin enough to minimize temperature differential through its thickness. The epoxy resin has passed the 3-month thermocylcing test of −35°C to 160°C every 24 hours as outlined in ASTM D-p16/4. Polyester resin is even more flexible and less susceptible to cracking than epoxy and has passed a thermocycling test of −35°C to 185°C.



Nomex is a registered trademark of E. I. Dupont.

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Maintenance
Westinghouse VPI Transformers require little maintenance. Unlike fluid-filled transformers which require regular inspection for possible leaks and periodic maintenance of the dielectric fluid, the Westinghouse VPI Transformer requires only the normal housekeeping of occasional dusting to assure free air passage.

Design Features

Class H Insulation Materials
Westinghouse VPI 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

Westinghouse has used Nomex class H insulation in its dry type transformers for over 20 years. Nomex insulation presently offers the best performance in:
- Temperature Stability
- Electrical Strength
- High Dielectric Strength that does not deteriorate with age
- Overall Reliability and Longest Life Expectancy

Transformer Coil Assembly
The high voltage and low voltage coils of the Westinghouse VPI Transformer are designed and manufactured as an assembly. The low voltage coils consist of either aluminum or copper sheet material to give maximum stability under short-circuit conditions. The turn-to-turn and layer-to-layer insulation is Nomex®.

The LV to HV insulation is wound directly over the LV winding. It consists of an air space with class H material spacers and a solid wall of Nomex insulation on each side.

The high voltage coils consist of either aluminum or copper strap material with Nomex class H materials for turn-to-turn and layer-to-layer insulation. The high voltage coils are wound directly over the LV-to-HV insulation to form a complete coil assembly.

The Westinghouse VPI Transformer coil assembly will pass all ANSI standard tests, including the BIL test, **before** being encapsulated. The coil assembly does not depend on the encapsulating material for the electrical insulation or mechanical strength needed to pass the standard tests.

Core
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 provides a low loss, low sound level design with the strength to withstand repeated short circuit forces.

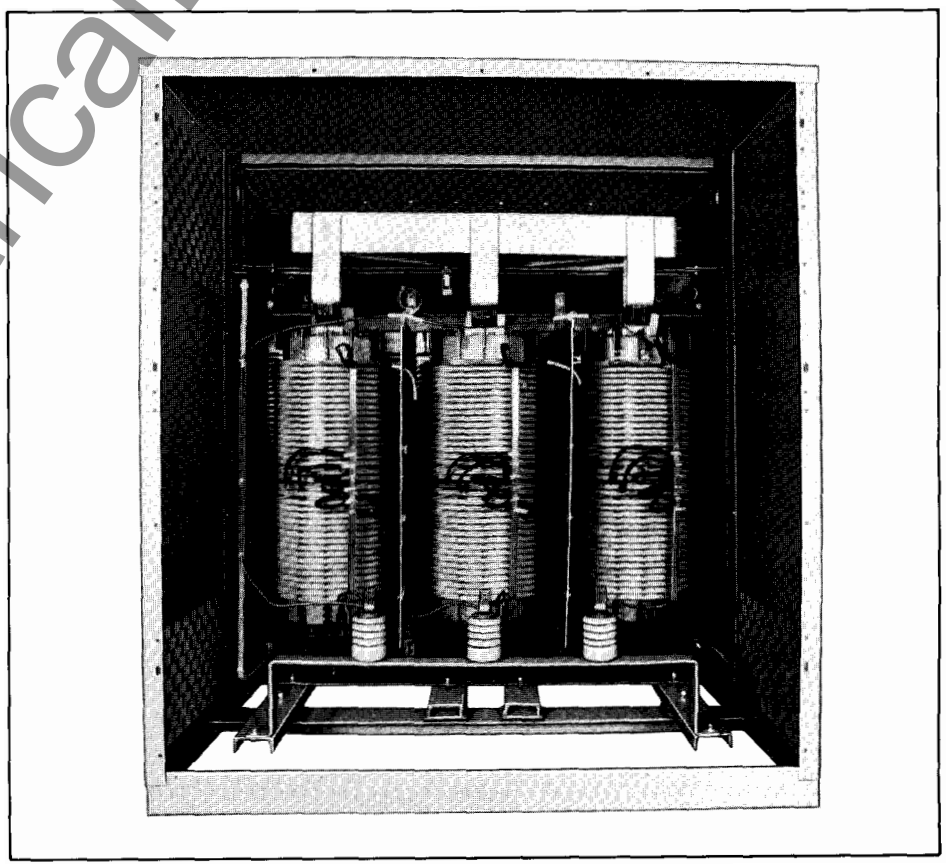
Taps
The taps can be reached from the front or back by removing a panel which also protects against tampering with the taps.

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.

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.

Case
The case has removable panels for access to the taps, and for core and coil inspection. The complete case structure can be removed and knocked down to reduce size and weight for rigging into tight locations. The case is constructed of heavy gauge steel and painted ANSI No. 61 light gray.

Standard case accessories are: jack pads, ground pad, diagrammatic nameplate, provisions for rolling, and protected ventilation grille.



Nomex is a registered trademark of E.I. Dupont.

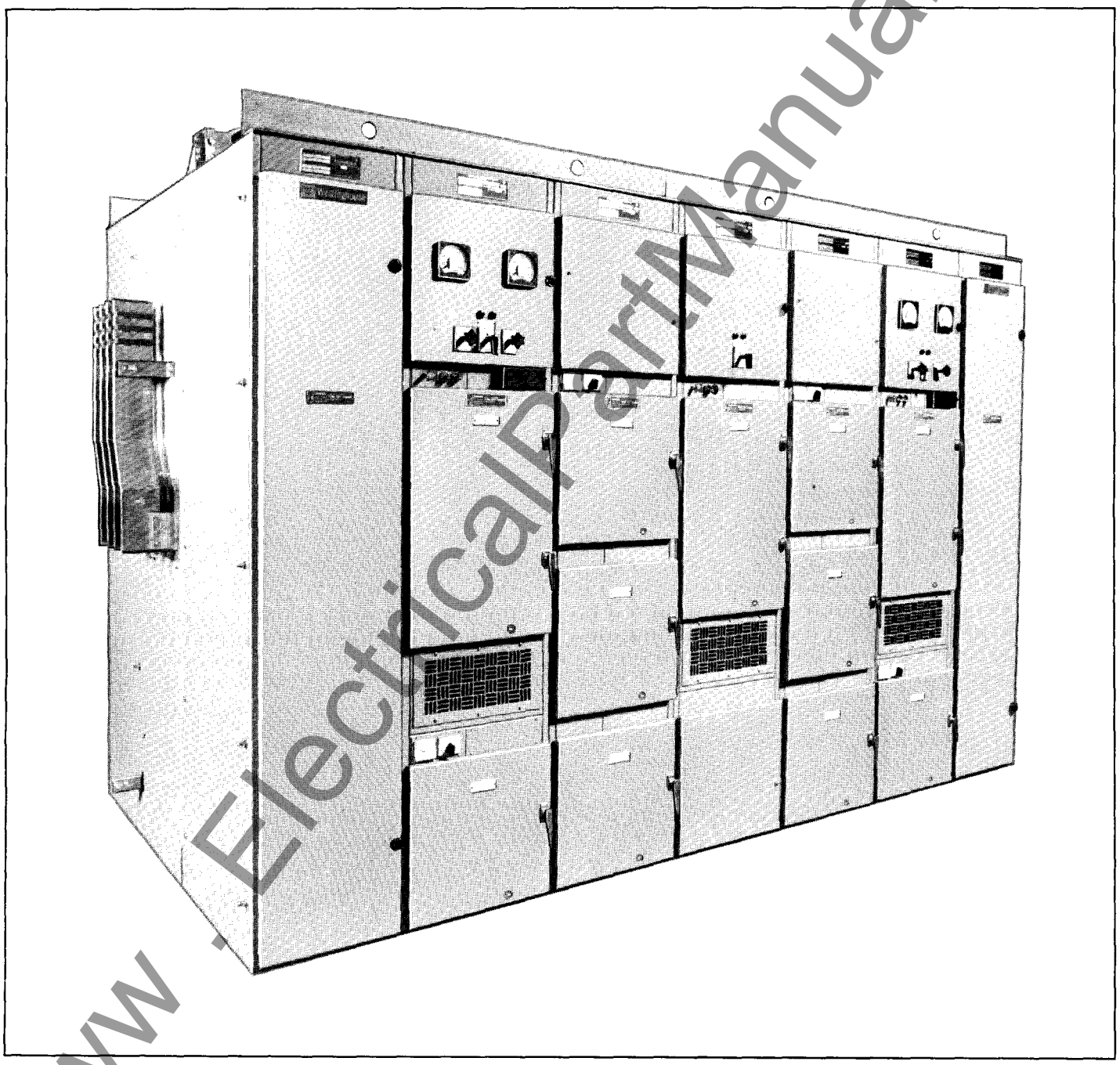
Power Centers With Type DS Secondary Switchgear

Type DS Low Voltage Switchgear Section

Modern design Type DS Low Voltage Metal Enclosed Switchgear and Circuit Breakers provide:

- Integral solid-state type breaker tripping systems
- Two-step stored-energy breaker closing
- Glass polyester insulation

and many other features for coordinated, safe, convenient, trouble-free and economical control and protection of low-voltage distribution systems.



Power Centers With Type DS Secondary Switchgear

Ratings
600 volts Ac
50 to 4000 Amperes continuous
30,000 to 200,000 amperes interrupting capacity

Features
Standard Indoor Finish—Light gray (ANSI No. 61) using modern electrodeposition (E-Coat) system.

Four Position Drawout—Breakers can be in connected, test, disconnected or remove position with compartment doors closed.

Standard Tin-Plated Aluminum Main Buses—Breaker load connections are silver-plated copper (silver-plated copper bus available).

Wiring Protection
Cross wiring is protected by dedicated steel wireways. Other wiring is bundled and secured with nylon ties.

Protection During Levering Operation—When levering the breaker between the connected, test and disconnected positions, the operator is protected by a steel barrier (faceplate) from contact with live parts and from arcs and hot gases.

Two-Step Stored Energy Closing Mechanism—Spring charging (1) and spring release to close breaker (2) are independent operations, and always give positive control of the instant of closing.

Motor Operated Stored-Energy Closing Mechanisms are supplied on electrically operated breakers. Standard control voltages are 48, 125 and 250 dc, and 120 and 240 ac.

Remote Closing and Tripping can be accomplished with manually operated breakers, by charging the closing mechanism manually, and closing and tripping it remotely through electric spring release and shunt trip coils; available as optional attachments.

Closing Spring Automatic Discharge—Mechanical interlocking automatically discharges the closing springs when the breaker is removed from its compartment.

Breaker Inspection—When withdrawn on the rails, breaker is completely accessible for visual inspection; tilting is not necessary. The rails are permanent parts of every breaker compartment.

Current Transformers for metering and instrumentation are mounted in the breaker compartments, and are front accessible. Accuracies meet ANSI Standard C37.20, Section 20-4.6.3 for Low Voltage Metal Enclosed Switchgear.

Integral Solid-State Type Breaker Overcurrent Trip Systems—provide maximum reliability and excellent repeatability, and require minimum maintenance. No external control source is required. Continuous stepless current pickup and time delay adjustments are made with sealed potentiometers, with no fixed taps or bands and no contact corrosion. Two types available: Standard Amptector II-A and Optional Amptector I-A.

Ground Fault Tripping is available optionally as an integral part of Amptector I-A.

Change in Trip Rating—The overcurrent trip pickup range is established by the rating of the current sensors on the breaker. A continuous long delay pickup adjustment 50% to 125% of sensor rating is provided. The sensors can be readily changed to provide a different pickup range.

Glass Polyester Insulation—Westinghouse-designed glass polyester, with excellent mechanical, dielectric and thermal properties, is used for the insulation system.

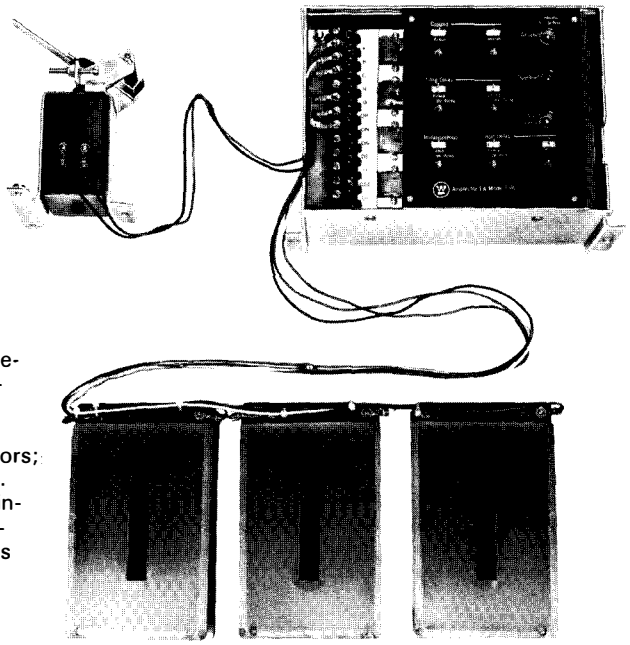
Double Steel Safety Barrier in front of each breaker during normal operation provides maximum safety.

Interphase Barriers—on breakers provide maximum insulation security. The barriers are easily removable for breaker inspection.

Provision for Padlocking—All breakers include provision for padlocking open to prevent electrical or manual closing. This padlocking also secures the breaker in the connected, test or disconnected position by preventing levering.

Ease of Inspection and Maintenance—Type DS switchgear and breakers are designed for maximum accessibility and the utmost facility of inspection and maintenance.

Conformity to Standards—Type DS switchgear and breakers conform to the following standards: NEMA SG3 and SG5; ANSI C37.13, C37.16, C37.17, C37.20 (IEEE No. 27), C37.51 and UL Standard 1558.



Solid-State Trip
Provides continuous wide-range adjustability. Step-type adjustment is eliminated. Energy and signal provided by current sensors; no potential connections. Long delay, short delay, instantaneous and ground-fault protection in various combinations.

Power Centers With Type DS Secondary Switchgear

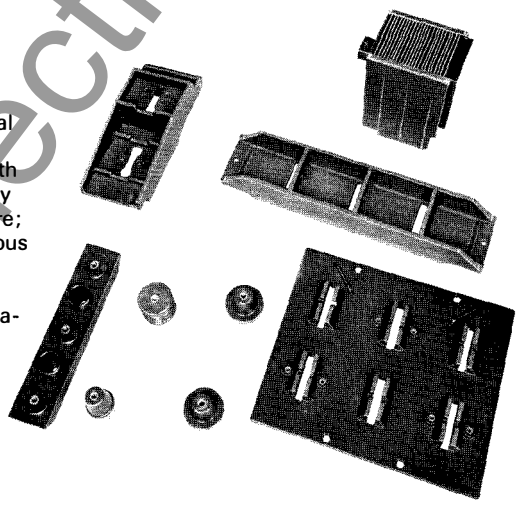
Design and Construction Features

Metal-Clad Safety Features

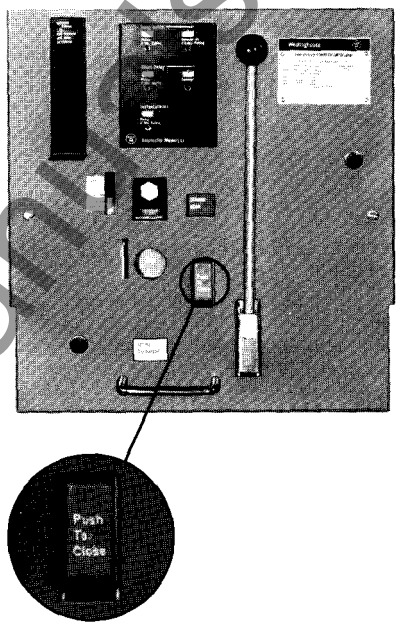
Outer door with quick-opening latches closes compartment completely with breaker in or cut. All controls are protected from unauthorized or accidental operation. Full-sized metal shield on breaker face protects operator from live parts, arcs and hot gases while operating, racking or checking Amptector settings. Double interlocked device prevents racking until contacts are open; contacts can't be closed until racking is complete. Separate cable entrance and bus compartments can be provided; removable barriers give access to bus compartment for inspection or cleaning.

Glass Polyester Insulation

Offers far better mechanical, thermal and electrical properties than phenolics. It has the mechanical strength to resist shortcircuit forces; is highly resistant to heat, flame and moisture; and has been designed with generous creepage distances. Often used on 5 Kv and 15 Kv Metal-Clad switchgear—Westinghouse gives these materials to you on all insulating parts in Type DS 600 volt switchgear.



Two-step Stored-energy Closing



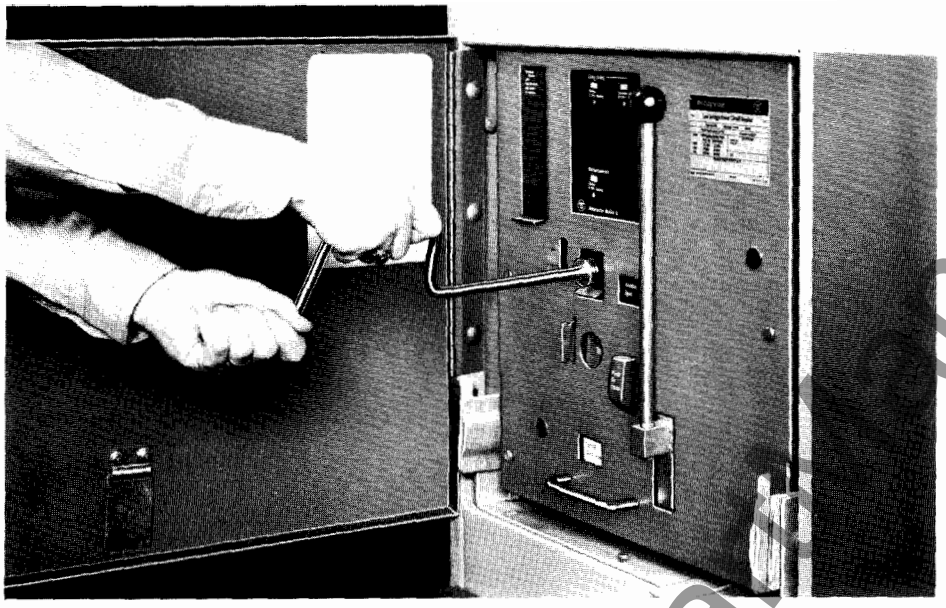
Gives operator positive control of closing after spring mechanism is charged. Breaker can't close while you're still charging. Operation is optional-full manual, full electric, or manual charge and remote electric release.

On manual breakers, the spring mechanism is manually charged by one downward stroke of the lever without pumping, and released by the mechanical "push-to-close" release button. On electrically operated breakers, the mechanism is normally charged and released electrically, but can be charged manually by pumping an accessory lever 10 to 12 times and released mechanically.

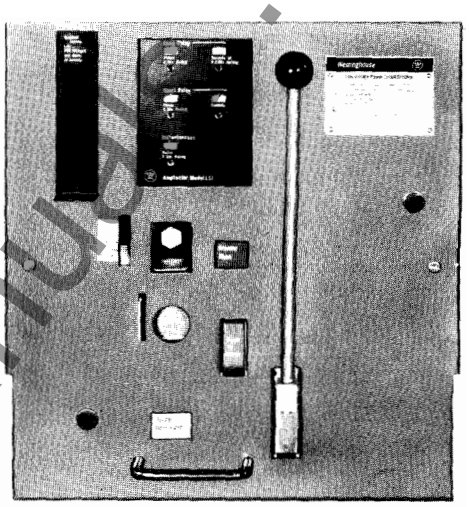
An interlock discharges the closing springs as the breaker is removed from the compartment. The system is patterned after 5 Kv and 15 Kv Metal-Clad switchgear.

Power Centers With Type DS Secondary Switchgear

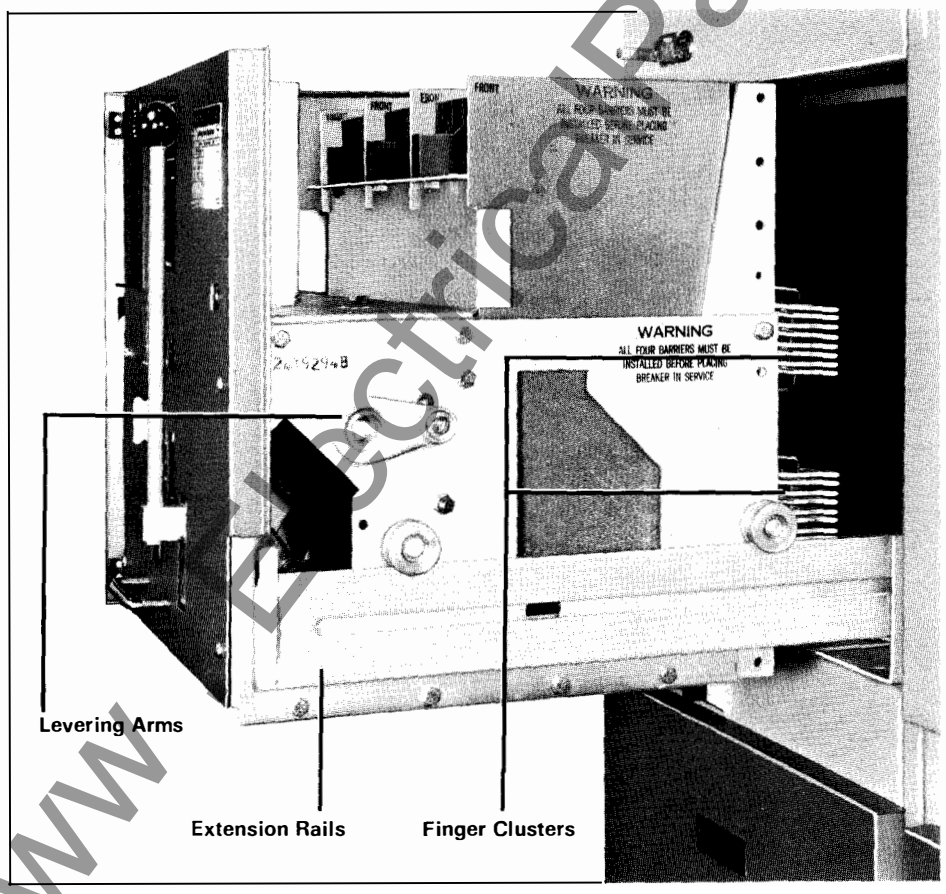
Design and Construction Features, *Continued*



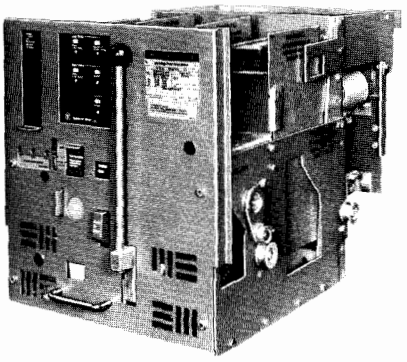
DS Breaker Levering Operation



DS Breaker Faceplate



DSL Breakers and Combinations



Type DSL Breakers are coordinated combinations of Type DS breakers and series connected current limiting fuses. They are intended for applications requiring the overload protection and switching functions of air circuit breakers on systems whose available fault currents exceed the interrupting rating of the breakers alone, and/or the withstand and interrupting ratings of "downstream" circuit components.

Power Centers With Type DS Secondary Switchgear

Design and Construction Features, *Continued*

Arc Chute

There are three basic means of extinguishing an arc: lengthening the arc path; cooling by gas blast or contraction; deionizing or physically removing the conduction particles from the arc path. It was the discovery by Westinghouse of this last method which made the first large power air circuit breaker possible.

The De-ion® principle is incorporated in all of these circuit breakers. This makes possible faster arc extinction for given contact travel; assures positive interruption and minimum contact burning.

Levering Mechanism

The worm gear levering mechanism is self-contained on the breaker drawout element and engages slots in the breaker compartment. A removable crank is used to lever the breaker between the Connected-Test-Disconnected positions.

Mechanical interlocking is arranged so that levering cannot be accomplished unless the breaker is in the tripped position.

Stored Energy Mechanism

A cam-type closing mechanism closes the breaker. It receives its energy from a spring which can be charged by a manual handle on the front of the breaker or by a universal electric motor.

Release of the stored energy is accomplished by manually depressing a bar on the front of the breaker or electrically energizing a releasing solenoid.

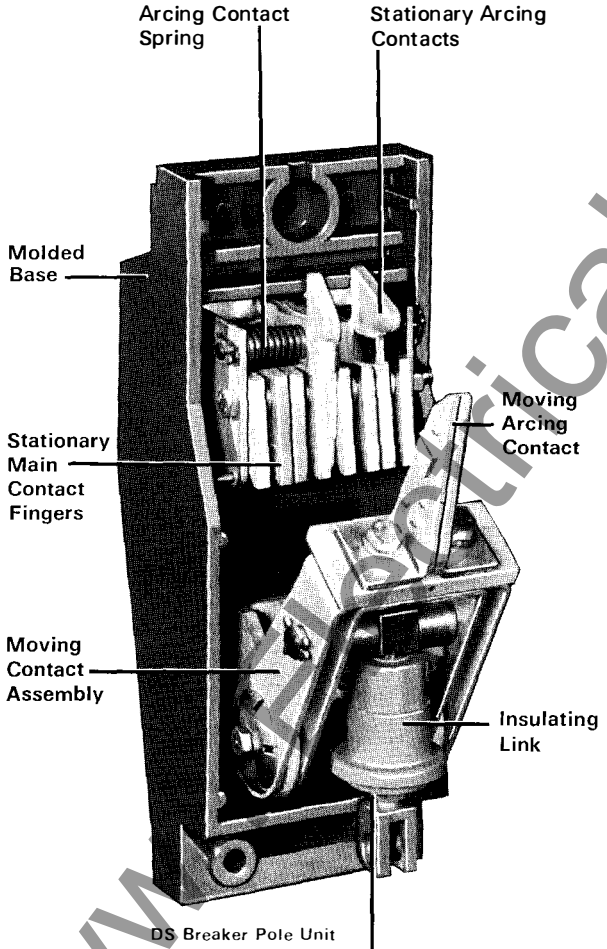
Contacts

All air circuit breakers have solid block, silver tungsten, inlaid main contacts. This construction insures lasting current-carrying ability, which is not seriously impaired even after repeated fault interruptions or repeated momentary overload.

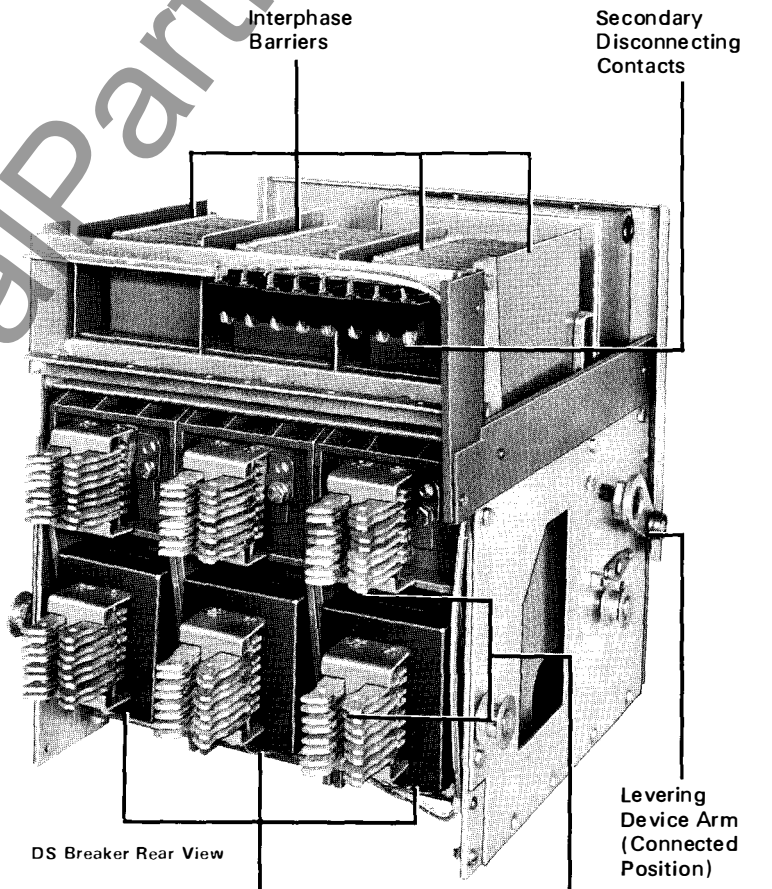
It is not necessary to provide a substantial margin of safety above the actual circuit load current to prevent contact deterioration.

The main contacts are of the butt type and are composed of a multiplicity of fingers to give many points of contact without alignment being critical.

All Type DS breakers are available as either manually or electrically operated.



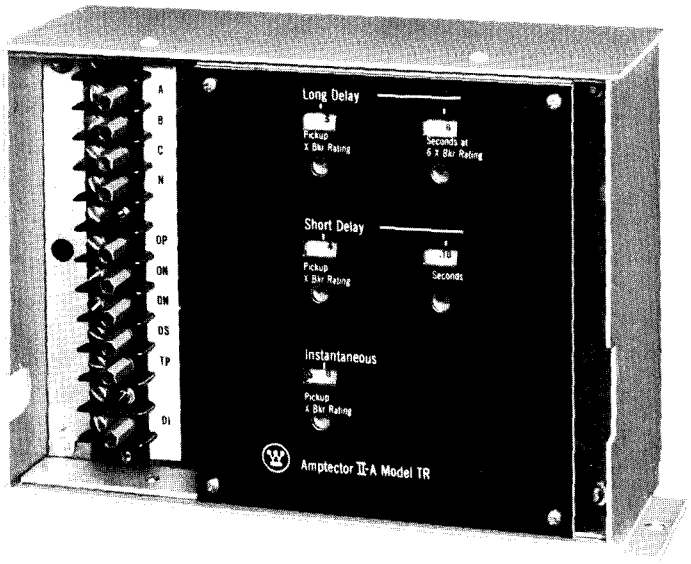
DS Breaker Pole Unit



DS Breaker Rear View

Power Centers With Type DS Secondary Switchgear

Standard Amptector II-A Solid-State Trip



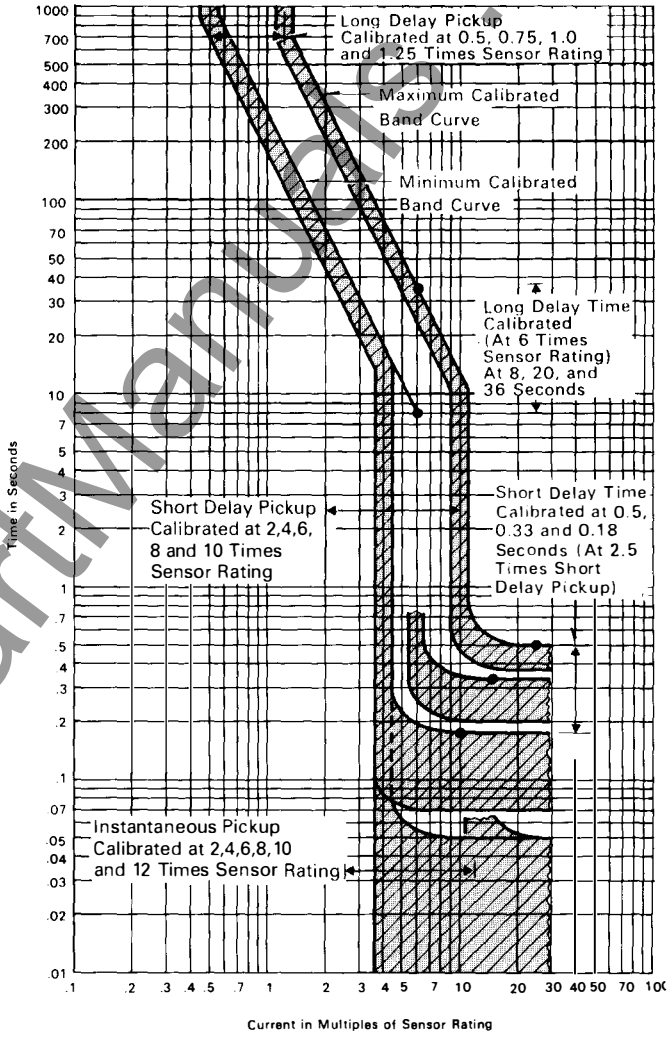
The Westinghouse Amptector II-A is a solid-state device that provides adjustable overcurrent tripping for Westinghouse Type DS low voltage Ac power circuit breakers. Only one Amptector II-A is required per breaker, and it receives all its energy from a set of sensors—one mounted on each pole of the breaker. It develops an output for an associated trip actuator when preselected conditions of current magnitude and duration are exceeded.

The device can be supplied in three models or combinations of three independent continuously adjustable overcurrent tripping functions: long delay, short delay and instantaneous. These models are:

DU (Dual)—Long delay and instantaneous
SE (Selective)—Long delay and short delay
TR (Triple)—Long delay, short delay and instantaneous

Model DU is the basic standard, and will be supplied when not otherwise indicated or required.

Amptector II-A Characteristics



Amptector I-A and II-A

Each Amptector includes terminal receptacles to permit easy field checking of operation and calibration with an external power supply. A specially designed portable test device with a plug to match the Amptector receptacle is available to provide the utmost in simplicity for checking Amptector operation.

Available Sensor Ratings

Breaker	Frame Size, Amperes	Sensor Ratings, Amperes
DS-206, DSL-206 or DS-206S	800	50, 100, 150, 200, 300, 400, 600, 800
DS-416, DSL-416 or DS-416S	1600	100, 150, 200, 300, 400, 600, 800, 1200, 1600
DS-420	2000	1200, 1600, 2000
DS-632	3200	2400, 3200
DS-840	4000	4000

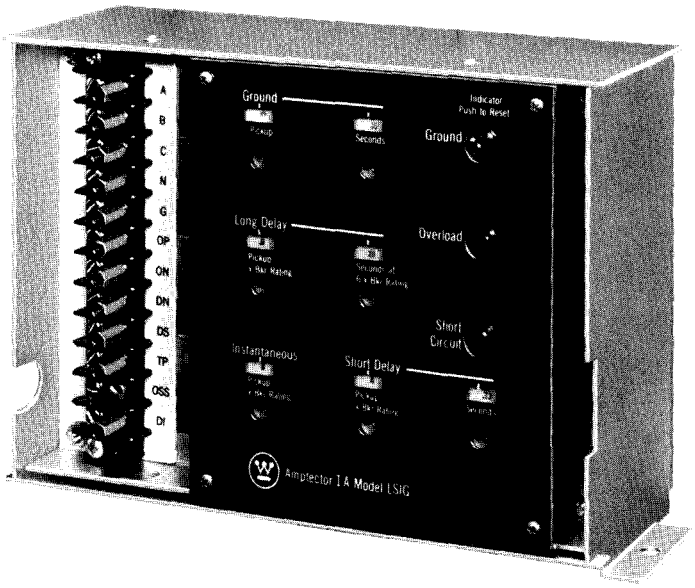
The narrow-band characteristic curves graphically illustrate the close coordination obtainable in breaker systems with Amptector tripping devices. Repeatability within 2%.

The particular breaker current rating for any breaker frame size is determined by the rating of the sensor used.

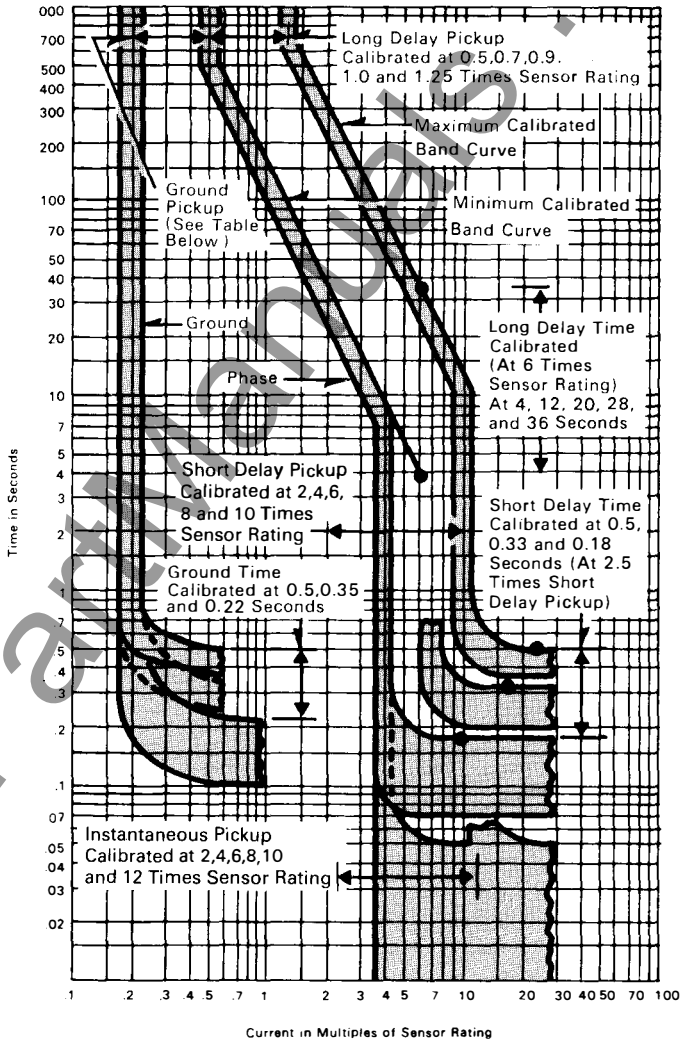
The breaker current rating for any frame size can be changed by simply changing the sensors, which are easily removed from the breaker drawout element. The wide range of long-delay pickup makes one set of sensors suitable for a number of current ratings. The Amptector itself need not be changed when the associated sensors are changed.

Power Centers With Type DS Secondary Switchgear

Optional Amptector I-A Solid-State Trip



Amptector I-A Characteristics



Offers all of the features of Standard Amptector II-A, plus:

- Integral ground fault protection (optional), with adjustable pickup and delay.
- Resettable operation indicators for Ground, Overload and Short circuit.

Amptector I-A can be supplied in various combinations of four independent continuously adjustable overcurrent tripping functions:

Long delay (L)
Short delay (S)
Instantaneous (I)
Ground (G)

The following combinations are available:

LI	LIG
LS	LSG
LSI	LSIG

Model LI is the basic standard and will be supplied when not otherwise indicated.

Amptector I-A

Ground Pick-Up Value—Amperes															
Dial Setting	Sensor Rating 50	100	150	200	300	400	600	800	1200	1600	2000	2400	3200	4000	Secondary Current ①
A	13	57	60	65	80	110	145	180	260	330	400	530	640	800	1.0
B	18	67	75	85	110	150	205	260	385	505	600	770	1000	1200	1.5
C	22	75	85	100	130	185	250	325	480	625	760	960	1200	N.A.	1.9
D	33	100	120	145	200	270	385	500	730	970	1200	N.A.	N.A.	N.A.	3.0

All pick up values may vary ± 10%

① Current of this value from the secondary of an external ground transformer will cause the ground element to function. Ground element pick-up can also be tested using this value. All sensors must be disconnected during test.

Power Centers With Type DS Secondary Switchgear

Optional Breaker Attachments and Accessories

(a) Shunt trip on manually operated breakers, for any standard control voltage. An auxiliary switch is also required.

(b) Auxiliary contacts on manually operated breakers, usually consisting of one 4 contact auxiliary switch. Maximum of three 4 contact auxiliary switches available on any breaker, manually or electrically operated. The contact rating is 10 amperes. (Two 4 contact switches are standard on each electrically operated breaker.)

(c) Compartment position switch (''TOC''), 6 or 12 contact, actuated by movement of drawout breaker between the connected and test positions. Most common uses are for disconnecting remote control circuits of electrically operated breaker, and for bypassing ''b'' interlocking auxiliary contacts, when breaker is withdrawn to test position.

(d) Undervoltage trip (ac and dc available). Acts to trip the breaker when the voltage on its solenoid coil is insufficient to restrain a spring-loaded core. The tropout point is within 30 to60 percent of the nominal coil voltage and is not adjustable. Available as either instantaneous or time delay type. The time delay is within 2 to 7 seconds after zero voltage occurs, and is not adjustable. The device automatically resets when the breaker opens; approximately one minute is required for resetting of the time delay type.

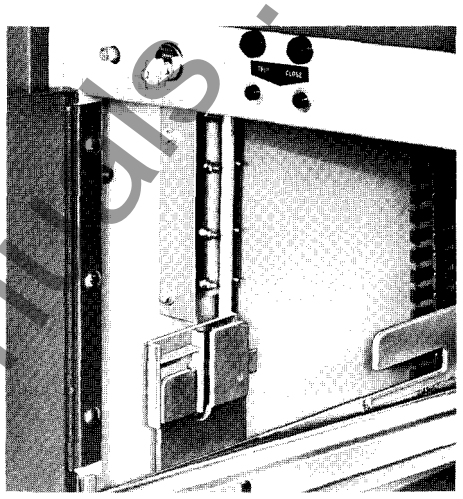
(e) Overcurrent trip switch (OTS). A latching type switch with two independent contacts either normally open or normally closed. Operates only when the breaker is tripped automatically on an overload or fault condition (including Amptector I-A integral ground fault tripping). It may be used for alarm and/or interlocking circuits. Resetting is done by a pushbutton on the breaker face plate, or by a remote switch through an optional reset coil.

(f) High load switch (HLS—available with Amptector I-A only). A self resetting relay which picks up on an overload condition at a lower value than the long delay pickup setting of the tripping device, thus, giving advance warning of an overload condition. The device is completely independent of the overcurrent tripping system, does not trip the breaker, and does not replace any protection in any phase. Adjustment is from 60 to 100 percent of the long delay pickup setting. The time delay is fixed and is approximately one minute. One normally open contact is provided.

(g) Electric Lockout (Manual Breakers). In order to close the breaker after manually charging the closing mechanism, it is necessary to operate an electrical pushbutton on the breaker faceplate. This pushbutton is in series with any required external interlocking. The mechanical ''push-to-close'' bar is made inoperative when the breaker is in the connected position. An electric spring release attachment (operated by the electrical pushbutton), a charged-spring limit switch, and an auxiliary switch are required.

(h) Electric close release on manually operated breakers, for any standard control voltage. Breaker can be closed by remote control switch or pushbutton after spring is manually charged. A charged-spring limit switch and an auxiliary switch are also required.

(i) Key interlock. Operative only after breaker has been withdrawn beyond disconnected position. Blocks any breaker from being levered into compartment. Breaker can be stored in compartment, and can be completely removed for maintenance or for use as a spare without disturbing interlock. No modification of breaker required.



Key Interlock—Blocking Position

(j) Operation counter.

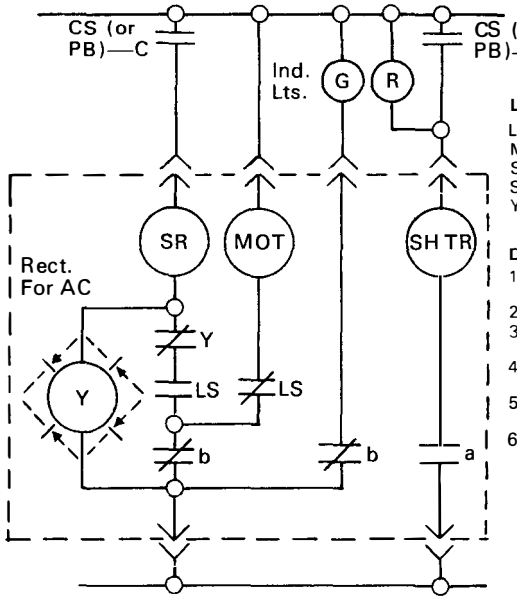
(k) Ac capacitor trip.

(l) Latch check switch.

(m) Mechanical interlock.

Standard Control Diagram

Standard control diagram for Type DS electrically operated breaker, for Ac or Dc control source.



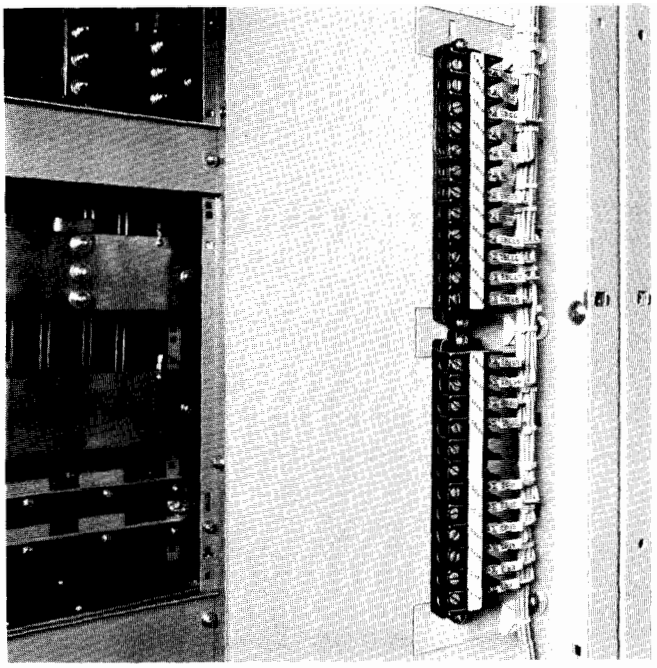
Legend

LS —Limit Sw. for Closing Spring
MOT —Motor for Spring Charging
SH TR—Shunt Trip
SR —Spring Release
Y —Anti-Pump Relay

Description of Operation

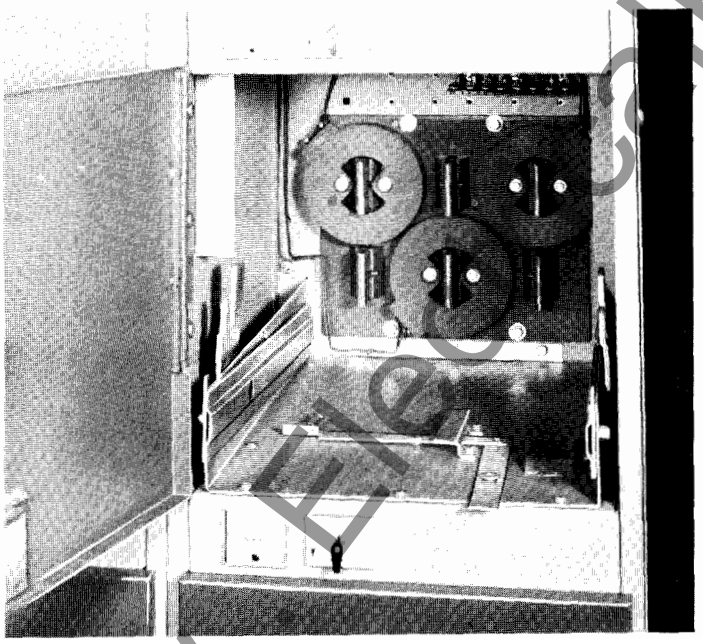
1-When Bkr opens, motor is energized through LS & ''b'' contact.
2-Motor runs and charges Closing Spring.
3-When Closing Spring fully charged, LS contacts reverse.
4-Closing CS-C contact energizes SR Coil through Y, LS & ''b'' contacts.
5-When Breaker closes, ''b'' opens and Y Coil is energized in series with SR Coil.
6-Y contact opens to open SR Coil circuit & prevent pumping should breaker open while CS-C is held closed, Y Coil has very low drop-out voltage.

Power Centers With Type DS Secondary Switchgear

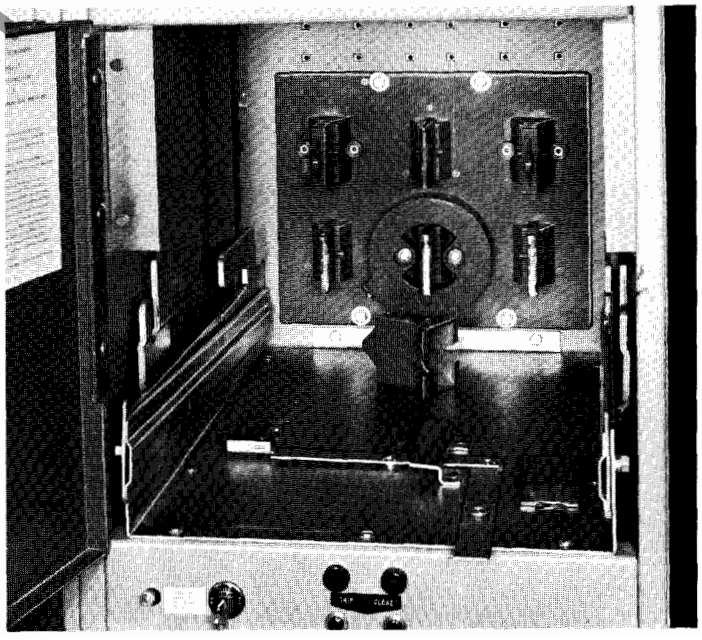


Terminal Blocks

Potential Transformer and Control Power Transformer with Primary and Secondary Fuses



Current Transformers



Insulating Boots

Insulation
All insulation is Westinghouse glass polyester, which has been compounded to include the dielectric and mechanical strength necessary for the application. It is highly resistant to heat, flame and moisture, and has been designed with generous creepage distances.

Wiring
Control circuit terminal blocks are mounted on the rear frame where they are readily accessible for purchaser's connections and inspection. Main circuit terminals may be oriented to suit cable entrance.

Power Centers With Type DS Secondary Switchgear

Buses and Connections

Available main bus ratings in Type DS switchgear are 600,800,1000,1200,1600,2000,2500, 3200 and 4000 amperes. All ratings are based on a standard temperature rise of 65°C above a maximum ambient air temperature 40°C outside of the switchgear enclosure.

Bolted, tin-plated aluminum main buses, in conjunction with bolted silver plated copper for field connections are standard. All standard 4000 amp buses are copper.

Optional copper main buses with silver-plated, bolted joints are available.

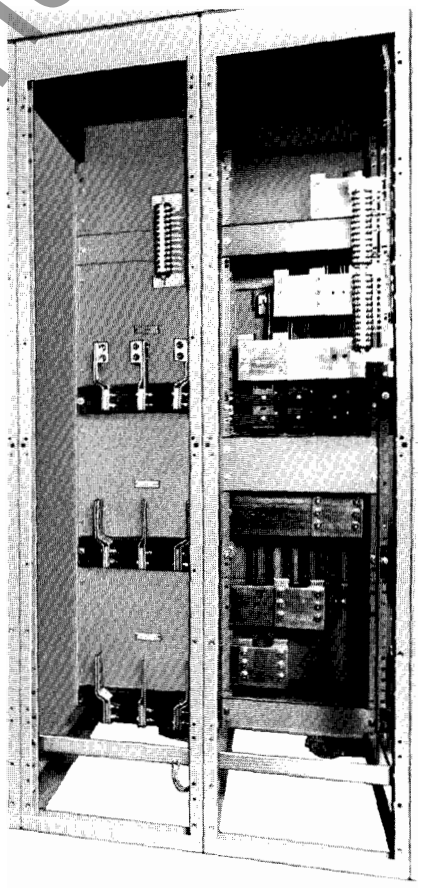
The rear portion of the switchgear assembly houses the main bus, connections, and terminals.

A ground bus is furnished the full length of the switchgear assembly and is fitted with terminals for purchaser's connections.

Rear covers are the bolt-on type. They are split into two horizontal sections to facilitate handling during removal and installation.

If the purchaser desires, steel barriers will be furnished to separate the main bus and connections from the purchaser's connection compartment.

Bus and Cable Compartment with Barriers Removed



Cable Connection Compartment with Barriers in Place

Power Centers With Type DS Secondary Switchgear

Meter Type Current Transformers for Mounting in Circuit Breaker Compartments

For Breaker Type*					ANSI Meter Accuracy Classification	
DS-206	DS 416	DS-420	DS-632	DS-840	Ratio	B-0.1	B-0.2
					100/5	1.2	—
					150/5	1.2	—
					200/5	1.2	1.2
					300/5	0.6	0.6
					400/5	0.6	0.6
					600/5	0.6	0.6
					800/5	0.3	0.3
					1200/5	0.3	0.3
					1500/5	0.3	0.3
					1600/5	0.3	0.3
					2000/5	0.3	0.3
					2500/5	0.3	0.3
					3000/5	0.3	0.3
					4000/5	0.3	0.3
					5000/5	0.3	0.3
					6000/5	0.3	0.3

*Also for Types DS-206S, DS416S, and DSL-206, DSL-416, DSL-632 and DSL-840 limiter type equipments.

Current transformers with meter accuracy classifications at higher burdens and/or suitable for relaying are also available. They will be mounted in the rear cable connection compartment.

Control Voltages and Currents

Standard control voltages, rated control currents and standard ranges are as follows:

Control Voltage	48 Dc	125 Dc	250 Dc	120 Ac	240 Ac
Close current (SR), amp.	5.0	2.0	1.0	3.0	2.0
Shunt trip current, amp.	5.0	2.0	1.0	2.0	1.0
Spring charge motor amp.	7.5	3.0	1.5	3.0	1.5
Control voltage range:					
Close—	38-56	100-140	200-280	104-127	208-254
Trip —	28-56	70-140	140-280	60-127	208-254

Motor currents are running currents; inrush is approximately 400%. Motor running time to charge spring approximately 5 seconds.

Potential Transformers

Potential transformers are rated 10 Kv BIL, and are protected by both primary and secondary fuses. The primary fuses are current limiting type.

Control Power Transformers

Control transformers are provided when required for Ac control of circuit breakers, space heaters, and/or transformer fans. Like potential transformers, they are protected by current limiting primary fuses. Non-current limiting secondary fuses are used on the secondary side to protect control circuits.

Switchgear Accessories

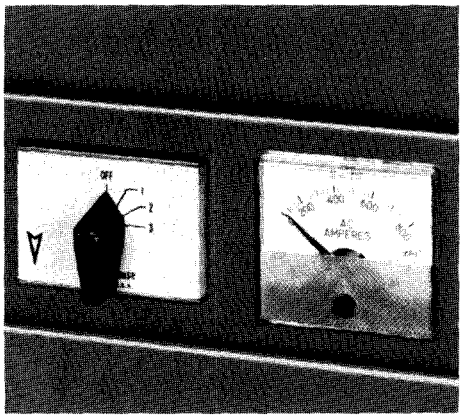
Standard accessories furnished with each Type DS switchgear assembly include:

- One breaker levering crank.
- One manual spring charging lever, if electrically operated breakers are included.
- Insulating covers or "boots" are furnished on live main stationary disconnecting contacts in compartments equipped for future breakers. One additional set is provided for each size breaker furnished.

Test plugs are furnished when "Flexitest" relays, Flexitest watthour meters or Flexitest Type FT-1 test switches are mounted on the switchgear.

Miscellaneous

For feeder circuit instrumentation, small 2 inch 2% accuracy class ammeters and Type W-2 ammeter switches can be mounted on the horizontal stationary panels adjacent to the breaker compartment doors. The ammeters and switches are immediately associated with definite breaker circuits. Other devices, such as control pushbuttons, indicating lights and test switches can be mounted on these panels, within space limits. Removable covers provide access to wiring.

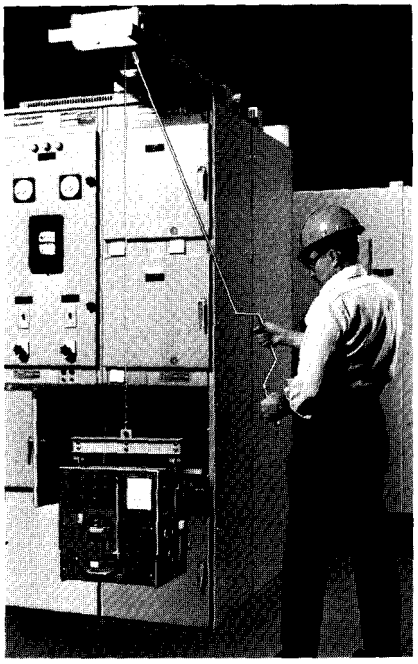


Interference interlocks are supplied on breakers and in compartments where the compartments are of the same physical size, to insure that a Type DS-206 breaker cannot be inserted into a compartment intended for a Type DS-416 or DS-420 breaker, and a Type DS-416 or DS-420 breaker cannot be inserted into a compartment for a Type DS-206 breaker.

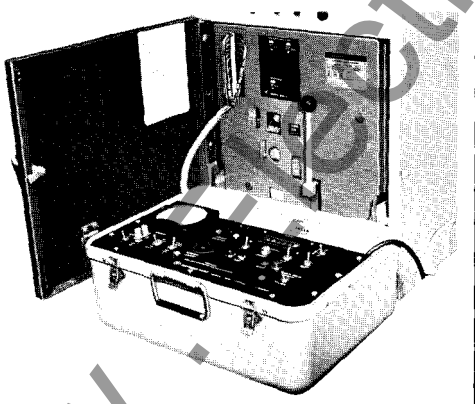
Standard wire is Type MTW stranded copper, flame retardent thermo-plastic insulated, No. 14 AWG minimum, with crimped, uninsulated grip ring tongue and locking fork-type terminals.

Power Centers With Type DS Secondary Switchgear

Optional Accessories

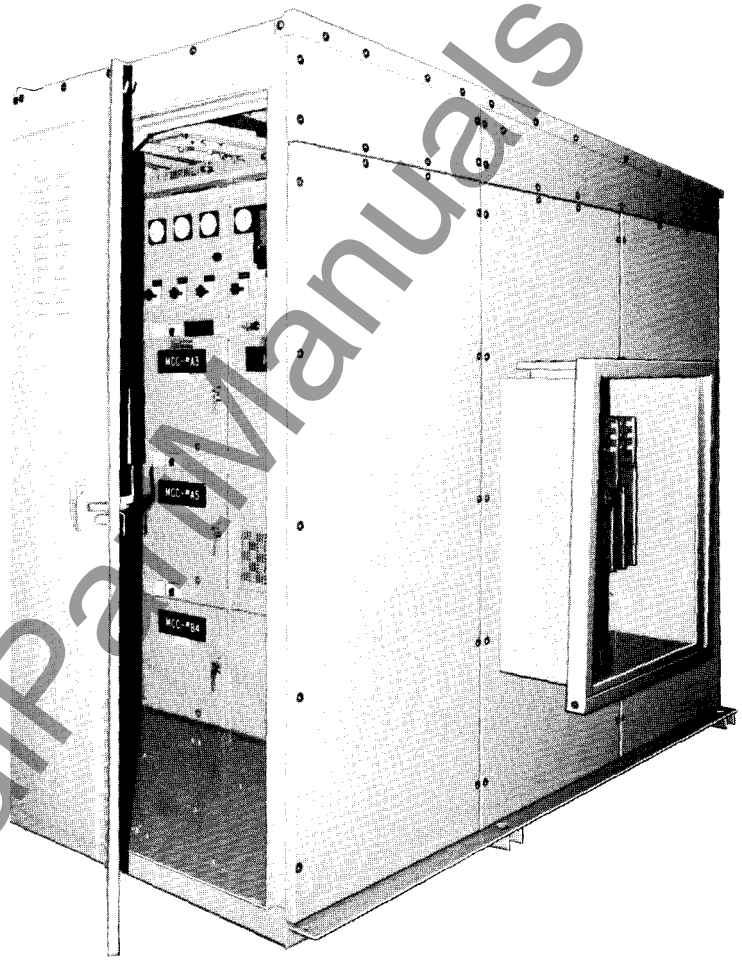


- Traveling type circuit breaker lifter, rail mounted on top of switchgear.
- Floor running portable circuit breaker transfer truck with manual lifting mechanism. Requires approximate 60" deep front aisle space.
- Test cabinet for electrically operated breakers, with pushbuttons, control cable and receptacle, for separate mounting.



- Portable test kit for testing and calibraiton of Amptector trip devices. Utilizes standard 120 volt, 20 ampere single phase 60 Hz supply, available from any outlet.

Outdoor Front Aisle Type Switchgear Enclosure



Outdoor switchgear consists of standard Type DS indoor structures assembled in a heavy gauge completely weatherproof enclosure, with a generous internal "walk-in" front operating aisle extending through all units of the assembly. Access door with provisions for padlocking are provided for each indoor section in the lineup.

Standard features also include:
- Bolted hinged rear doors for access to cable and bus compartments.
- Filtered ventilation openings.
- Traveling type geared breaker lifter.
- Space heaters.
- Lighting outlets and convenience receptacles.
- Rigid base structure; no channels required.
- Walk-in aisle within shipping group shipped completely assembled.

The standard finish is ANSI No. 61 inside and outside. A corrosion-resistant coating is provided on the underside and base.

Metal Enclosed Bus Runs

For connecting outdoor transformers through building walls to indoor switchgear, low voltage metal enclosed buses in ratings from 600 amperes to 4000 amperes are available. These buses can also be used for bus tie circuits between separate low voltage switchgear assemblies.

Design and construction follow Low Voltage Switchgear Standards, with bare aluminum or copper conductors with silver plated bolted joints and glass polyester supports. Momentary ratings (minimum 50,000 amperes) are as required. Standard finish color is ANSI No. 61 light gray indoor and outdoor.

Power Centers With Type DS Secondary Switchgear

Application Data, Dimensions and Weights

Load Interrupter Switch, Type WLI
Standard for all transformer types

Air Interrupter Switch Ratings

- 5 Kv, 60 Kv BIL, and 15 Kv, 95 Kv BIL
- 600 A and 1200 A continuous and load interrupting
- Momentary ratings 40,000 A and 80,000 A asymmetrical.
- Fault close in ratings 40,000 A and 61,000 A asymmetrical

Transformer Primary Fuse Application ①

System Circuit Volts	Fuse Data Identification			Interrupting Rating		Max. Transf. Kva Rating ②	
	Type	Kv (Max.)	Maximum Amperes	Amperes Symm.	Equiv. 3 Ph. Mva	Self Cooled	Forced Air
2400	CLE-1	2.8	225E	50,000	205	670	780
	CLE-2	2.8	450X	50,000	205	1335	1560
	CXN	8.3	300C	50,000	205	890	1035
	RBA-200	8.3	200E	19,000	80	600	695
	RBA-400	8.3	400E	37,500	150	1190	1385
	RBA-800	8.3	720E	37,500	150	2140	2500
4160	CLE-1	5.5	225E	50,000	360	1155	1350
	CLE-2	5.5	450X	50,000	360	2315	2700
	CXN	8.3	300C	50,000	360	1545	1800
	RBA-200	8.3	200E	19,000	137	1030	1200
	RBA-400	8.3	400E	37,500	270	2055	2400
	RBA-800	8.3	720E	37,500	270	3700	4320
4800	CLE-1	5.5	225X	50,000	415	1335	1560
	CLE-2	5.5	450X	50,000	415	2675	3120
	CXN	8.3	300C	50,000	415	1780	2075
	RBA-200	8.3	200E	19,000	158	1190	1385
	RBA-400	8.3	400E	37,500	310	2375	2775
	RBA-800	8.3	720E	37,500	310	4280	5000
6900	CLE-1	8.3	125E	50,000	600	1065	1245
	CLE-2	8.3	200E	40,000	480	1705	2000
	CXN	8.3	300C	50,000	600	2560	2985
	RBA-200	8.3	200E	16,600	200	1705	2000
	RBA-400	8.3	400E	29,400	350	3415	3985
	RBA-800	8.3	720E	29,400	350	6150	7170
7200	CLE-1	8.3	125E	50,000	625	1115	1300
	CLE-2	8.3	200E	40,000	500	1785	2080
	CXN	8.3	300C	50,000	625	2670	3110
	RBA-200	8.3	200E	16,600	205	1785	2080
	RBA-400	8.3	400E	29,400	365	3565	4160
	RBA-800	8.3	720E	29,400	365	6420	7500
12,000	CLE-1	15.5	65E	85,000	1770	905	1080
	CLE-2	15.5	125X	85,000	1770	1745	1985
	CLE-3	15.5	200X	50,000	1040	2790	3175
	CXN	15.5	175C	50,000	1040	2595	3025
	RBA-200	15.5	200E	14,400	300	2970	3465
	RBA-400	15.5	400E	29,400③	610	5945	6930
12,470	CLE-1	15.5	65E	85,000	1835	940	1070
	CLE-2	15.5	125X	85,000	1835	1810	2060
	CLE-3	15.5	200X	50,000	1080	2900	3300
	CXN	15.5	175C	50,000	1080	2695	3140
	RBA-200	15.5	200E	14,400	310	3085	3600
	RBA-400	15.5	400E	29,400③	635	6170	7200
13,200	CLE-1	15.5	65E	85,000	1945	1000	1135
	CLE-2	15.5	125X	85,000	1945	1920	2180
	CLE-3	15.5	200X	50,000	1145	3070	3490
	CXN	15.5	175C	50,000	1145	2855	3330
	RBA-200	15.5	200E	14,400	330	3265	3810
	RBA-400	15.5	400E	29,400③	670	6530	7620
13,800	CLE-1	15.5	65E	85,000	2030	1045	1185
	CLE-2	15.5	125X	85,000	2030	2000	2280
	CLE-3	15.5	200X	50,000	1195	3200	3650
	CXN	15.5	175C	50,000	1195	2985	3480
	RBA-200	15.5	200E	14,400	330	3415	3985
	RBA-400	15.5	400E	29,400③	670	6830	7970

	For Self Cooled Transformers	For Forced Air Transformers
Type CLE Current Limiting Fuses: Through 8.3 Kv Fuse Rating—	1.4	1.2
15.5 Kv Fuse Rating—	1.49	1.31
Type RBA Expulsion Type Non-Current Limiting Fuses, all Ratings—	1.4	1.2
Type CXN Current Limiting Fuses, all Ratings —	1.4	1.2

② Maximum Transformer Kva Ratings are based on Ratios of Maximum Fuse Current Rating to Transformer Full Load Current (I_F/I_T) as listed at left. For a 55°C Rise Liquid Filled Transformer, use the Kva Rating for 65°C rise (55°C rating × 1.12).

① These applications are subject to modification when specific factors such as Transformer Characteristics, other Protective Devices, Coordination Requirements and Load Variations may indicate a different I_F/I_T Ratio.

Caution: Primary Fuses must not be relied upon for clearing Secondary Ground Faults

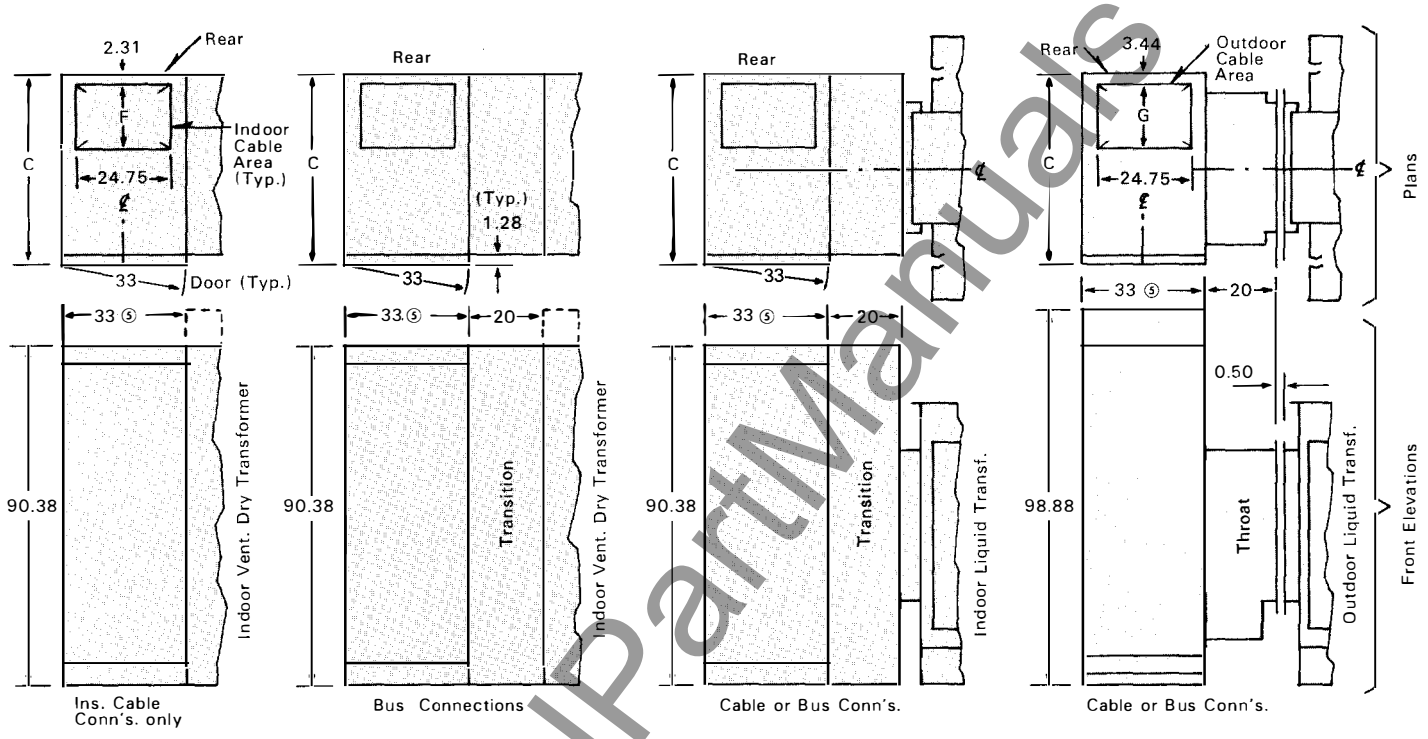
Note: The type RBA interrupting ratings shown are those of the discharge filter type, in which the noise is minimized and deionization of expulsion gases is assured.

③ Type RBA-400 at 14.4 Kv only, has ratings of 870 Mva and 34,800 A symmetrical with available special discharge filter.

Power Centers With Type DS Secondary Switchgear

Dimensions of High Voltage Incoming Line Sections—Inches (Approximate)

Type WLI Air Interrupter Switch (Single Units as Shown; See Note for Duplex)



Note: Two (2) units each 33 (or 36) wide, with two (2) cable areas, required for duplex arrangements.

Unit Depth C	Cable Sp. F(I.D.)	Cable Sp. G(O.D.)
①49.28	16.97	15.84
②55.28	22.97	21.84
③④62	29.69	28.56
70	37.69	36.56

① Provides 18" max. stress cone space for top entrance.

② Required for add'l stress cone space for top entrance, or for 54" deep dry type transformer case.

③ Min. for single unit selector type, 5 Kv, with top or bottom entrance.

④ Min. for single unit selector type, 15 Kv, with bottom entrance; top entrance 70".

⑤ Except 15 Kv with 61,000 A (fault close) rating 36" wide.

Min. depth with pothead: 5 Kv 49.28; 15 Kv 55.28

Note: For Dimensional effect of other modifications, refer to Westinghouse.

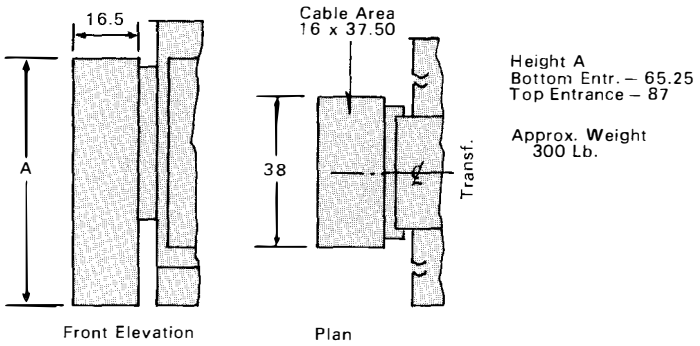
Approximate Weights—Lb.
Singe unit, 2 pos., unfused: indoor 1500; outdoor 1800. (Use two for Duplex.)
Single unit selector, unfused: indoor 1800; outdoor 2100.
Indoor transition—300.
Outdoor throat—200.
Fuses, set of 3—200.

Power Centers With Type DS Secondary Switchgear

Dimensions of High Voltage Incoming Line Sections-Inches (Approximate)

Cable Entrance Compartment, Air Filled

Fluid Filled Transformer, Indoor or Outdoor



Dry Type Transformer — Indoor or Outdoor

The HV cable entrance compartment for dry types is integral to the main enclosure and does *not* require additional floor space.

Transformer Data and Standards

Transformer Kva Ratings, 3 Phase

In addition to their basic self-cooled (AA or OA, 100%) Kva ratings, Westinghouse standard Secondary Unit Substation Transformers are designed for continuous operation at the following supplementary self-cooled and fan-cooled (FA) Kva ratings:

Fluid Filled

65°C Rise		55/65°C Rise			
OA	FA	OA 55°C	OA 65°C	FA 55°C	FA 65°C
300	....	300	336	....	....
500	....	500	560	....	....
750	862	750	840	862	966
1000	1150	1000	1120	1150	1288
1500	1725	1500	1680	1725	1932
2000	2300	2000	2240	2300	2576
2500	3125	2500	2800	3125	3500

Ventilated Dry Type

150°C Rise		115/150°C Rise			80/115°C Rise			80/150°C Rise		
AA	FA	AA 115°	AA 150°	FA 150	AA 80°	AA 115°	FA 115°	AA 80°	AA 150°	FA 150°
300	400	300	345	460	300	354	472	300	405	540
500	667	500	575	767	500	590	787	500	675	900
750	1000	750	863	1151	750	885	1180	750	1013	1351
1000	1333	1000	1150	1533	1000	1180	1573	1000	1350	1800
1500	2000	1500	1725	2300	1500	1770	2360	1500	2025	2700
2000	2667	2000	2300	3067	2000	2360	3147	2000	2700	3600
2500	3333	2500	2875	3833	2500	2950	3933	2500	3375	4500

Power Centers With Type DS Secondary Switchgear

Transformer Data and Standards, *Continued*

3 Phase Transformer Secondary Ampere Ratings

Fluid Filled Transformers

		65°C Rise		55/65°C Rise		
Base Kva	Sec. Volts	OA	FA	OA 55°	OA 65°	FA 65°
300	208	833	....	833	933	....
	240	722	....	722	808	....
	480	361	....	361	404	....
	600	289	....	289	323	....
500	208	1389	....	1389	1556	....
	240	1203	....	1203	1347	....
	480	601	....	601	674	....
	600	481	....	481	539	....
750	208	2083	2396	2083	2333	2683
	240	1804	2075	1804	2021	2324
	480	902	1038	902	1011	1162
	600	722	830	722	808	929
1000	208	2778	3194	2778	3111	3578
	240	2406	2767	2406	2695	3099
	480	1203	1383	1203	1347	1549
	600	962	1106	962	1077	1239
1500	480	1804	2075	1804	2021	2324
	600	1443	1659	1443	1616	1859
2000	480	2406	2767	2406	2695	3099
	600	1924	2213	1924	2155	2478
2500	480	3008	3759	3008	3368	4211
	600	2406	3008	2406	2694	3367

Ventilated Dry Type Transformers

Base Kva	Sec. Volts	150°C Rise		115/150°C Rise			80/115°C Rise			80/150°C Rise		
		AA	FA	AA 115°	AA 150°	FA 150°	AA 80°	AA 115°	FA 115°	AA 80°	AA 150°	FA 150°
300	208	833	1111	833	950	1264	833	983	1311	833	1125	1500
	240	722	962	722	830	1104	722	852	1136	722	975	1300
	480	361	481	361	415	552	361	426	568	361	487	649
	600	289	385	289	332	442	289	341	455	289	390	520
500	208	1389	1852	1389	1597	2124	1389	1639	2185	1389	1875	2500
	240	1203	1604	1203	1383	1839	1203	1420	1893	1203	1624	2165
	480	601	802	601	691	919	601	709	945	601	811	1081
	600	481	641	481	553	735	481	568	757	481	649	865
750	208	2083	2778	2083	2395	3185	2083	2458	3277	2083	2812	3749
	240	1804	2406	1804	2075	2760	1804	2129	2839	1804	2435	3247
	480	902	1203	902	1037	1379	902	1064	1419	902	1218	1624
	600	722	962	722	830	1104	722	852	1136	722	975	1300
1000	208	2778	3704	2778	3195	4249	2778	3278	4371	2778	3750	5000
	240	2406	3208	2406	2767	3680	2406	2839	3785	2406	3248	4331
	480	1203	1604	1203	1383	1839	1203	1419	1892	1203	1624	2165
	600	962	1283	962	1106	1471	962	1135	1513	962	1299	1732
1500	480	1804	2406	1804	2075	2760	1804	2129	2839	1804	2435	3247
	600	1443	1924	1443	1659	2206	1443	1703	2271	1443	1948	2597
2000	480	2406	3208	2406	2767	3680	2406	2839	3785	2406	3248	4331
	600	1924	2565	1924	2213	2943	1924	2270	3027	1924	2597	3463
2500	480	3008	4010	3008	3459	4600	3008	3549	4732	3008	4061	5415
	600	2406	3208	2406	2767	3680	2406	2839	3785	2406	3248	4331

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): ①
   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 and Losses
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

① 600 Y and 600 Δ also available.

Power Centers With Type DS Secondary Switchgear

Transformer Data and Standards, *Continued*

Standard Insulation Levels—Kv BIL

High Voltage Rating	Fluid Filled Transformer HV	Fluid Filled Transformer LV (600 Max.)	Vent. Dry Transformer HV	Vent. Dry Transformer LV (600 Max.)
2400	45	30	30	10
4160	60	30	30	10
4800	60	30	30	10
6900	75	30	40	10
7200	75	30	40	10
12000	95	30	60	10
12470	95	30	60	10
13200	95	30	60	10
13800	95	30	60	10

Standard Guaranteed Sound Levels— Decibels

Max. Base Kva (Self Cooled)	Fluid Filled Transformer OA	Fluid Filled Transformer FA	Vent. Dry Transformer AA	Vent. Dry Transformer FA
300	55	—	58	67
500	56	—	60	67
750	58	67	64	67
1000	58	67	64	68
1500	60	67	64	68
2000	61	67	66	69
2500	62	67	68	71

Impedances (±7½% Tolerance):

Kva	Vent. Dry Transformer	Fluid Filled Transformer
300	①4.50%	5.0%
500	5.75%	5.0%
750	5.75%	5.75%
1000	5.75%	5.75%
1500	5.75%	5.75%
2000	5.75%	5.75%
2500	5.75%	5.75%

① 5.75% at 95 Kv BIL

Standard Tests (ANSI)

- Resistance measurements
- Ratio tests
- Polarity and phase relation
- No-load loss and excitation current
- Impedance and load loss
- Applied potential test
- Induced potential test

Power Centers With Type DS Secondary Switchgear

Transformer Dimensions and Weights—Inches (Approximate)

Fluid-Filled

Aluminum Windings, Standard Design & Losses, Delta-Wye, 60 Hz, Indoor or Outdoor, 600 Volt LV Class @ 30 Kv BIL

KVA	HV CLASS	HV BIL	%Z	65°C Rise H	W	D	Weight	55°C Rise H	W	D	Weight
Oil-Filled											
300	5	30,60	5.00	81	31	60	3470	81	32	64	3570
	15	95	5.00	81	29	60	3300	81	30	64	3400
500	5	60,60	5.00	86	49	56	4000	86	49	66	4200
	15	95	5.00	86	47	56	3800	86	47	66	4000
750	5	30,60	5.75	86	53	66	5300	86	55	79	5450
	15	95	5.75	86	51	63	5000	86	52	75	5200
1000	5	30,60	5.75	86	56	70	6650	86	57	89	6850
	15	95	5.75	86	53	87	6300	86	55	89	6500
1500	5	30,60	5.75	86	57	74	7900	86	60	92	8200
	15	95	5.75	86	54	72	7500	86	57	89	7800
2000	5	30,60	5.75	86	59	101	10000	86	61	112	10300
	15	95	5.75	86	58	101	9550	86	58	112	9800
2500	5	30,60	5.75	86	63	105	12300	86	62	117	12100
	15	95	5.75	86	60	105	11700	86	59	117	11500
WECOSOL®-Filled											
300	5	30,60	5.00	82	30	65	4450	86	30	78	4950
	15	95	5.00	82	29	65	4200	86	29	78	4700
500	5	30,60	5.00	86	49	60	5250	86	49	74	5500
	15	95	5.00	86	47	60	5000	86	47	74	5200
750	5	30,60	5.75	86	53	76	6800	86	49	86	7100
	15	95	5.75	86	51	76	6800	86	49	86	7100
1000	5	30,60	5.75	86	59	86	7900	86	52	96	8800
	15	95	5.75	86	56	86	7900	86	52	96	8800
1500	5	30,60	5.75	86	60	75	9900	86	57	97	10400
	15	95	5.75	86	57	75	9400	86	54	97	9900
2000	5	30,60	5.75	86	59	101	11200	86	59	113	12100
	15	95	5.75	86	58	101	11200	86	59	113	12100
2500	5	30,60	5.75	86	62	108	13350	86	65	121	14700
	15	95	5.75	86	59	108	12700	86	62	121	14000
Silicone-Filled											
300	5	30,60	5.00	84	31	72	3675	84	32	74	3700
	15	95	5.00	84	29	72	3500	84	30	74	3500
500	5	30,60	5.00	86	49	68	4400	86	49	80	4800
	15	95	5.00	86	47	68	4200	86	47	80	4500
750	5	30,60	5.75	86	53	76	5800	86	54	86	6100
	15	95	5.75	86	50	76	5800	86	52	86	6100
1000	5	30,60	5.75	86	55	84	6800	86	57	96	7600
	15	95	5.75	86	52	84	6800	86	54	96	7600
1500	5	30,60	5.75	86	58	88	8700	86	60	109	8950
	15	95	5.75	86	54	88	8300	86	57	109	8500
2000	5	30,60	5.75	86	60	101	9800	86	61	113	9000
	15	95	5.75	84	58	101	9800	84	59	113	10900
2500	5	30,60	5.75	86	63	119	12700	86	62	121	14100
	15	95	5.75	86	60	119	12100	86	59	121	13400

Ventilated Dry Type

Aluminum Windings, Standard Design & Losses, Delta-Wye, 60 Hz, Indoor, 600 Volt LV Class @ 10 Kv BIL

KVA	HV	HV-BIL	%Z	H	W	D	Weight
150°C Rise							
300	5	30	4.50	90	60	54	2870
	15	60	4.50	90	60	54	3200
		95	5.75	90	60	54	3190
500	5	30	5.75	90	60	54	3250
	15	60	5.75	90	60	54	3580
		95	5.75	90	70	60	4080
750	5	30	5.75	90	60	54	3930
	15	60	5.75	90	70	60	4720
		95	5.75	90	70	60	4920
1000	5	30	5.75	90	70	60	4740
	15	60	5.75	90	70	60	5600
		95	5.75	90	70	60	6170
1500	5	30	5.75	90	70	60	6060
	15	60	5.75	90	70	60	7000
		95	5.75	90	70	74	7880
2000	5	30	5.75	105	105	60	8100
	15	60	5.75	105	105	60	9000
		95	5.75	105	115	60	9800
2500	5	30	5.75	105	105	60	9400
	15	60	5.75	105	115	60	10400
		95	5.75	105	115	60	11200
115°C Rise							
300	5	30	4.50	90	60	54	2850
	15	60	4.50	90	60	54	3210
		95	5.75	90	60	54	3250
500	5	30	5.75	90	60	54	3520
	15	60	5.75	90	60	54	3760
		95	5.75	90	70	60	4230
750	5	30	5.75	90	60	54	4150
	15	60	5.75	90	70	60	4950
		95	5.75	90	70	66	5400
1000	5	30	5.75	90	70	60	5210
	15	60	5.75	90	70	74	6150
		95	5.75	90	70	74	6420
1500	5	30	5.75	90	70	60	6680
	15	60	5.75	90	70	74	8060
		95	5.75	90	70	82	8560
2000	5	30	5.75	105	105	60	8700
	15	60	5.75	105	115	60	10000
		95	5.75	105	115	66	10500
2500	5	30	5.75	105	115	60	11600
	15	60	5.75	105	115	60	11700
		95	5.75	105	130	68	12500
80°C Rise							
300	5	30	4.50	90	60	54	3200
	15	60	4.50	90	60	54	3480
		95	5.75	90	70	60	3780
500	5	30	5.75	90	60	54	3810
	15	60	5.75	90	70	60	4650
		95	5.75	90	70	66	5080
750	5	30	5.75	90	70	60	5010
	15	60	5.75	90	70	74	6250
		95	5.75	90	70	74	6480
1000	5	30	5.75	90	70	74	6230
	15	60	5.75	90	70	74	7350
		95	5.75	90	70	82	7710
1500	5	30	5.75	90	70	74	8030
	15	60	5.75	90	70	82	9360
		95	5.75	90	70	82	10130
2000	5	30	5.75	105	115	60	10600
	15	60	5.75	105	115	60	12800
		95	5.75	105	130	68	13800
2500	5	30	5.75	105	130	68	16700
	15	60	5.75	105	130	68	15900
		95	5.75	105	130	68	19400

Power Centers With Type DS Secondary Switchgear

Application—Type DS Air Circuit Breakers

Standards
Type DS circuit breakers meet or exceed all applicable requirements of the latest ANSI Standards C37.13 and C37.16

System Voltage and Frequency
Type DS breakers are designed for operation on Ac systems only, 60 Hz or 50 Hz, 600 volts maximum.

Continuous Current Ratings
Unlike transformers, generators and motors, circuit breakers are maximum-rated devices and have no built-in temporary overload current ratings. Consequently, it is vital that each application take into consideration the maximum anticipated current demand, initial and future, including temporary overloads.

The continuous rating of any Type DS breaker is limited to 125% of the sensor rating, or the frame size current rating, whichever is the lesser. For instance, a Type DS-416 1600 ampere frame breaker with 800 ampere sensors has a maximum continuous rating of 800 times 1.25 or 1000 amperes, but the same breaker with 1600 ampere sensors is limited to 1600 amperes maximum.

All current ratings are based on a maximum ambient air temperature of 40°C (104°F) outside of the switchgear enclosure.

Altitude
The breakers are applicable at their full voltage and current ratings up to a maximum altitude of 6600 feet (2000 meters) above sea level. When installed at higher ltitudes, the ratings are subject to correction factors in accordance with ANSI Standards.

Repetitive Duty
Repetitive breaker opening and closing, such as in frequent motor starting and stopping, are covered by ANSI Standards C37.13 and C37.16. These Standards list the number of operations between servicing (adjusting, cleaning, lubrication, tightening, etc.) and the total numbers of operations under various conditions without requiring replacement of parts, for the various breaker frame sizes.

For motor starting duty, when closing starting currents up to 600% and opening running currents up to 100% of the breaker frame size, at 80% power factor or higher, the endurance or total operations (not requiring parts replacement) will be as follows:

Type DS-206—1400
Type DS-416— 400

The frequency of operation should not exceed 20 starts in 10 minutes or 30 in one hour.

Unusual Environmental and Operating Conditions

Special attention should be given to applications subject to the following conditions:

1. Damaging or hazardous fumes, vapors, etc.

2. Excessive or abrasive dust.

   For such conditions, it is generally recommended that the switchgear be installed in a clean, dry room, with filtered and/or pressurized clean air. This method permits the use of standard indoor switchgear, and avoids the derating effect of non-ventilated enclosures.

3. Salt spray, excessive moisture, dripping, etc.

   Optional drip-proof top covers and space heaters in indoor switchgear, or outdoor weatherproof enclosures, may be indicated, depending upon the severity of the conditions.

4. Excessively high or low ambient temperatures.

   For ambient temperatures exceeding 40°C, and based on a standard temperature rise of 65°C, the continuous current ratings of breaker frame sizes, and also buses, current transformers, etc., will be subject to a rating factor calculated from the following formula:

$$\sqrt{\frac{105\,^{\circ}\text{C Total—Special Ambient, }^{\circ}\text{C}}{105\,^{\circ}\text{C Total—40}\,^{\circ}\text{C Standard Ambient}}}$$

Interrupting ratings of Type DS breakers at system voltages are given in the following table.

Breaker Type	Frame Size, Amp.	Interrupting Ratings, RMS Symmetrical Amperes With Instantaneous Trip 208-240V	480V	600V	With Short Delay Trip ①② 208-240V	480V	600V
DS-206	800	42,000	30,000	30,000	30,000	30,000	30,000
DS-206H©	800	50,000	42,000	42,000	42,000	42,000	42,000
DS-416	1600	65,000	50,000	42,000	50,000	50,000	42,000
DS-416H©	1600	65,000	65,000	50,000	65,000	65,000	50,000
DS-420	2000	65,000	65,000	50,000	65,000	65,000	50,000
DS-632	3200	85,000	65,000	65,000	65,000	65,000	65,000
DS-840	4000	130,000	85,000	85,000	85,000	85,000	85,000

© Changed since previous issue.
① Also short-time ratings.
② Short circuit ratings of non-automatic breakers except the DS-840 which is 65,000.

Maximum voltages at which the interrupting ratings apply are:

System Voltage	Maximum Voltage
208 or 240	254
480	508
600	635

Interrupting ratings are based on the standard duty cycle consisting of an opening operation, a 15 second interval and a close-open operation, in succession, with delayed tripping in case of short-delay devices.

The standard duty cycle for short-time ratings consists of maintaining the rated current for two periods of ½ second each, with a 15-second interval of zero current between the two periods.

Power Centers With Type DS Secondary Switchgear

Application — Type DS Air Circuit Breakers, *Continued*

The circuit breakers are not adversely affected by very low outdoor ambient temperatures, particularly when energized and carrying load currents. The standard space heaters in weatherproof switchgear will raise the temperature slightly and prevent condensation.

5. Abnormal vibration or shock.

   Applications involving such conditions should be referred to Westinghouse with complete data.

6. Abnormally high repetitive and frequency of operation.

   In line with "Repetitive Duty" above, a lesser number of operations between servicing, and more frequent replacement of parts, may be indicated.

System Application
Tables 3A through 3D on Pages 40 and 41 list the calculated secondary short circuit currents and applicable main secondary and feeder breakers for secondary unit substation switchgear.

The short circuit currents are calculated by dividing the transformer basic (100%) rated amperes by the sum of the transformer and primary system impedances, expressed in "per unit." The transformer impedance percentages are standard for most secondary unit substation transformers. The primary impedance is obtained by dividing the transformer base (100%) Kva by the primary short-circuit Kva. The motor contributions to the short circuit currents are estimated as approximately 4 times the motor load amperes, which in turn are based upon 50% of the total load for 208 volts and 100% for all other voltages.

Higher transformer impedances and/or lower percentages of motor loads will reduce the short circuit currents correspondingly. Supplementary transformer ratings (see Tables on Page 49) will not increase the short circuit currents, provided the motor loads are not increased.

The Tables do not apply for 3 phase banks of single phase distribution transformers, which usually have impedances of 2% to 3% or even lower. The short circuit currents must be recalculated for all such applications and the breakers selected accordingly.

Main Transformer Secondary Breakers
Transformer secondary breakers are required or recommended for one or more of the following purposes:

1. To provide a one-step means of removing all load from the transformer. The NEC limits the maximum number of feeder breakers on a transformer bus without a main breaker to six (6).

2. To provide transformer overload protection in the absence of an individual primary breaker, and/or when primary fuses are used.

3. To provide the fastest clearing of a short circuit in the secondary main bus.

4. To provide a local disconnecting means, in the absence of a local primary switch or breaker, for maintenance purposes.

5. For automatic or manual transfer of loads to alternate sources, as in double ended secondary selective unit substations.

6. For simplifying key interlocking with primary interrupter switches.

Main secondary breakers as selected in Tables 3A thru 3D have adequate interrupting ratings, but not necessarily adequate continuous current ratings. They should be able to carry continuously not only the anticipated maximum continuous output of the transformer, but also any temporary overloads.

Maximum capabilities of transformers of various types, in terms of Kva and secondary current, are given on Pages 40 and 41. It will be noted that the maximum ratings will often require the substitution of larger frame main breakers than those listed in Tables. Even if a self-cooled transformer only is considered, it should be remembered that with ratings of 750 Kva and higher, provision for the future addition of cooling fans is automatically included. It is recommended that the main breaker have sufficient capacity for the future fan-cooled rating, plus an allowance for overloads if possible, particularly since load growth cannot always be predicted.

The same considerations should be given to the main bus capacities and main current transformer ratios.

Bus Sectionalizing (Tie) Breakers
The minimum recommended continuous current rating of bus sectionalizing or tie breakers, as used in double ended secondary selective unit substations or for connecting two single ended substations, is one-half that of the associated main breakers. The interrupting rating should be at least equal to that of the feeder breakers. It is common practice to select the tie breaker of the next frame size below that of the main breakers. However, many users and engineers prefer that the tie breaker be identical to and interchangeable with the main breakers, so that under normal conditions it will be available as a spare main breaker.

Generator Breakers
In most applications where generators are connected through breakers to the secondary bus, they are used as emergency standby sources only, and are not synchronized or paralleled with the unit substation transformers. Under these conditions, the interrupting rating of the generator breaker will be based solely on the generator Kva and sub-transient reactance. This reactance varies with the generator type and Rpm, from a minimum of approximately 9% for a 2 pole 3600 rpm turbine driven generator to 15% or 20% or more for a medium or slow speed engine type generator. Thus the feeder breakers selected for the unit substation will usually be adequate for a standby generator of the same Kva as the transformer.

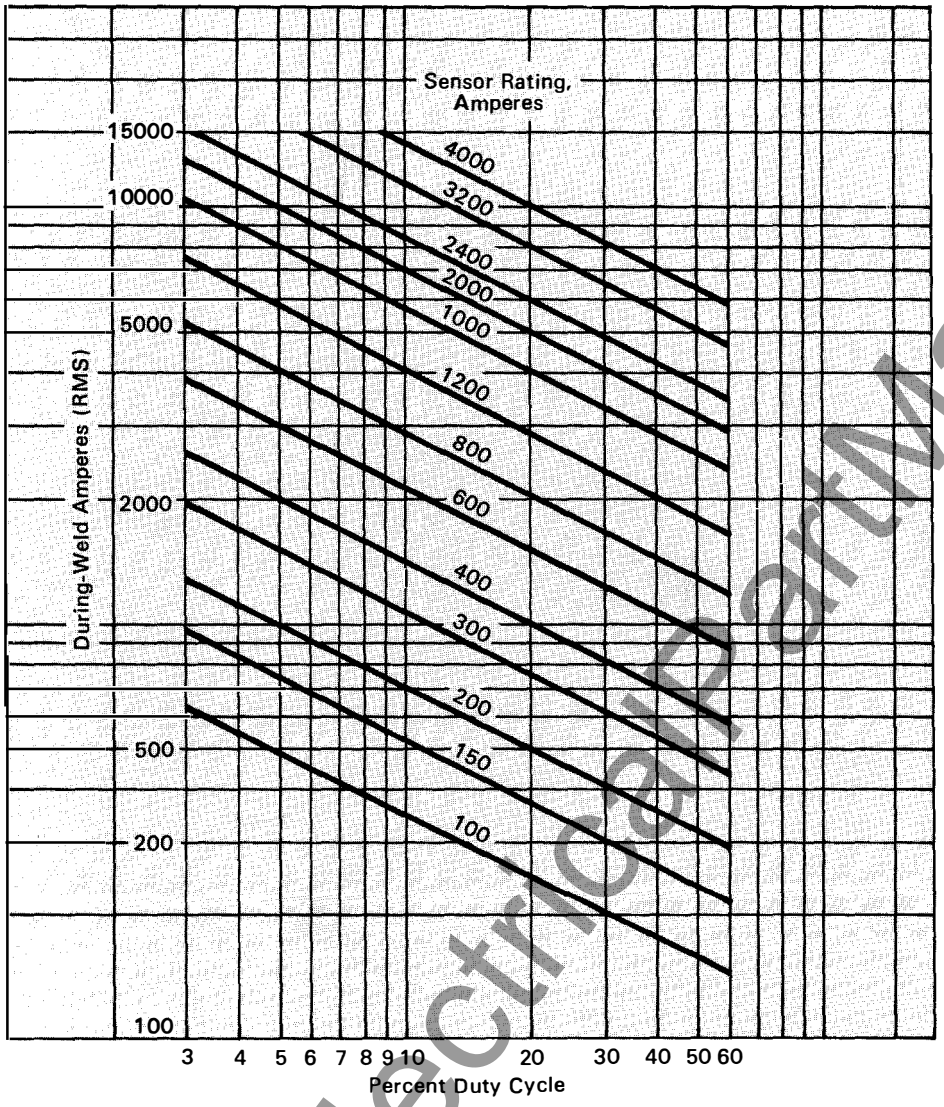
Most generators have a 2-hour 25% overload rating, and the generator breaker must be adequate for this overload current. Selective type long and short delay trip devices are usually recommended for coordination with the feeder breakers, with the long delay elements set at 125% to 150% of the maximum generator current rating for generator protection.

In the case of two or more paralleled generators, Type CRN-1 antimotoring reverse power relays are recommended for protection of the prime movers, particularly piston type engines. For larger generators requiring Type DS-632 or DS-840 breakers, Type COV voltage-restraint type overcurrent relays are recommended.

Power Centers With Type DS Secondary Switchgear

Application-Type DS Air Circuit Breakers, *Continued*

Type DS Breaker Sensor Selection Guide for Resistance Welding Applications



Resistance Welding Feeder Breakers
The application of Type DS breakers to resistance welding circuits is shown on the Sensor Selection Guide.

Sensor ratings only are given; the breaker frame will also be as required for interrupting ratings.

Type DS breaker solid state tripping devices are well suited for this service, since the chattering, noise, wear and calibration changes experienced in electro-mechanical devices are eliminated.

These applications are based on Amptector II-A or Amptector I-A long delay and instantaneous trip devices with the following settings:

Long delay pickup 1.0 times sensor rating
Long delay time 36 seconds.
Instantaneous trip setting 2 times average weld amperes (during-weld amperes times percent duty cycle) or higher.

Power Centers With Type DS Secondary Switchgear

Application-Type DS Air Circuit Breakers, *Continued*

Feeder Breakers––General
Circuit breakers for feeder circuit protection may be manually or electrically operated, with long and short delay or long delay and instantaneous type trip devices, and trip settings, as required for the specific circuit and load requirements.

Feeder breakers as selected in Tables 3A thru 3D have adequate interrupting ratings, and are assumed to have adequate continuous current ratings for maximum load demands.

General purpose feeder breakers, such as for lighting circuits, are usually equipped with long delay and instantaneous trip devices, with the long delay pickup set for the maximum load demand in the circuit. Where arcing fault protection is required, the instantaneous trip setting should be as low as practicable consistent with inrush requirements.

Motor Starting Feeder Breakers
These breakers are usually electrically operated, with long delay and instantaneous tripping characteristics for motor running, locked rotor and fault protection.
The breaker sensor rating should be chosen so that the long delay pickup can be set at 125% for motors with a 1.15 service factor or at 115% for all other motors.

When system short circuits are less than 40 times the motor full load current, the motor breaker tripping characteristic should include a short delay characteristic for greater fault protection.

Group Motor Feeder Breakers
Typical loads for such circuits are motor control centers. The feeder breakers may be either manually or electrically operated as preferred, and are usually equipped with long and short delay trip devices for coordination with the individual motor circuit devices. The minimum long delay pickup setting should be 115% of the running current of the largest motor in the group plus the sum of the running circuits of all other motors.

Ground Fault Protection With Westinghouse Amptector I-A Static Trip

Distribution Systems
The power distribution in three phase low voltage systems can be three or four wire distribution. The three wire distribution can be served from either delta or wye sources, but the four wire distribution is obtained from wye source only. Fig. No. 1 shows three wire distribution with delta source and Fig. No. 2 shows three wire distribution with wye source. It is significant on Fig. No. 2, that the wye connection of a transformer secondary does not necessarily mean four wire distribution in switchgear. This is worthwhile to note because four wire distribution is quite frequently assumed when the transformer secondary is wye connected. The low voltage system is three phase four wire distribution only if a fourth wire is carried through the switchgear and single phase loads are connected to feeder breakers. This fourth wire is the neutral bus. The neutral bus is connected to the neutral of the wye connected transformer secondary as shown on Fig. No. 3. The standard neutral bus capacity is one half of the phase bus current carrying capacity but full capacity neutral busses are also available on request.

Three or four wire systems can be grounded or ungrounded in service. Generally where the source is delta connected it is ungrounded, but in some very rare cases it is grounded at one corner of the delta or at some other point. When the source is wye connected it can be grounded or ungrounded and when grounded the grounding is at the neutral. When low voltage systems are grounded they are generally solidly grounded. However occasionally the grounding is through a resistor. Three and four wire solidly grounded systems are shown on Fig. No. 4 and 5. At present the new installations are mostly solidly grounded or ungrounded low voltage systems with a definite trend toward the increase of the solidly grounded systems. An ungrounded low voltage system is a good operating system if it is equipped with a ground detection device and if the operators and maintenance crew are trained to locate the initial ground and clear it as soon as practical. The grounded neutral system results in a ground current as soon as any ground occurs on a phase conductor and if the current exceeds the setting of the protective device it will operate and isolate the fault.

Need For Ground Fault Protection
If the magnitude of all ground currents would be large enough to operate the short delay or instantaneous elements of the phase overcurrent trip devices there would be no problem in solidly grounded systems. Unfortunately this is not the case, because low magnitude ground currents are quite common. Low level ground currents can exist if the ground is in the winding of a motor or a transformer or if it is a high impedance ground. Low level ground currents may also be due to an arcing type ground. The arcing type grounds are the source of the most severe damages to electrical eqiupment. The lower limit of the arcing ground currents is unpredictable and the magnitude may be considerably below the setting of the breaker phase overcurrent trip devices.

Since the breaker phase overcurrent trip devices cannot provide fast protection against low magnitude ground faults there is a need for an additional protective device. This additional device is not to operate on normal overloads and it is to be sensitive and fast enough to protect against low magnitude grounds. It is also important that this additional ground protecting device be simple and reliable. The Westinghouse Amptector I-A solid-state tripping system including an optional "ground element" will assure good ground fault protection.

The Ground Element
The ground element of the solid-state trip is part of the Amptector I-A and is in addition to the usual phase protection. The ground element has a continuously adjustable pickup with calibrated marks as shown in Table 2 and a continuously adjustable time delay with calibrated marks at 0.22-0.35-0.50 seconds. The input current to the Amptector I-A terminals can be provided by:

(a) Residual connection of phase sensors with residual circuit connected to ground element terminals. This is the Westinghouse Type DS Low Voltage Switchgear standard ground protection system. This produces pickup values as shown in Table 2.

(b) External ground sensing current transformer directly connected to ground element terminals. This is one of the unique features of the Westinghouse Amptector I-A. This means that this external ground sensor will trip the breaker on grounds without the use of external relay and without the application of a breaker shunt trip and external power source. The lower the CT ratio the more sensitive the ground fault protection.

Power Centers With Type DS Secondary Switchgear

Application-Type DS Air Circuit Breakers, *Continued*

Ground Fault Protection Application and Coordination

In well designed systems the continuity of service is very important. For reliable service continuity selective tripping is applied between main tie and feeder breakers and the downstream protecting devices for phase-to-phase faults. Similar selective tripping is desirable when breakers trip on grounds. The application of ground protection on main breakers only may assure good ground protection, however it will not provide good service continually because the main breaker will trip on grounds which should have been cleared by feeder breakers. When the switchgear itself feeds the loads directly the applied ground protection must be such that on a load circuit ground the associated feeder breaker will trip first. Therefore, for proper protection and for good service continuity, main, tie and feeder breakers all should be equipped with ground protection. Ground protection is not required for non-automatic tie breakers having no phase overcurrent protection.

The necessary coordinated tripping is not easily accomplished when the switchgear feeds into downstream sub-distribution panels which do not have ground protection. If full selective tripping is required the downstream protecting devices should also be equipped with ground protection. If not, the system designer will face a coordination problem in obtaining selectivity between the low pickup and fast tripping switchgear breaker ground elements and phase overcurrent protective devices. This is a very difficult problem because of the time-current tripping characteristic of the phase overcurrent protective devices. When such coordination is desired, the ground element pickup must be increased in order to "desensitize" the device. It is obvious that when the ground element is set at its highest setting, valuable protection is lost for low magnitude arcing ground currents. If higher ground element pickup is attempted to achieve coordination with fairly large sized downstream phase devices the ground protection setting approaches the characteristic of a short time phase element and the ground protection will lose its true meaning and not provide the expected protection.

In view of the above it is evident that properly applied ground protection requires ground elements as far down the system to the loads as practical. For best results down stream molded case breakers should have individual ground protection. This would result in excellent ground protection because ground elements of switchgear and downstream breakers having similar tripping characteristic can be coordinated.

Coordination between switchgear breaker ground elements and downstream branch circuit fuses is not practical. This is due to the basic fact that the blowing of one phase fuse will not clear a ground on a three phase system. The other two phase fuses will let the load "single-phase" and also continue to feed the ground through the load as shown in Figure 6.

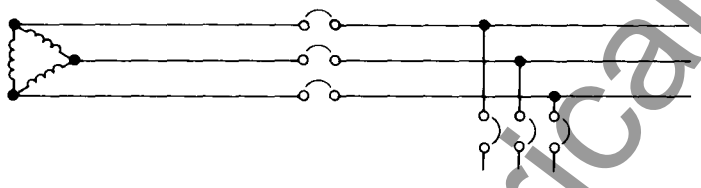


Figure 1. 3 Wire Distribution, Delta Source (Ungrounded)

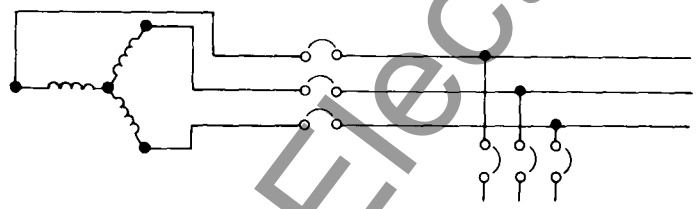


Figure 2. 3 Wire Distribution, Wye Source (Ungrounded)

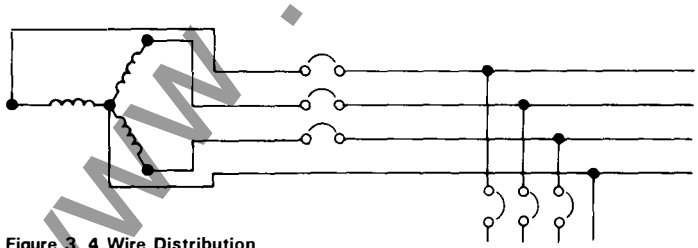


Figure 3. 4 Wire Distribution

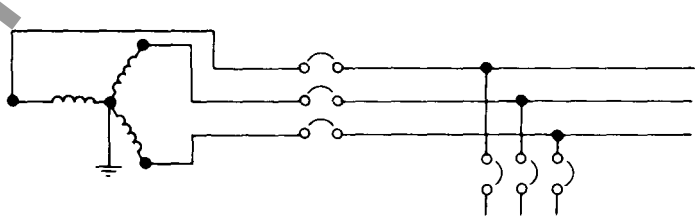


Figure 4. 3 Wire Distribution Solidly Grounded System

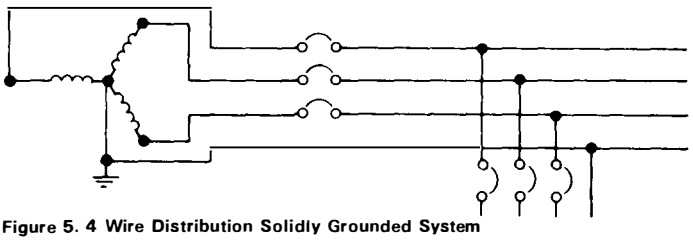


Figure 5. 4 Wire Distribution Solidly Grounded System

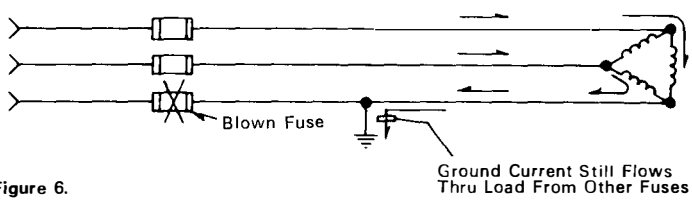


Figure 6.

Power Centers With Type DS Secondary Switchgear

Application-Type DS Air Circuit Breakers, *Continued*

Table 2

Ground Pick-Up Value—Amperes

Dial Setting	Sensor Rating 50	100	150	200	300	400	600	800	1200	1600	2000	2400	3200	4000	Secondary Current ●
A	13	57	60	65	80	110	145	180	260	330	400	530	640	800	1.0
B	18	67	75	85	110	150	205	260	385	505	600	770	1000	1200	1.5
C	22	75	85	100	130	185	250	325	480	625	760	960	1200	N.A.	1.9
D	33	100	120	145	200	270	385	500	730	970	1200	N.A.	N.A.	N.A.	3.0

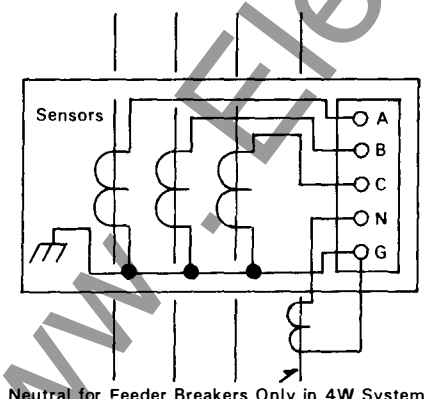
All pick up values subject to ± 10% tolerance.

① Current of this value from the secondary of an external ground transformer will cause the ground element to function.

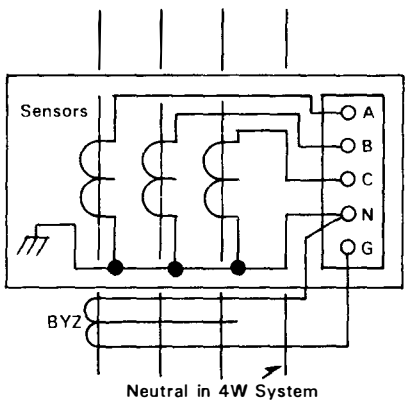
The Following Provides Guideline for Ground Fault Protection.

System	Advantages	Disadvantages	Equipment Available for Protection: Main Breaker	Tie Breaker	Fdr. Breaker	Notes
Ungrounded (3 Wire)	Minimum disturbance to service continuity. Currents for the majority of grounds will be limited to capacitance charging current of the system. Can operate with the first ground until it is removed during a regular shutdown.	When ground detector shows that a ground exists corrective action must be taken at the earliest possible shutdown. However, experience indicates that this attention is not always possible. Therefore most ungrounded systems operate with one phase grounded through the first uncleared ground. A ground on another part of the system, due to fault impedance, would probably result in low values of current which would not operate a breaker phase trip, and would produce fire damage.	Lamp type ground detector or ground detecting voltmeters without or with PT's. If PT's are used a ground alarm relay can be added for remote or local alarm.			With proper maintenance this system would result in the minimum disturbance to service continuity.
	Ground protection for an ungrounded system		Amptector I-A ground 3W protection, minimum pick-up. .50 sec. time delay. See SK No. 1 & No. 6.	Amptector I-A ground 3W protection, minimum pick-up. .35 sec. time delay.	Amptector I-A ground 3W protection, minimum pick-up. .22 sec. time delay. See SK No. 1 & No. 6.	Ground fault protection on this ungrounded system would trip the breaker when the second ground occurs and current exceeds minimum pick-up setting.
Solid Grounded	Psychologically safer. Practically results in good continuity of service. Isolation of faults automatic through ground protection system; no overvoltages due to ferroresonance or switching.	Probability of very high ground current and extensive damage however, normally these high currents are not obtained. Grounds are automatically isolated and continuity of service is interrupted.	Amptector I-A standard residual ground protection in 3W systems and source neutral CT feeding into Amptector I-A in 4 wire systems. Minimum pickup. .50 sec. time delay. See SK No. 1, No. 3 & No. 6.	Amptector I-A ground 3W or 4W (as required) fault protection. Minimum pick-up. .35 sec. time delay.	Amptector I-A ground 3W or 4W (as required) fault proteciton. Minimum pick-up. .22 sec. time delay or BYZ current transformer feeding into above Amptector I-A. See SK No. 1, No. 2 & No. 6.	This is the most common system in use today and as long as it is not necessary to coordinate with phase devices down the line it will give very good main bus and feeder protection.
High Resistance Grounded (3 Wire)	Ground fault current is limited. Ungrounding can result in high voltages during switching and this is corrected by high resistance grounding.	Very sensitive detection is required to detect the limited fault current. Since overvoltage due to switching isn't prevalent on ungrounded low voltage systems high resistance grounding is not required.	Same as for ungrounded except if ground alarm relay is used connect relay across grounding resistor.	Same as for ungrounded.	Same as for ungrounded.	This system is very seldom used and is not recommended.

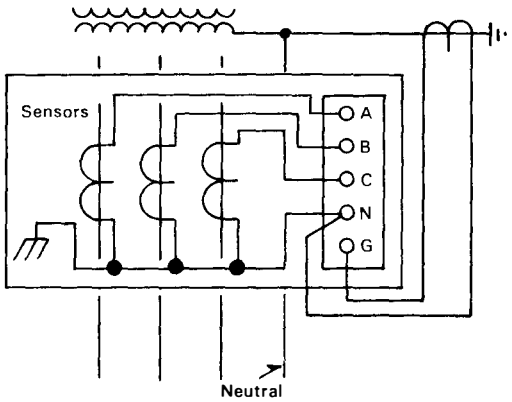
Sketch 1. ②
Residual Main and Feeder Breaker



Sketch 2.
Zero Sequence Feeder Breaker



Sketch 3.
Source Neutral Main Breaker



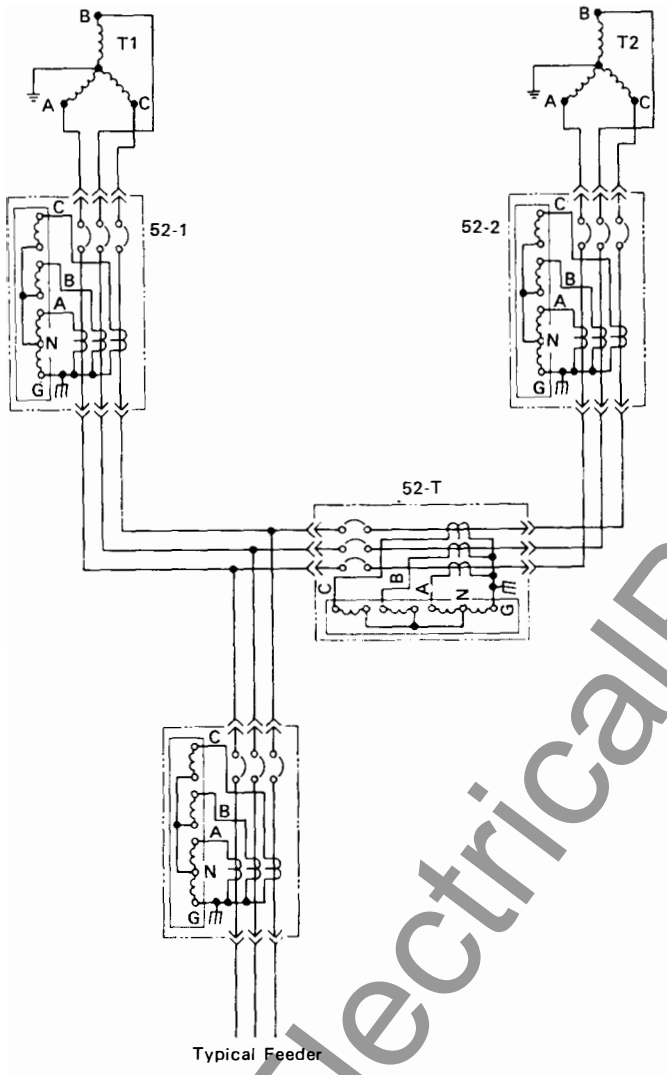
② Apply in 3 Wire Systems for Main Breaker and in 3 or 4 Wire Systems for Feeder Breakers.

Note: For double ended secondary unit substations ground fault protection should be as indicated on sketches No. 4 and No. 5; however for this type application, Westinghouse should be consulted for the actual bill of materials to be used. The application becomes rather complex if single phase to neutral loads are being served.

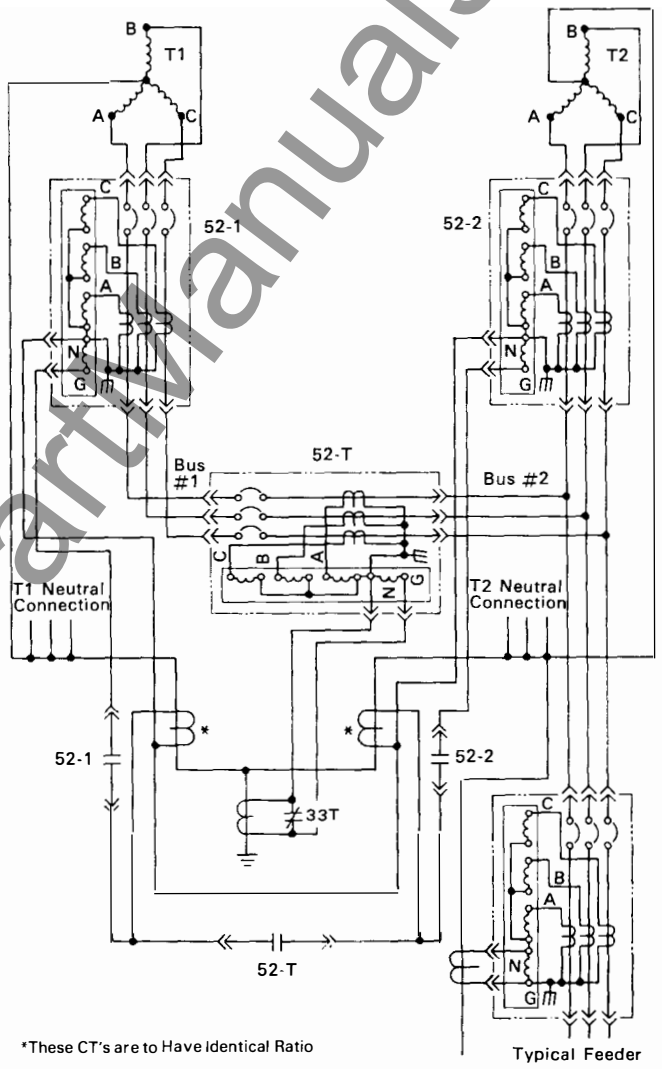
Power Centers With Type DS Secondary Switchgear

Application-Type DS Air Circuit Breakers, *Continued*

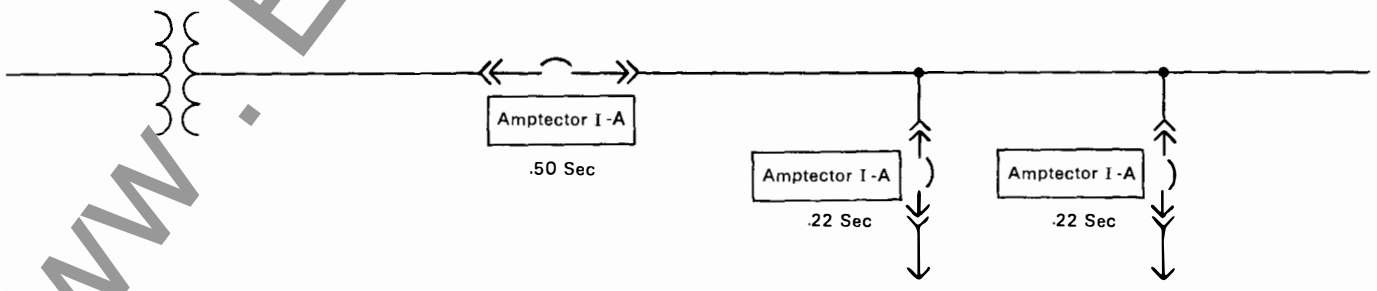
Sketch 4. 3 Wire Double Ended Unit Substation



Sketch 5. 4 Wire Double Ended Unit Substation

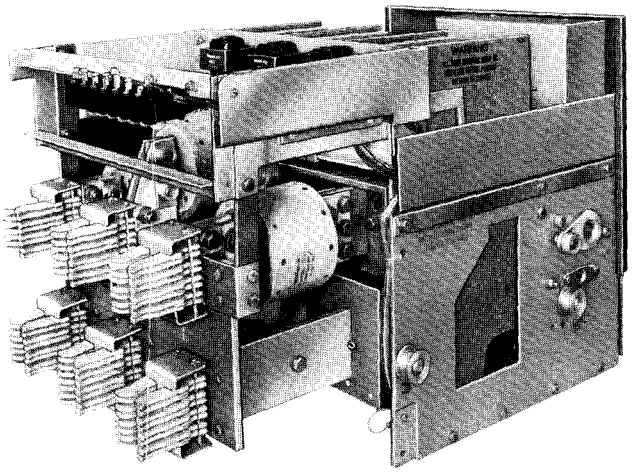


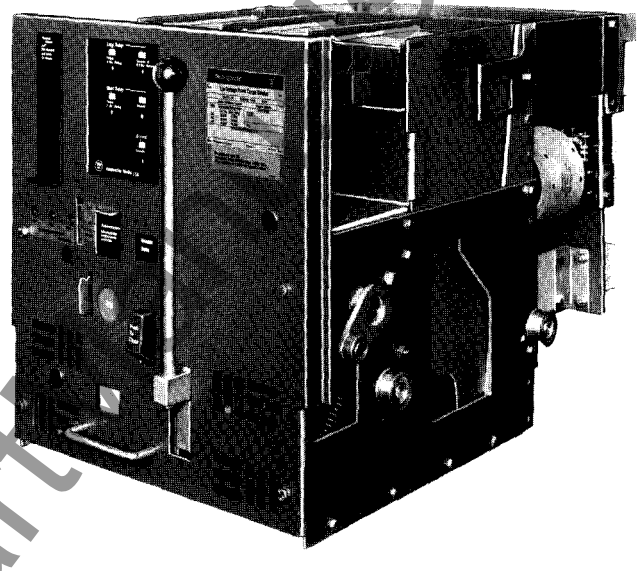
Sketch 6.



Power Centers With Type DS Secondary Switchgear

Type DSL Limiter Type Air Circuit Breakers





Application
Type DSL breakers are coordinated combinations of Type DS breakers and series connected current limiters. They are intended for applications requiring the overload protection and switching functions of air circuit breakers on systems whose available fault currents exceed the interrupting rating of the breakers alone, and/or the withstand and interrupting ratings of "downstream" circuit components.

Sizes and Arrangements
Types DSL-206 800 ampere frame and DSL-416 1600 ampere frame breakers include the limiters integrally mounted on the drawout breaker elements, in series with the upper terminals.

Current limiters used in Types DSL-632 and DSL-840 combinations are mounted on separate drawout trucks in additional equal size compartments alongside the respective breaker compartment.

Scope of Fault Interruption
With properly selected and coordinated limiters, it is expected that the breaker itself will clear overloads and faults within its interrupting rating, leaving the limiters intact and undamaged. The limiters will provide fast interruption of fault currents beyond the breaker rating, up to a maximum of 200,000 amperes symmetrical. Thus, on overloads and faults within the breaker interrupting rating, the breaker protects the limiters; on higher fault currents exceeding the breaker rating the limiters protect the breaker.

Protection Against Single Phasing
Loads are protected against single phase operation by interlock arrangements which trip the circuit breaker whenever any one limiter blows. The breaker cannot be reclosed on a live source until there are three unblown limiters in the circuit.

On the Types DSL-206 and DSL-416 breakers, the primaries of small auxiliary transformers are connected in parallel with the limiters. The voltage between the ends of an unblown limiter is zero, but when any limiter blows, the associated transformer is energized and (1) operates an indicator identifying the fuse and (2) picks up a solenoid which raises the breaker trip bar, holding the breaker trip-free.

The DSL-632 and DSL-840 combinations with separately mounted limiters operate on the same principle except that the solenoid operates a micro-switch which trips the breaker electrically through a shunt trip coil.

Safety Features
The integral fuses on Types DSL-206 and DSL-416 breakers are inaccessible until the breaker is completely withdrawn from its compartment, thereby assuring complete isolation.

Likewise, the Type DSL-632 and DSL-840 fuses are inaccessible until the separate fuse truck is completely withdrawn and the fuses isolated. The fuse truck is key interlocked with the breaker to prevent withdrawing or insertion unless the breaker is open.

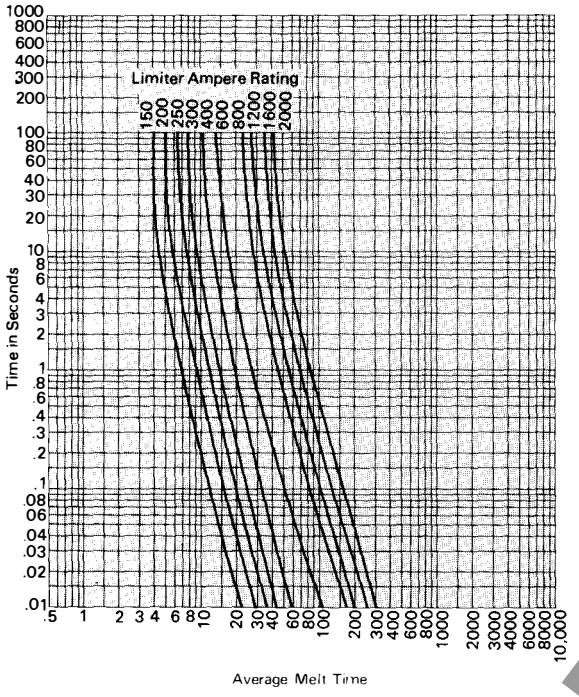
Current Limiting Type Breakers and Combinations

Type	DSL-206	DSL-416	DSL-632	DSL-840
Frame Size, Amperes	800	1600	3200	4000
Max. Interrupting Rating, RMS Symm. Amp., System Voltage 600 or Below	200,000	200,000	200,000	200,000

Notes: DSL-206 and DSL-416 include limiters integral with drawout breaker elements. DSL-632 includes DS-632 breaker and DS-3200 drawout fuse truck, in separate interlocked compartments. DSL-840 includes DS-840 breaker and DS-4000 drawout fuse truck, in separate interlocked compartments. Maximum interrupting rating limited to 150,000 amperes when 6000A fuses are used.

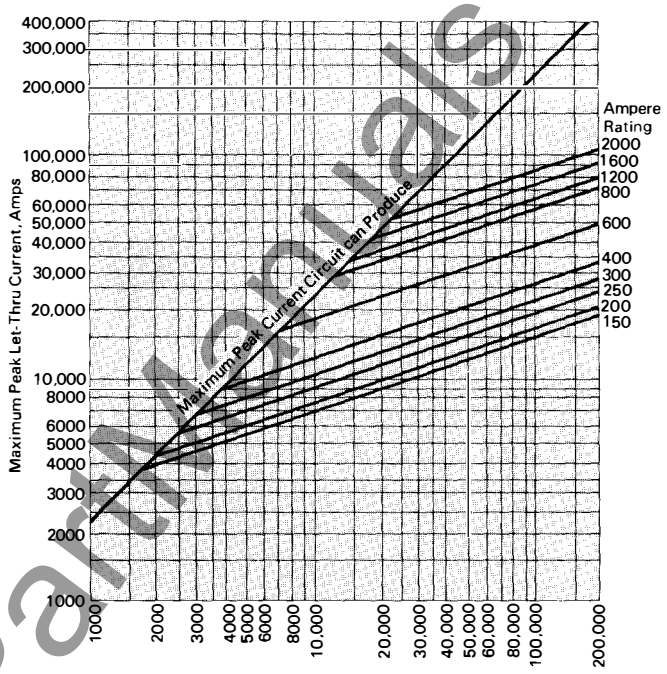
Power Centers With Type DS Secondary Switchgear

Type DSL Limiter Type Air Circuit Breakers, *Continued*



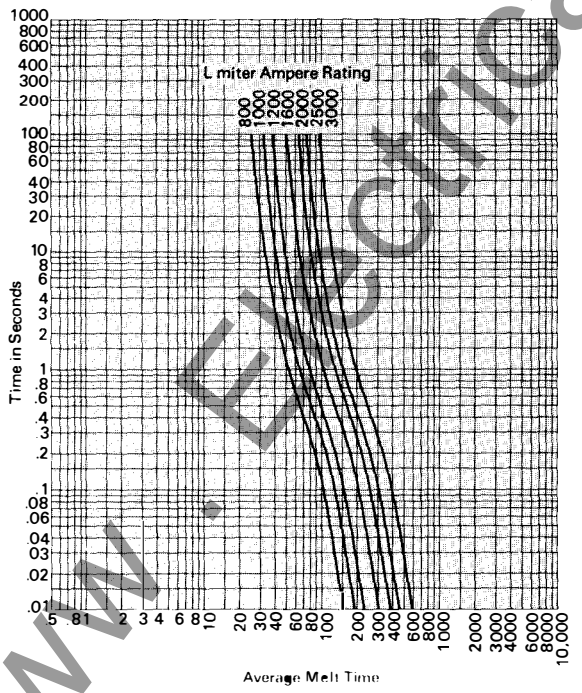
Scale x 100 = Current in Amperes
Limiter Time-Current Characteristic Curves
For DSL-206 Breaker

Curve 1



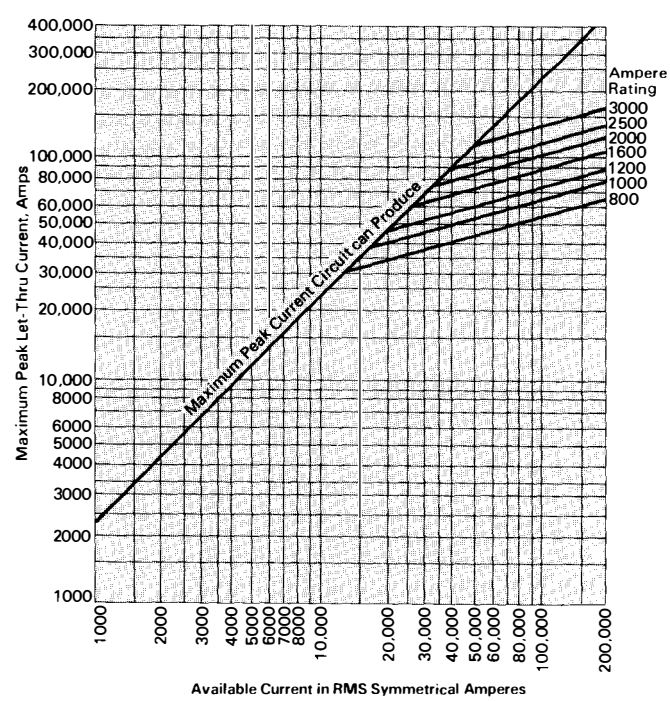
Maximum Peak Let-Through Current Curves
For DSL-206 Breaker

Curve 2



Scale x 100 = Current in Amperes
Limiter Time Current Characteristic Curves
For DSL-416 Breaker

Curve 3

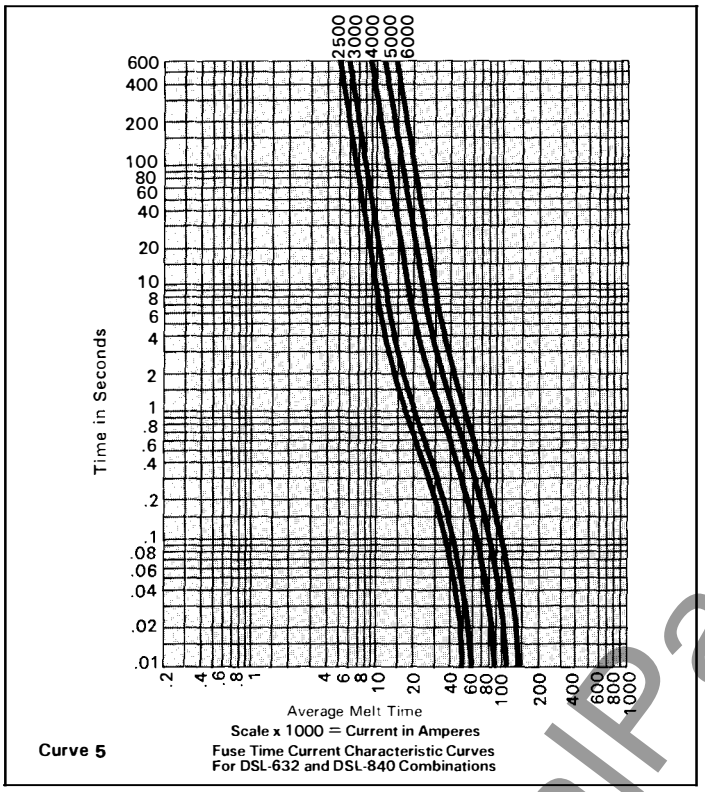


Maximum Peak Let-Through Current Curves
For DSL-416 Breaker

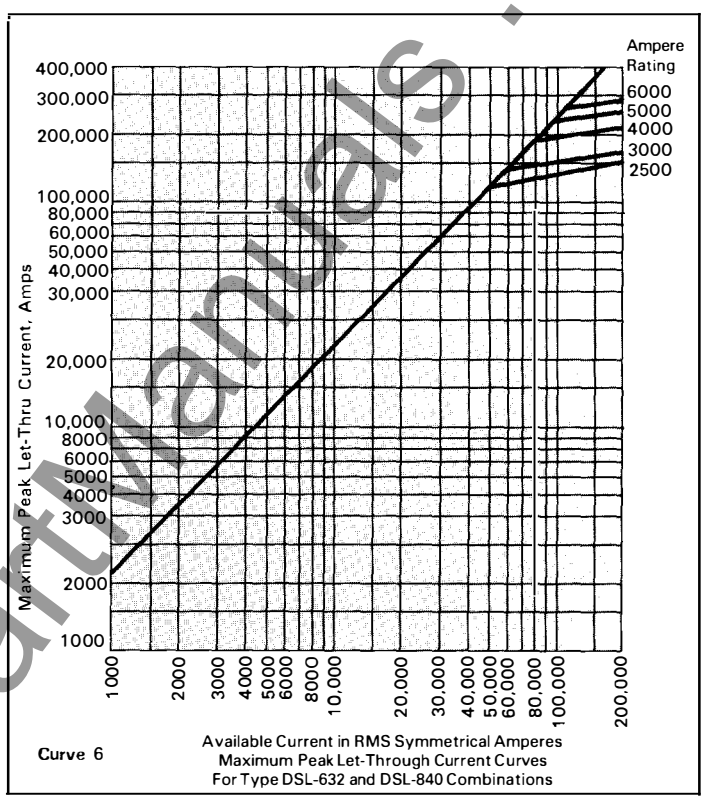
Curve 4

Power Centers With Type DS Secondary Switchgear

Type DSL Limiter Type Air Circuit Breakers, *Continued*



Curve 5 Fuse Time Current Characteristic Curves For DSL-632 and DSL-840 Combinations



Curve 6 Maximum Peak Let-Through Current Curves For Type DSL-632 and DSL-840 Combinations

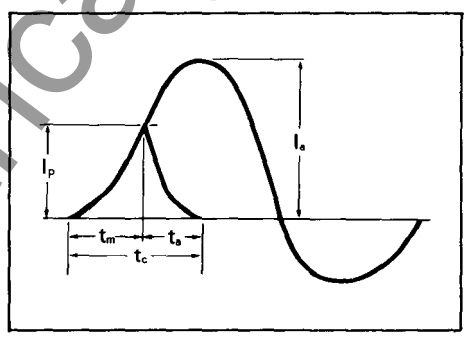
Curves Nos. 1 through 6 illustrate the ratings, melting time-current characteristics and current limiting or let-through characteristics of limiters for Type DSL breakers.

The let-through current for a given limiter application is readily determined from Curve No. 2, No. 4 or No. 6, by extending a vertical line from the applicable maximum available symmetrical fault amperes at the bottom margin to the characteristic line for the particular limiter, and from this intersection extending a horizontal line to the left margin and reading the peak current. The withstand rating of any circuit elements protected by the limiters should be at least equal to this peak current.

It will be noted that the let-through current increases with the limiter size or ampere rating; in other words, the maximum current limiting effect is obtained with the smallest size. This effect is to be expected, since the resistance decreases as the rating increases. If the vertical line from the bottom margin as described in the previous paragraph does not intersect the limiter characteristic line, it is indicated that the available system fault current is below the "threshold" current of that limiter, and it will offer no current limiting effect.

The current limiting principle is illustrated on Curve 7.

Curve 7: Current Limiting Effect of Type DSL Limiters



I_a = The Available Peak Fault Current
t_m = The Melting Time
I_p = The Peak Let-Through Current
t_a = The Arcing Time
t_c = The Total Interrupting (Clearing) Time

Limiter Selection

The selection of a suitable limiter rating for a given application is generally governed by a choice of the following types of protection:

A. Maximum protection of "downstream" components. Type DSL breakers are often used for this purpose even when the maximum available fault currents are within the interrupting rating of the corresponding Type DS unfused breakers.

B. Protection of the circuit breaker only.

Case A would tend to use the smallest available limiter; Case B the largest. When downstream protection is required, the selection is usually a compromise, since certain small limiters cannot be coordinated with the breaker to avoid nuisance blowing on overloads or small and moderate short circuits.

Minimum, recommended, and maximum limiter sizes for Type DSL-206 and DSL-416 breakers are given in the following table.

Breaker Type	Sensor Rating Amperes	Limiter Rating, Amperes Minimum ●	Recommended ②	Maximum ●
DSL-206	50 or 100	150	1200	2000
DSL-206	150	200	1200	2000
DSL-206	200	250	1200	2000
DSL-206	300	400	1200	2000
DSL-206	400	600	1200	2000
DSL-206	600	800	1200	2000
DSL-206	800	1200	1600	2000
DSL-416	600	800	2000	3000
DSL-416	800	1000	2000	3000
DSL-416	1200	2000	2500	3000
DSL-416	1600	3000	3000	3000

① For use only when protection of downstream equipment is required. Not completely coodinated with breaker to avoid nuisance blowing.
② Lowest rating which can be coordinated with breaker to minimize nuisance blowing.
● Highest available ratings, for protection of breaker only.

Fuse Time-Current Characteristics Curves are available from the nearest Westinghouse Sales Office.

Power Centers With Type DS Secondary Switchgear

Application of Type DS Air Circuit Breakers With Standard 3 Phase Transformers—Fluid Filled and Ventilated Dry Types

Table 3

Transformer Base (100%) Rating			Secondary Short-Circuit Currents RMS Symmetrical Amperes			Breakers for Selective Trip Systems			Breakers for Non-Selective Trip Systems	
Kva and Percent Impedance	Amperes	Maximum Short Circuit Kva Available from Primary System	Through Transformer Only	Motor Contribution	Combined	Main Breaker Short Delay Trip	Feeder Breaker Short Delay Trip	Feeder Breaker Instantaneous Trip	Main Breaker Instantaneous Trip	Feeder Breaker Instantaneous Trip
Table 3A: 208 Volts 3 Phase—50% Motor Load										
300	833	50000	14900	1700	16600	DS-416	DS-206	DS-206	DS-416	DS-206
5.0%		100000	15700		17400		DS-206	DS-206		DS-206
		150000	16000		17700		DS-206	DS-206		DS-206
		250000	16300		18000		DS-206	DS-206		DS-206
		500000	16500		18200		DS-206	DS-206		DS-206
		Unlimited	16700		18400		DS-206	DS-206		DS-206
500	1389	50000	23100	2800	25900	DS-416 ②	DS-206	DS-206	DS-416 ②	DS-206
5.0%		100000	25200		28000		DS-206	DS-206		DS-206
		150000	26000		28800		DS-206	DS-206		DS-206
		250000	26700		29500		DS-206	DS-206		DS-206
		500000	27200		30000		DS-206	DS-206		DS-206
		Unlimited	27800		30600		DS-206S	DS-206		DS-206
750	2083	50000	28700	4200	32900	DS-632	DS-206S	DS-206	DS-632	DS-206
5.75%		100000	32000		36200		DS-206S	DS-206		DS-206
		150000	33300		37500		DS-206S	DS-206		DS-206
		250000	34400		38600		DS-206S	DS-206		DS-206
		500000	35200		39400		DS-206S	DS-206		DS-206
		Unlimited	36200		40400		DS-206S	DS-206		DS-206
1000	2778	50000	35900	5600	41500	DS-632 ②	DS-206S	DS-206	DS-632 ②	DS-206
5.75%		100000	41200		46800		DS-416	DS-206S		DS-206S
		150000	43300		48900		DS-416	DS-206S		DS-206S
		250000	45200		50800		DS-416S	DS-416		DS-416
		500000	46700		52300		DS-416S	DS-416		DS-416
		Unlimited	48300		53900		DS-416S	DS-416		DS-416
Table 3B: 240 Volts 3 Phase—100% Motor Load										
300	722	50000	12900	2900	15800	DS-206 ②	DS-206	DS-206	DS-206 ②	DS-206
5.0%		100000	13600		16500		DS-206	DS-206		DS-206
		150000	13900		16800		DS-206	DS-206		DS-206
		250000	14100		17000		DS-206	DS-206		DS-206
		500000	14300		17200		DS-206	DS-206		DS-206
		Unlimited	14400		17300		DS-206	DS-206		DS-206
500	1203	50000	20000	4800	24800	DS-416 ②	DS-206	DS-206	DS-416 ②	DS-206
5.0%		100000	21900		26700		DS-206	DS-206		DS-206
		150000	22500		27300		DS-206	DS-206		DS-206
		250000	23100		27900		DS-206	DS-206		DS-206
		500000	23600		28400		DS-206	DS-206		DS-206
		Unlimited	24100		28900		DS-206	DS-206		DS-206
750	1804	50000	24900	7200	32100	DS-420 ②	DS-206S	DS-206	DS-420 ②	DS-206
5.75%		100000	27800		35000		DS-206S	DS-206		DS-206
		150000	28900		36100		DS-206S	DS-206		DS-206
		250000	29800		37000		DS-206S	DS-206		DS-206
		500000	30600		37800		DS-206S	DS-206		DS-206
		Unlimited	31400		38600		DS-206S	DS-206		DS-206
1000	2406	50000	31000	9600	40600	DS-632 ②	DS-206S	DS-206	DS-632 ②	DS-206
5.75%		100000	35600		45200		DS-416	DS-206S		DS-206S
		150000	37500		47100		DS-416	DS-206S		DS-206S
		250000	39100		48700		DS-416	DS-206S		DS-206S
		500000	40400		50000		DS-416	DS-206S		DS-206S
		Unlimited	41800		51400		DS-416S	DS-416		DS-416

Power Centers With Type DS Secondary Switchgear

Application of Type DS Air Circuit Breakers With Standard 3 Phase Transformers—Fluid Filled and Ventilated Dry Types, *Continued*

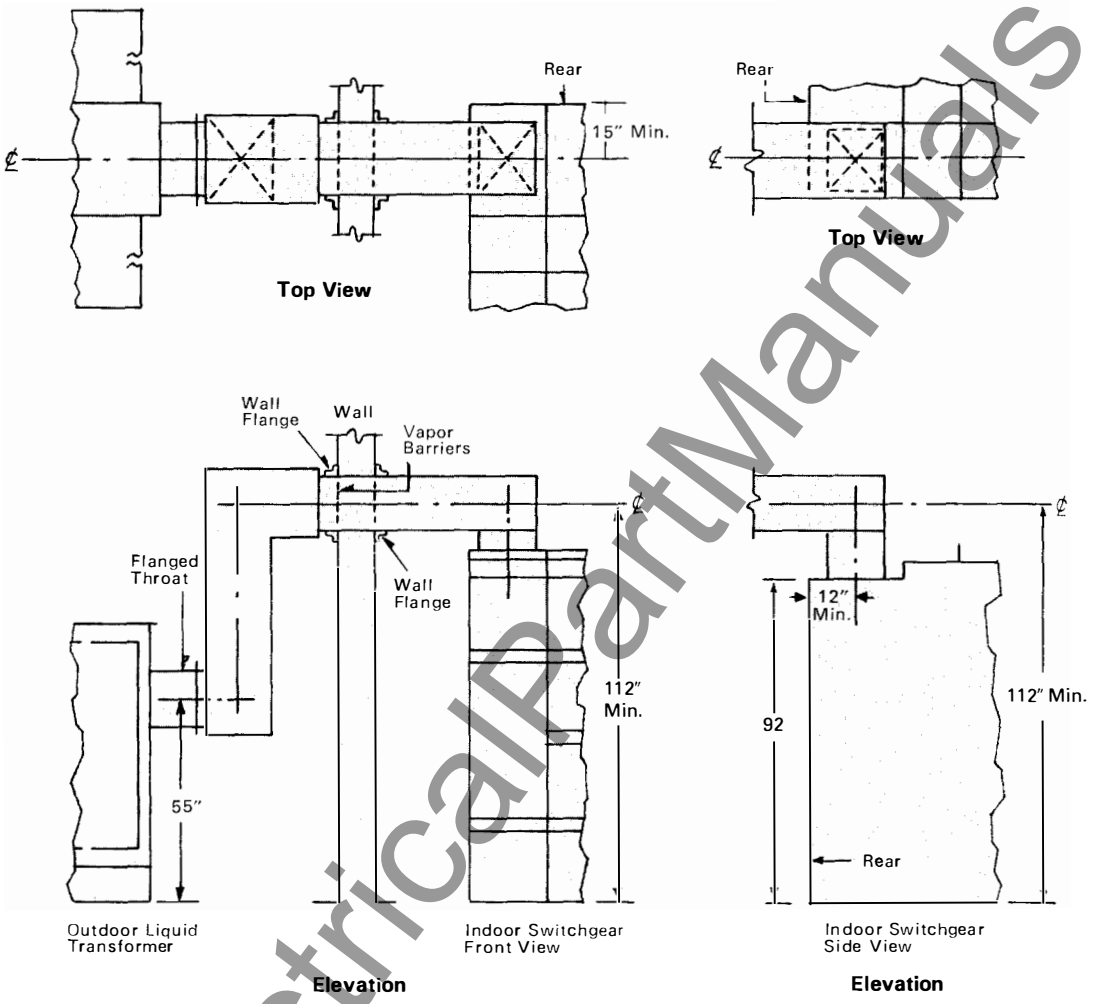
Transformer Base (100%) Rating			Secondary Short-Circuit Currents RMS Symmetrical Amperes			Breakers for Selective Trip Systems			Breakers for Non-Selective Trip Systems	
Kva and Percent Impedance	Amperes	Maximum Short Circuit Kva Available from Primary System	Through Transformer Only	Motor Contribution	Combined	Main Breaker Short Delay Trip	Feeder Breaker Short Delay Trip	Feeder Breaker Instantaneous Trip	Main Breaker Instantaneous Trip	Feeder Breaker Instantaneous Trip
Table 3C: 480 Volts 3 Phase—100% Motor Load										
500	601	50000	10000	2400	12400	DS-206 ②	DS-206	DS-206	DS-206 ②	DS-206
5.0%		100000	10900		13300		DS-206	DS-206		DS-206
		150000	11300		13700		DS-206	DS-206		DS-206
		250000	11600		14000		DS-206	DS-206		DS-206
		500000	11800		14200		DS-206	DS-206		DS-206
		Unlimited	12000		14400		DS-206	DS-206		DS-206
750	902	50000	12400	3600	16000	DS-416	DS-206	DS-206	DS-416	DS-206
5.75%		100000	13900		17500		DS-206	DS-206		DS-206
		150000	14400		18000		DS-206	DS-206		DS-206
		250000	14900		18500		DS-206	DS-206		DS-206
		500000	15300		18900		DS-206	DS-206		DS-206
		Unlimited	15700		19300		DS-206	DS-206		DS-206
1000	1203	50000	15500	4800	20300	DS-416 ②	DS-206	DS-206	DS-416 ②	DS-206
5.75%		100000	17800		22600		DS-206	DS-206		DS-206
		150000	18700		23500		DS-206	DS-206		DS-206
		250000	19600		24400		DS-206	DS-206		DS-206
		500000	20200		25000		DS-206	DS-206		DS-206
		Unlimited	20900		25700		DS-206	DS-206		DS-206
1500	1804	50000	20600	7200	27800	DS-420 ②	DS-206	DS-206	DS-420 ②	DS-206
5.75%		100000	24900		32100		DS-206S	DS-206S		DS-206S
		150000	26700		33900		DS-206S	DS-206S		DS-206S
		250000	28400		35600		DS-206S	DS-206S		DS-206S
		500000	29800		37000		DS-206S	DS-206S		DS-206S
		Unlimited	31400		38600		DS-206S	DS-206S		DS-206S
2000	2406	50000	24700	9600	34300	DS-632 ②	DS-206S	DS-206S	DS-632 ②	DS-206S
5.75%		100000	31000		40600		DS-206S	DS-206S		DS-206S
		150000	34000		43600		DS-416	DS-416		DS-416
		250000	36700		46300		DS-416	DS-416		DS-416
		500000	39100		48700		DS-416	DS-416		DS-416
		Unlimited	41800		51400		DS-416S	DS-416S		DS-416S
2500	3008	50000	28000	12000	40000	DS-632 ②	DS-416	DS-416	DS-632 ②	DS-416
5.75%		100000	36500		48500		DS-416	DS-416		DS-416
		150000	40500		52500		DS-416S	DS-416S		DS-416S
		250000	44600		56600		DS-416S	DS-416S		DS-416S
		500000	48100		60100		DS-416S	DS-416S		DS-416S
		Unlimited	52300		64300		DS-416S	DS-416S		DS-416S
Table 3D: 600 Volts 3 Phase—100% Motor Load										
500	481	50000	8000	1900	9900	DS-206	DS-206	DS-206	DS-206	DS-206
5.0%		100000	8700		10600		DS-206	DS-206		DS-206
		150000	9000		10900		DS-206	DS-206		DS-206
		250000	9300		11200		DS-206	DS-206		DS-206
		500000	9400		11300		DS-206	DS-206		DS-206
		Unlimited	9600		11500		DS-206	DS-206		DS-206
750	722	50000	10000	2900	12900	DS-206 ②	DS-206	DS-206	DS-206 ②	DS-206
5.75%		100000	11100		14000		DS-206	DS-206		DS-206
		150000	11600		14500		DS-206	DS-206		DS-206
		250000	11900		14800		DS-206	DS-206		DS-206
		500000	12200		15100		DS-206	DS-206		DS-206
		Unlimited	12600		15500		DS-206	DS-206		DS-206
1000	962	50000	12400	3900	16300	DS-416	DS-206	DS-206	DS-416	DS-206
5.75%		100000	14300		18200		DS-206	DS-206		DS-206
		150000	15000		18900		DS-206	DS-206		DS-206
		250000	15600		19500		DS-206	DS-206		DS-206
		500000	16200		20100		DS-206	DS-206		DS-206
		Unlimited	16700		20600		DS-206	DS-206		DS-206
1500	1443	50000	16500	5800	22300	DS-416 ②	DS-206	DS-206	DS-416 ②	DS-206
5.75%		100000	20000		25800		DS-206	DS-206		DS-206
		150000	21400		27200		DS-206	DS-206		DS-206
		250000	22700		28500		DS-206	DS-206		DS-206
		500000	23900		29700		DS-206	DS-206		DS-206
		Unlimited	25100		30900		DS-206S	DS-206S		DS-206S
2000	1924	50000	19700	7700	27400	DS-420 ②	DS-206	DS-206	DS-420 ②	DS-206
5.75%		100000	24800		32500		DS-206S	DS-206S		DS-206S
		150000	27200		34900		DS-206S	DS-206S		DS-206S
		250000	29400		37100		DS-206S	DS-206S		DS-206S
		500000	31300		39000		DS-206S	DS-206S		DS-206S
		Unlimited	33500		41200		DS-206S	DS-206S		DS-206S
2500	2406	50000	22400	9600	32000	DS-632 ②	DS-206S	DS-206S	DS-632 ②	DS-206S
5.75%		100000	29200		38800		DS-206S	DS-206S		DS-206S
		150000	32400		42000		DS-206S	DS-206S		DS-206S
		250000	35600		45200		DS-416S	DS-416S		DS-416S
		500000	38500		48100		DS-416S	DS-416S		DS-416S
		Unlimited	41800		51400		DS-632 ①	DS-632 ①		DS-632 ①

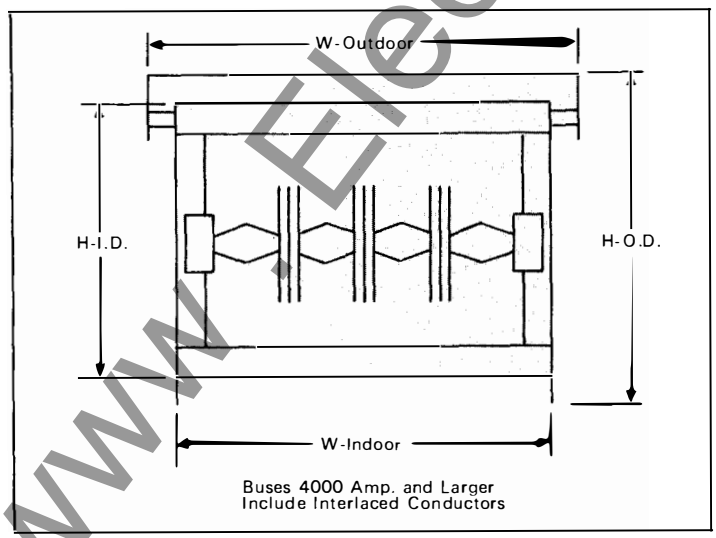
① Type DSL-416 1600 ampere frame or DSL-206 800 ampere frame fused type breakers may be substituted for Type DS-632 feeder breakers, if adequate for load demands.

② Next larger frame size main breaker may be required for 55/65°C rise and/or forced-air cooled (FA) transformer. Check Table of Transformer Secondary Ampere Ratings on Page 27.

Power Centers With Type DS Secondary Switchgear

Typical Metal Enclosed Bus Arrangements





Bus Dimensions, Inches

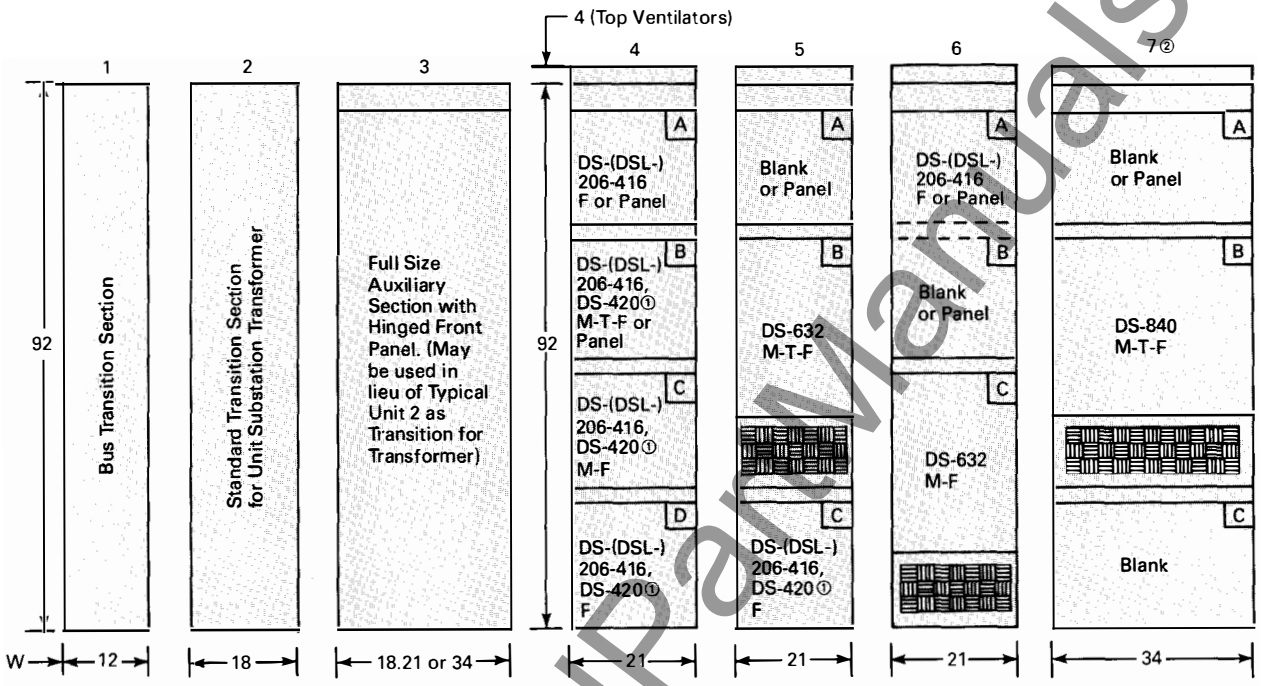
Cont. Rating, Amp. ①	Copper or Aluminum Conductors, Except as Noted						
	Ventilated				Non-Vent.		
	Indoor		Outdoor		Outdoor		Notes
	W	H	W	H	W	H	
600	18.00	10.00	21.25	13.12	21.25	13.12	3 Wire or 4 Wire
1200	20.00	14.38	23.25	17.50	23.25	17.50	
1600	20.00	14.38	23.25	17.50	23.25	17.50	Dimension W
2000	20.00	14.38	23.25	17.50	23.25	17.50	Based on 3 Wire;
2500 ③	20.00	14.38	23.25	17.50	23.25	17.50	Add 4 In.
3000 ②	20.00	14.38	23.25	17.50	N.A.	N.A.	for 4 Wire.
3500 ②	20.00	14.38	23.25	17.50	N.A.	N.A.	
4000 ②	30.00	22.87	33.25	26.00	N.A.	N.A.	3 Wire Only
4000 ③	34.00	22.87	37.25	26.00	37.25	26.00	
4500 ②	34.00	22.87	37.25	26.00	N.A.	N.A.	3 Wire or 4 Wire
5000 ②	34.00	22.87	37.25	26.00	N.A.	N.A.	

① Continuous ratings are based on Standard 65°C Temperature Rise above ambient air temperature of 40°C maximum outside of bus enclosure.
② Copper conductors only. ③ Copper only when non-ventilated.

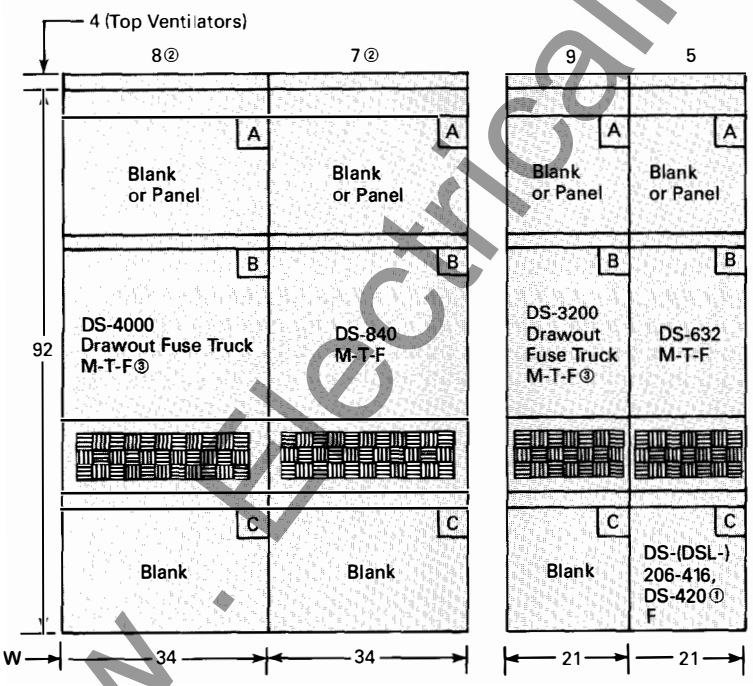
Power Centers With Type DS Secondary Switchgear

Type DS Indoor Switchgear Dimensions—Inches

Front Views of Typical Units



M = Main Breaker
T = Tie Breaker
F = Feeder Breaker



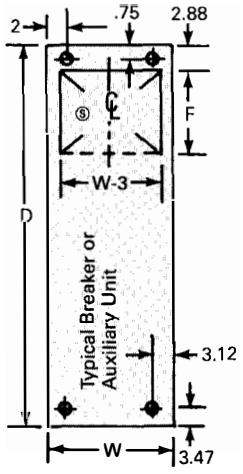
NOTE: For DS-206S and DS-416S space requirements, dimensions and weights use those shown for DS-206 and DS-416 respectively.

Shipping Groups
Each shipping group includes a maximum of five (5) vertical sections or ten (10) feet, whichever is less.

① Only one active DS-420 per vertical section.
② DS-840 section mounted adjacent to sections containing smaller DS frame sizes requires 12 in. bus transition section. All sections in lineup must be same uniform depth. Not required when adjacent section contains DSL breakers.
③ Fuse trucks are electrically connected to top studs of the associated DS breaker.

Power Centers With Type DS Secondary Switchgear

Plans

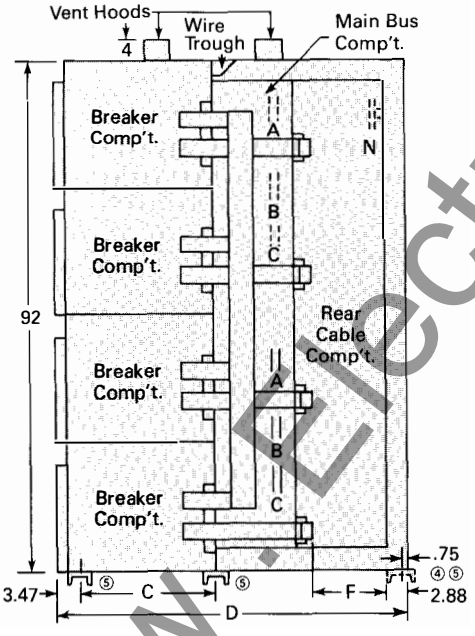


⑥Space for power and control cables, top and bottom.
Minimum recommended front aisle for breaker removal:
- For DS-206-416-420-632 36
- For DS-840 or DSL 44
- For transfer & lift truck 60

Top-of-gear mounted breaker lifter:
- Overall height, approximate 103
- Projection front of switchgear 26

Maximum height over lift truck 110
Minimum recommended rear aisle 30

Section of Typical Breaker Unit



④Rear Channel Optional
⑥Floor Channels Not Included

Switchgear Type	Dim. C	Dim. F
DS	23.59	See Table
DSL	31.59	Above

Breakers in Vertical Section	Unit Depth D①	Cable Space F③
DS-206 DS-416 DS-420, DS-632	60 66② 72 78	11 17 23 29
DS-840	72 78	15 21
DSL-206, DSL-416	66 72② 78	9 15 21
DSL-632, DSL-840	72 78	15 21

① Maximum depth requirement for any unit determines uniform depth of complete assembly.

② Minimum recommended depth with 3 or 4 DS-206 (DSL-206) or DS-416 (DSL-416) feeder breakers, initial or future, in same unit. Also required for metal enclosed bus termination.
Next deeper unit required for zero sequence ground fault current transformers, and/or phase current transformers for relaying.

③ Additional 6 in. available for cables thru floor if bottom compartment is blank and in all auxiliary and transition sections.

Type DS Indoor Switchgear Weights—Pounds (Approximate)

Stationary Structures

- 21 in. wide breaker unit less breakers:
  - 66 in. maximum depth 1300
  - 78 in. maximum depth 1400
- 34 in. wide breaker unit less breaker 1500
- 18 or 21 in. wide auxiliary unit:
  - 66 in. maximum depth 1000
  - 78 in. maximum depth 1100
- 34 in. wide auxiliary unit
  - 66 in. maximum depth 1100
  - 78 in. maximum depth 1200
- 12 in. Bus Transition Section 800
- 18 in. Transformer Transition Section 1000

Drawout Elements

- DS-206 Breaker⑥ 175
- DS-416 Breaker⑥ 180
- DS-420 Breaker⑥ 185
- DS-632 Breaker⑥ 300
- DS-840 Breaker⑥ 405
- DSL-206 Breaker⑥ 205
- DSL-416 Breaker⑥ 255
- DS-3200 Fuse Truck 325
- DS-4000 Fuse Truck 430

⑥ Manually or elec. operated. For approx. impact weight, add 50% of breaker weight.

Shipping Groups

Each shipping group includes a maximum of five (5) vertical sections or ten (10) feet, whichever is less.

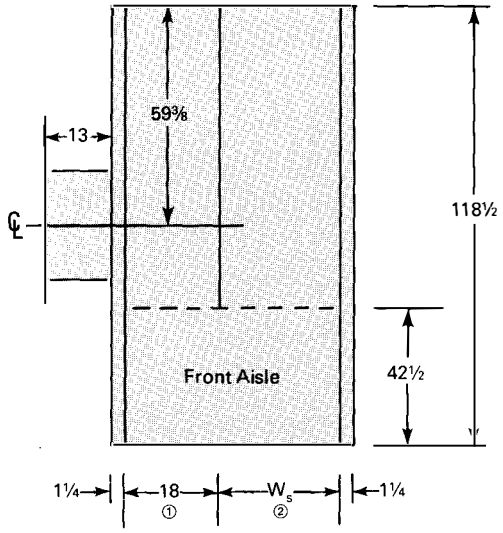
NOTE: For DS-206S and DS-416S space requirements, dimensions and weights use those shown for DS-206 and DS-416 respectively.

Power Centers With Type DS Secondary Switchgear

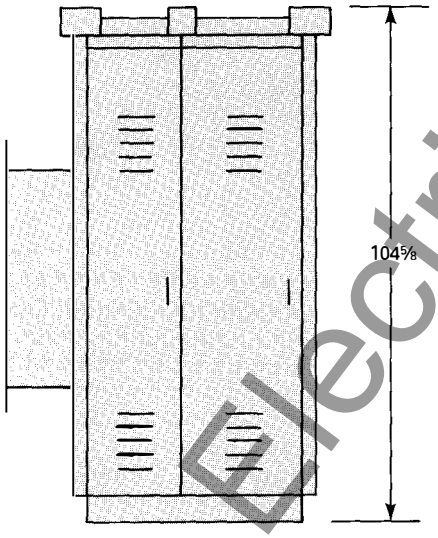
Type DS Outdoor Walk-in Enclosure ④ ⑥

Dimensions, Inches
Transition Coupled To Power Transformer

Plan View

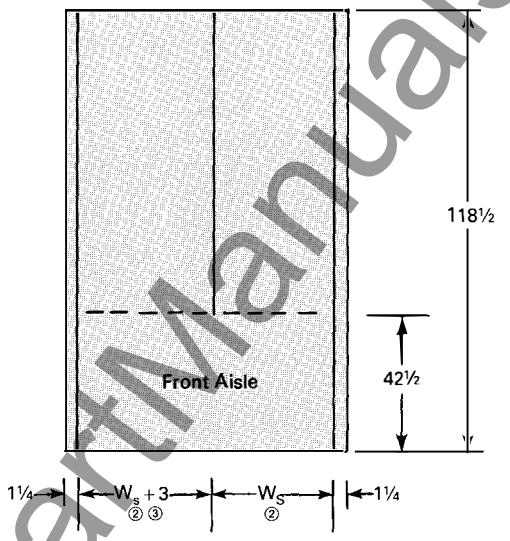


Elevation

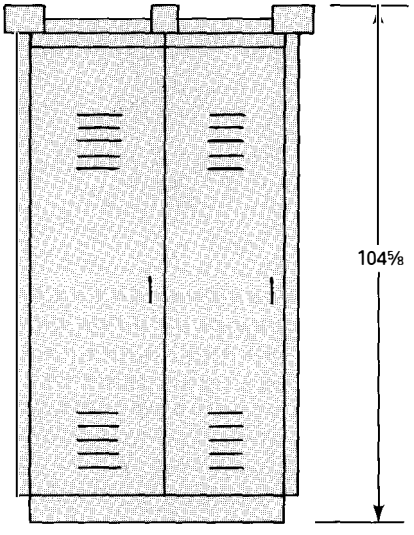


Without Transition To Transformer

Plan View



Elevation



● - Transition to transformer.
● - W_s = Width of indoor section.
③ - Left end or single section only.
④ - Walk-in enclosures equipped with hinged, full height front doors and bolted closed hinged rear doors on each section.
⑤ - Weight of stationary structures less breakers.
⑥ - Maximum shipping group is five (5) vertical sections including transition sections or ten (10) feet, whichever is less.

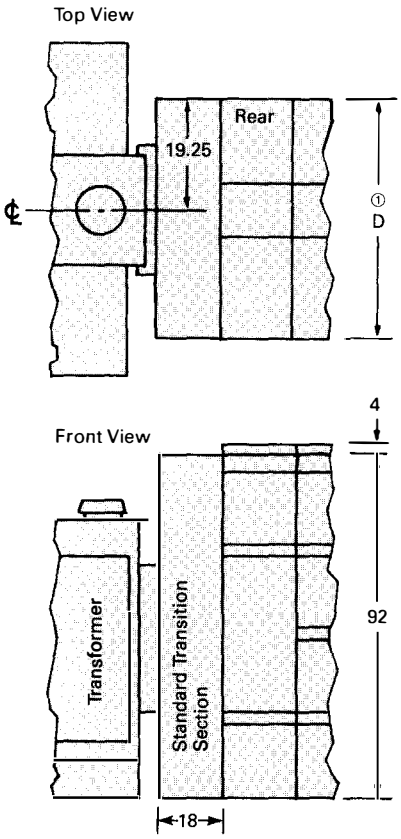
Weights (Approx. Pounds)

Stationary Structures⑤	
End trims (one set per lineup)	1500
21 in. wide breaker section	2600
34 in. wide breaker section	2700
18 or 21 in. wide aux. section	2300
34 in. wide auxiliary section	2400
12 in. bus transition section	1800
18 in. transformer transition section	2300

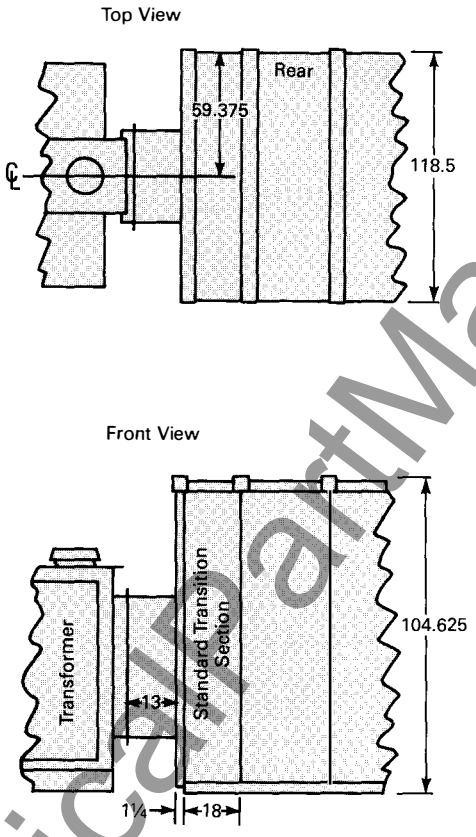
Power Centers With Type DS Secondary Switchgear

Power Center Coordination—Dimensions in Inches

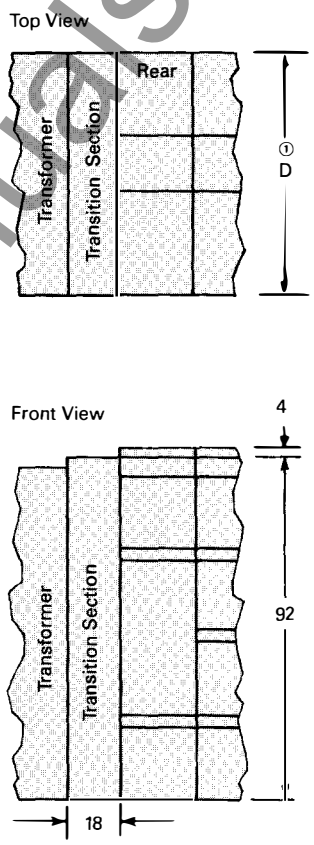
Indoor Power Center with Fluid Filled Transformer



Outdoor Power Center with Fluid Filled Transformer



Indoor Power Center with Ventilated Dry Type Transformer



Notes
Units are shown with LV to right. LV right is standard and will be supplied unless otherwise specified. Any unit substation may be opposite hand or double ended.

① See Table, page 44 for standard depth dimensions.

Power Centers With Type DS Secondary Switchgear

Specification Guide for Power Centers and Type DS Low Voltage Switchgear

General
This specification includes an (Indoor) (Outdoor) secondary unit substation complete from the incoming line terminals to the feeder terminals.

The secondary unit substation shall be designed, assembled and tested in accordance with applicable standards of NEMA, IEEE, ANSI and UL.

The following sections shall be included and arranged (left-to-right) (right-to-left) when facing the control side of the switchgear and the nameplate side of the transformer:
- Incoming Line Section
- Transformer Line Section
- Outgoing Low Voltage Switchgear Section

Incoming Line Section

Air Interrupter Switch—The HV switch shall be manually operated and rated at 600A (1200A) continuous, load break with fault closing rating of _____ amperes asymmetrical and a momentary rating of _____ amperes asymmetrical. The switch mechanism shall provide quick closing and opening, independent of the handle speed. When the switch access door is open, a screen barrier shall exist over the area where energized parts may be readily touched.

Switch shall be (cable) (bus) connected to the transformer terminals. The switch enclosure shall be made of a minimum of 12 gauge steel.

3-Pole 2-Position—The HV section shall be provided with a gang operated 3 pole, 2 position air-insulated load interrupter switch. The switch compartment shall have a sight window for visual inspection of switch contacts. The switch handle shall be operable from the front of the unit.

Selector Switch—The HV section shall be provided with a gang operated 3 pole, 3 position (open - feeder 1 - feeder 2) selector switch consisting of a no load selector switch for switching from one feeder to the other on the line side in series with an air-insulated load interrupter switch. The load interrupter switch must be open before the selector switch can be changed from one feeder to another. The switch compartment shall have a sight window for visual inspection of switch load contacts. The switch handles shall be operable from the front of the unit. The selector switch handle shall visually indicate line 1 and line 2.

Duplex Switch—The HV section shall be provided with a gang operated 3 pole, 2 position duplex switch consisting of 2 air insulated load interrupter switches connected together on the load side for connecting the transformer to one of 2 available feeders. The two switches shall be interlocked to prevent both feeders from being connected to the transformer simultaneously. Each of the 2 switch compartments shall have a sight window for visual inspection of switch contacts. The switch handles shall be operable from the front of the unit.

Fuses—[Three - current limiting (CLE) (CXN) _____ AMP] [three RBA boric acid _____ Amp] fuses are to be provided on the load side of the HV switch in the HV switch compartment. _____ Kva interrupting capacity required. The hinged access door shall be interlocked with the switch so that the door cannot be opened until the switch is in the open position. Also the switch cannot be closed until the door is closed. The fuses shall have a continuous rating to protect the transformer. (Three spare fuses are to be supplied.)

Cutouts—The HV section shall consist of 3, single pole _____ ampere gang-operated oil fused cutouts (complete with _____ spare fuse links).

Air Terminal Compartment—The HV section shall consist of a terminal compartment for cable entrance. The terminal connectors shall be located so as to give sufficient space for stress cones.

Lightning Arresters—Provide 3_____ Kv (station type) (intermediate) (distribution) arresters for _____ Kv (grounded) (ungrounded) service.

Interlocks—Provide _____ key interlock(s) to interlock with _____.

Terminals—Provide (compression lugs) (pothead(s)) (clamp terminals) for termination of the (single feed) (loop feed) _____ MCM cables, _____ per phase.

Power Centers With Type DS Secondary Switchgear

Fluid Filled Transformer Section

The (Indoor) (Outdoor) transformer shall be rated as follows:

_____ Kva, 3 phase, 60 hertz, OA/FFA, oil (Silicone) (WECOSOL®) insulated, 65°C rise (55° C rise) (Complete with 230V 1ϕ fans, OA/FA, for increased rating to _____ Kva).
HV _____ volts, 3 wire, plus two 2½%, minus two 2½% no load full capacity taps, delta connected.
LV _____ volts, 4 wire (3 wire) wye (delta) connected.

High Voltage Lead Facility—A flange shall be provided on the end wall of the tank for attachment to the Incoming Line Compartment. Flange shall be located on the left (right) when facing the front of the transformer.

Low Voltage Lead Facility—A flange shall be provided on the end wall, opposite high voltage flange, for attachment to the low-voltage switchgear.

Accessories shall include the following:
Combination drain and filter valve and sampling device
De-energized tap changer, externally operated. Cover mounted operating handle
Pressure test connection
1-inch filling plug and filter press connection in cover
Thermometer, dial type, without (with) alarm contacts
Liquid level gauge, without (with) low level alarm contacts
Provision for lifting
Provision for jacking
Pressure relief device, without (with) alarm contacts. (Silicone only)
Instruction nameplate
Ground pad
Pressure vacuum gauge
Welded-on main tank cover

Impedance—The impedance of the transformer at normal rating and frequency shall be *% ± 7½% tolerance.

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

Sealed Tank—The transformer shall be of sealed tank construction to prevent breathing. Adequate gas space shall limit the internal pressure due to normal load cycle operation.

Shot Blast—The case and cooling tubes shall be cleaned by shot blast or pickling and phosphatized before the paint is applied.

Finish—Paint finish shall be manufacturer's standard, applied over a properly prepared surface. The color shall be light gray ANSI No. 61, indoor and outdoor.

Future Capacity—Each 750 Kva through 2500 Kva transformer shall be OA/FFA rated, i.e., include all design and construction capacities for future addition of fans.

Ventilated Dry Type Transformer Section

Type
The transformer shall be dry-type with both primary and secondary coils encapsulated with polyester (epoxy) resin using a vacuum pressure impregnation (VPI) process for maximum penetration of the resin. The transformer will be explosion-resistant, fire-resistant, dry-type construction, and cooled by the circulation of air through the windings.

The unit shall be mounted in an indoor NEMA 1 (outdoor NEMA 3R) ventilated enclosure.

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

Rating
The transformer shall be rated as follows:
KVA: _____ self-cooled, AA
_____ future forced-air, FFA (forced-air, FA)

Phase: 3
Hertz: 60 (50)
HV: _____delta (wye)
HV BIL: _____ KV
HV taps: Full capacity with 2-2.5% above and below rated high voltage.
LV: _____ wye (delta)
LV BIL: _____ KV
Average Temperature Rise 150°C (115) (80)
NOTE: Epoxy-encapsulated are limited to 115°C or 80°C rise.

Impedance
The impedance of the transformer at self-cooled rating shall be 5.75% (or Westinghouse standard), with a tolerance of plus or minus 7.5%

Conductor Material
The conductors shall be an electrical grade aluminum (copper).

Insulation Materials
All insulation materials for the primary and secondary coil assembly shall be rated for continuous 220°C total temperature (Class H) duty.

Coil Assembly
The HV and LV coils shall be designed and manufactured as an assembly. The insulated coil assembly shall be capable of passing all standard ANSI and NEMA tests, including the impulse test, before the coils are encapsulated with resin.

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

Encapsulation System
The HV/LV coil assembly shall be encapsulated utilizing a vacuum pressure impregnation process to completely seal and bind the windings. The encapsulating material shall be polyester (epoxy).

The transformer coil assembly shall be constructed such that the polyester (epoxy) is used for environmental protection and not as a necessary part of the insulation system.

Core and Core Structure
The core shall be constructed of non-aging, cold-rolled, grain oriented, high permeability silicon steel. All core laminations shall be free of burrs and stacked without gaps.
The core framing structure shall be of rigid construction to provide full clamping pressure upon the core and provide the support points for the coils. The top and bottom core clamps shall be mechanically connected by vertical steel bars on each leg of the core.

The outside surfaces of the core and core parts shall be coated to protect against corrosion.

Power Centers With Type DS Secondary Switchgear

Enclosure and Finish
The enclosure shall be constructed of 13 gauge minimum sheet steel equipped with removable panels for access to the core and coils on the front and rear. Ventilated openings shall be furnished to meet NEMA standards. A bolted cover shall be supplied for access to the core and coil assembly lifting loops.

The case shall be cleaned and finished with an ANSI No. 61 color coating.

Sound Level
The transformer shall be designed to meet the sound level standards for dry-type transformers as defined in NEMA TR27.

Forced-Air Cooling Equipment
Provisions for adding forced-air equipment shall include bus sized for FA capacity, provisions for control panel, and provisions for temperature sensing device in "B-phase" coil.

or

A complete forced-air cooling system shall be provided for automatically increasing the self-cooled rating by 33⅓%. The system shall contain 120VAC single phase fans and a control panel with indicating lights, temperature indicator, fan position test switch, and alarm mode selector switch.

Accessories
Accessories shall include, but not limited to:

- Provisions for lifting, jacking, and rolling
- Vibration dampening pads under core/coil assembly
- Rodent-proof enclosure
- Core ground strap
- Ground bus

Tests
The following tests shall be performed on each unit in accordance with ANSI C57.12.91:

- Resistance measurements
- Ratio tests
- Polarity and phase-relation tests
- No-load loss and excitation current
- Impedance and load-loss
- Applied potential tests
- Induced potential tests

The dry-type transformer shall be manufactured by Westinghouse or approved equal.

High Voltage Lead Facility
A flange shall be provided on the end wall of the tank for attachment to the incoming line section. The flange shall be located on the (left) (right) when facing the front of the transformer.

Low Voltage Lead Facility
A flange shall be provided opposite the high voltage flange for attachment to the low voltage switchgear.

Power Centers With Type DS Secondary Switchgear

Outgoing Low-Voltage Switchgear Section

General—Type DS indoor (outdoor) low-voltage metal-enclosed switchgear shall consist of a stationary structure assembly and one or more removable "De-ion" air circuit breaker units fitted with disconnecting devices and other necessary equipment. The switchgear shall be suitable for 600 volts maximum service and shall receive a dielectric test for that voltage class in accordance with NEMA standards. It shall be designed, manufactured and tested in accordance with the latest standards of IEEE, NEMA, ANSI, and UL.

Stationary Structure—Each steel unit forming part of the stationary assembly shall be a self-contained housing having one or more individual breaker or instrument compartments and a rear compartment for the bare buses and outgoing cable connections. Each circuit breaker compartment shall be equipped with primary and secondary contacts, rails, stationary levering mechanism parts and required instrument current transformers. A blank formed steel door equipped with ventilation openings in the lower flange, an emergency trip button, and supported on concealed hinges shall be provided for each circuit breaker compartment.

The top of the unit shall be enclosed with removable steel sheets which include necessary hooded ventilation openings.

The structure shall be so designed that future additions may readily be made at any time. The steel structure shall be thoroughly cleaned and phosphatized prior to the application of the light gray ANSI No. 61 finish.

A black, laminated, plastic engraved circuit designation nameplate 1¼ inches high and 3½ inches wide shall be provided on each circuit breaker door.

Buses and Connections—Each circuit shall include the necessary 3 phase bus and connections between the bus and one set of circuit breaker studs. Solderless type terminals on silver-plated copper extensions for the outgoing cables shall be provided on the other set of circuit breaker studs. The buses and connections shall consist of (high-conductivity tin-plated aluminum) (silver-plated copper) bar mounted on heavy duty glass polyester supports and having bolted joints. Shipping breaks and provisions for future bus extensions shall have silver-plated bolted connections. Terminal blocks with integral-type barriers shall be provided for secondary circuits. The terminal blocks shall be mounted at the rear of the units, and shall be accessible through a removable cover.

Disconnecting Devices—The stationary part of the primary disconnecting devices for each circuit breaker shall consist of a set of contacts extending through a glass polyester insulating base. Buses and outgoing cable terminals shall be directly connected to them. The corresponding moving contacts shall consist of a set of contact fingers suitably spaced on the circuit breaker studs. In the "connected" position, these contact fingers shall engage the stationary contacts forming a current-carrying bridge. The assembly shall provide a multitude of silver-to-silver high-pressure point contacts. High uniform pressure on each finger shall be maintained by springs. The entire assembly shall be full floating and shall provide ample flexibility between the stationary and moving elements. Contact engagement shall be maintained only in the "connected" position.

The secondary disconnecting devices shall consist of floating fingers mounted on the removable unit and engaging flat contact segments located at the rear of the compartment. The secondary disconnecting devices shall be silver-plated to insure permanence of contact. Contact engagement shall be maintained in the "connected" and "test" positions.

Removable Element—The removable element shall consist of a type DS De-ion air circuit breaker equipped with the necessary disconnecting contacts, wheels, and interlocks for drawout application. The removable element shall have four-position features and shall permit closing the compartment door with the breaker in the "connected", "test", "disconnected", and "remove" positions.

Power Centers With Type DS Secondary Switchgear

Air Circuit Breakers—The air circuit breaker shall be type DS (DSL) operating on the Westinghouse De-ion arc interruption principle. These breakers shall incorporate specially designed circuit-interrupting devices which provide high interrupting efficiency and minimize the formation of arc flame and gases.

The air circuit breakers shall have silver-tungsten butt type contacts which operate under high pressure. The arcing contacts shall be of arc-resisting silver-tungsten. The breaker shall be equipped with "De-ion" arc chutes which effectively enclose the arcing contacts and confine the arc to reduce the disturbance caused by short-circuit interruption. Each breaker shall be equipped with a position indicator, mechanically connected to the circuit breaker mechanism.

Include when DSL breakers specified above: Circuit breakers shall include current limiters, integrally, or separately mounted coordinated with the breaker trip device so as to avoid unnecessary blowing of the current limiters. Breaker shall include an anti single phase device that will trip the breaker in the event of a blown limiter, indicate from the front of the breaker which limiter is blown and prevent the breaker from being reclosed on a single phase condition due to missing or blown limiters.

Each breaker shall be equipped with an Amptector II-A (Amptector I-A) solid-state trip device. The adjustments shall be Long delay pick-up between 50% and 125% of the trip rating, Long time delay between 4 and 36 seconds at 6 times trip rating, Short delay pick-up between 2 and 10 times trip rating, Short time delay between 0.18 and 0.5 seconds at 2.5 times Short delay pick-up, instantaneous pick-up between 2 and 12 times trip rating, ground fault (Amptector I-A only) pick-up approximately 20% of trip rating and ground fault time between 0.22 and 0.5 seconds. Adjustments shall be of the continuous type, each independent of all the others. All components shall be covered with a sealing compound to prevent deterioration in corrosive atmospheres.

It shall be possible to test and calibrate the time and current characteristics and trip circuit by means of a portable plug-in test device.

Both electrically operated, and manually operated breakers shall have stored energy operating mechanisms. Only one stroke of the operating handle shall be necessary to charge the stored energy spring when operating the manual breaker. The release of the energy to close the breaker manually shall be by means of a mechanical pushbutton which insures positive control of the closing operation. Electrical close shall be initiated by means of a release solenoid.

Factory Assembly and Tests
The switchgear shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchgear shall be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of the equipment.

The main circuits shall be given a dielectric test of 2200 volts for one minute between live parts and ground and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one minute between live parts and ground.

Detail Specification
1—Indoor (Outdoor) low-voltage metal-enclosed switchgear assembly including the following equipment:

a. 1—Set of necessary provisions for throat connection or close coupling to the transformer secondary.

b. 1—Set of necessary bare main bus and ground bus connections. (Including full neutral) (including 50% neutral).

c. ____Current transformers_____/5 ampere ratio. (2 for 3 wire, and 3 for 4 wire with neutral bus in switchgear.)

d. ____Potential transformers_____/120 volt ratio complete with primary and secondary fuses. (2 for 3 wire, and 3 for 4 wire with neutral bus in switchgear.)

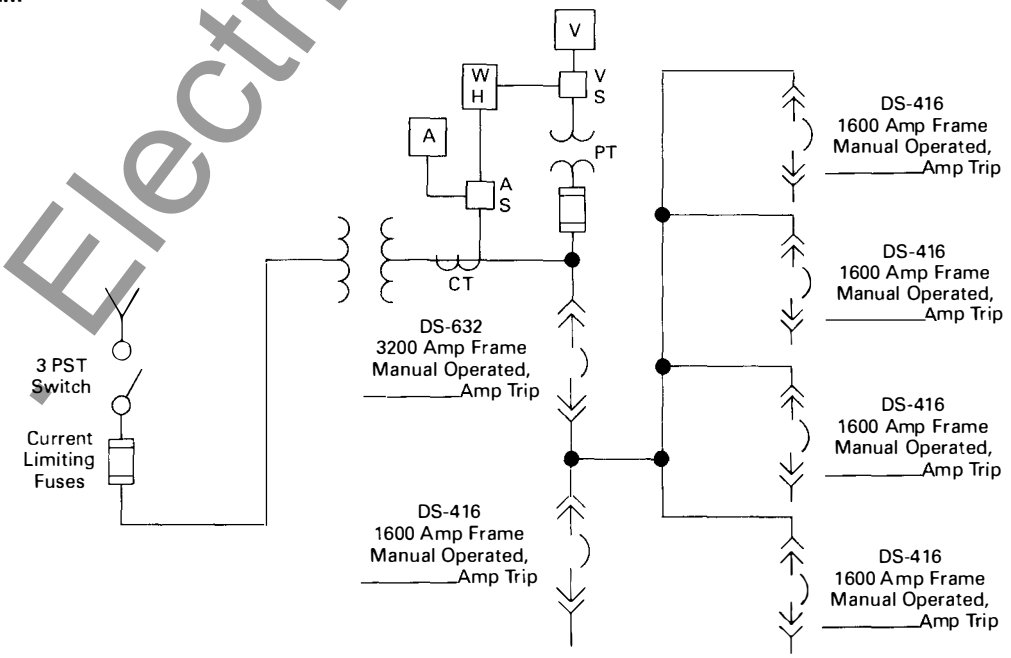
e. 1—Ammeter, 0-_____ ampere range. 2% accuracy class.

f. 1—Ammeter switch for reading each phase current.

g. 1—Voltmeter, 0-_____ volt range, 150 volt coil, 2% accuracy class.

Note: Only those characteristics as required should be specified.

Single Line Diagram



Power Centers With Type DS Secondary Switchgear

h. 1—Voltmeter switch arranged for reading phase to phase (phase to phase and phase to neutral) voltages.

i. 1—Watthour meter 2 element, 3 wire (2½ element, or 3 element, 4 wire) 5 ampere, 120 volt coils.

j. _____ Main secondary breaker(s), _____ ampere frame, — Amps sym. int. cap. (manually) (electrically) operated with Amptector II-A (Amptector I-A) solid state trips with long delay, short delay (and ____ wire ground) characteristics.

k. _____ Tie breaker(s), _____ ampere frame, ____ Amps sym. int. cap. (manually) (electrically) operated with Amptector II-A (Amptector I-A) solid state trips with long delay, short delay (and ____ wire ground) characteristics.

l. _____ Feeder breakers, _____ ampere frame, ____ Amps sym. int. cap (manually) (electrically) operated with Amptector II-A (Amptector I-A) solid state trips with long delay, instantaneous (and ____ wire ground) characteristics (with integrally mounted current limiters for max. 200,000A int. cap.)

m. Control power transformer complete with primary and secondary fuses for space heaters, lights, receptacles and circuit breaker control as required.

n. Sets of clamp type terminals for _____ _____ MCM cables per phase and _____ _____ MCM cables for neutral entering from the bottom (top) of the unit.

o. 1—Set of engraved nameplates.

p. 1—Set of necessary small wiring, wiring accessories and terminal blocks.

q. 1—Set of space heaters, light and receptacles as required. (Standard for outdoor).

Caution:

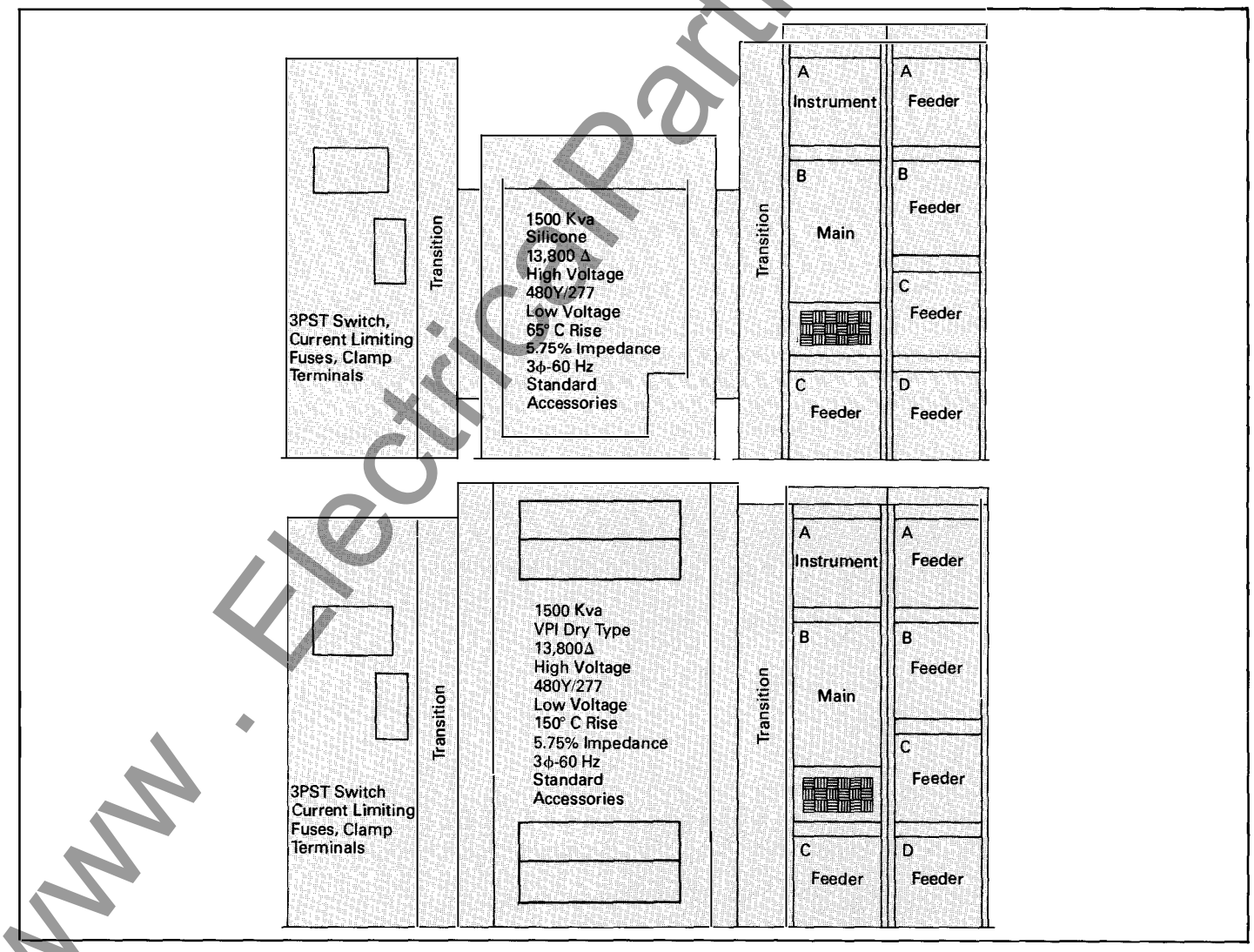
1. (b) Be sure to specify current carrying capacity and arrangement of neutral bus if one is required. Normally 50% capacity will be supplied if full capacity is not specified.
2. (j-k-l) If trip characteristics other than shown are required please be sure to specify them.

Accessories

a-1 Top of assembly mounted circuit breaker lifting device (optional).
b-1 Test plug for watthour meter.
c-1 Levering crank.

Note: Arrangement sketch and single line diagram similar to samples shown should accompany the written specification.

Indoor Secondary Unit Substations



Printed in USA

Westinghouse Electric Corporation
Distribution and Control Business Unit
Pittsburgh, Pennsylvania, U.S.A. 15220

TYPE DB-25 DE-ION AIR CIRCUIT BREAKER
600 Ampere Frame - 250/600 Volts - D-c/A-c - 3 Pole

Refer to I.B. 33-850-1&2A for Maintenance and Parts Identification

For Typical Illustration, See Reverse Side

the following parts are most subject to wear in ordinary operation:

Ref. No.	name of part	identification number	number required
	POLE UNIT		
1	Moving Contact Assembly	....	3
2	Moving Main Contact with Shunt	1491 414	3#
3	Moving Arcing Contact	1491 412	3#
8	Operating Link	1491 410	3
13	Stationary Main Contact with Upper Stud	1491 419	3#
14	Stationary Arcing Contact	1491 421	3#
15	Opening Spring	1809 546	3
16	Lower Stud	1735 836	3
..	Retaining Ring Assortment	497A346G02	1#
	OPERATING MECHANISM		
1	Breaker Lever	1491 459	1
12	Reset Spring	1491 448	1
13	Roller Lever	1491 454	1
14	Pawl	1491 442	1
15	Pawl Spring	1491 450	1
22	Tripping Lever	1572 414	1
27	Trip Lever Spring	1491 445	1
34	Tripping Spring	....	1
35	Closing Spring	....	1

COILS

Volts	Cycles	Closing		Shunt Trip		Elec. Lockout& U.V. Trip	Relay*
		Instant. Tripping	Selective Tripping	Without Alarm Sw.	With Alarm Sw.		
24	D-c*	....	....	1574 584	1649 455	1491 403	1718 987
48	D-c*	....	....	1574 583	1491 404	1491 404	1529 443
125	D-c*	1529 458	1574 627	1491 403	1491 991	1611 027	1529 444
250	D-c*	1718 045	1574 630	1491 404	1640 660	1529 248	1574 335
110	25	300P166G01	300P325G01	1491 403	1574 583	1491 404	1529 443
220	25	300P167G01	300P326G01	1491 404	1491 403	1611 027	1529 457
440	25	....	....	1491 405	1491 404	1649 804	1766 826
550	25	300P563G01	....	1491 405	1491 404	1649 804	1574 335
110	60	300P614G01	300P614G01	1574 583	1574 584	1491 403	1718 987
220	60	300P166G01	300P325G01	1491 403	1574 583	1491 404	1529 443
440	60	300P167G01	300P326G01	1491 404	1491 403	1611 027	1529 457
550	60	300P167G01	300P167G01	1491 404	1491 403	1611 027	1529 444
600	60	300P167G01	300P167G01	....	....	....	....

*D-C Relays Also Use Blowout Coil S#1589340.

Auxiliary Switch	4 Stage-Drawout	8 Stage-Drawout	4 Stage-Fixed	8 Stage-Fixed
	1649 877	1649 878	1649 879	1649 880

#Minimum Recommendations for Stock Are: Contact & Retaining Rings - 1 Breaker Order 1 Set, 2 to 5 Breakers - 2 Sets, 6 to 10 Breakers - 4 Sets. Coil & Auxiliary Switches - 1 Breaker Order 0, 2 to 5 Breakers - 1 Each, 6 to 10 Breakers - 2 Each.

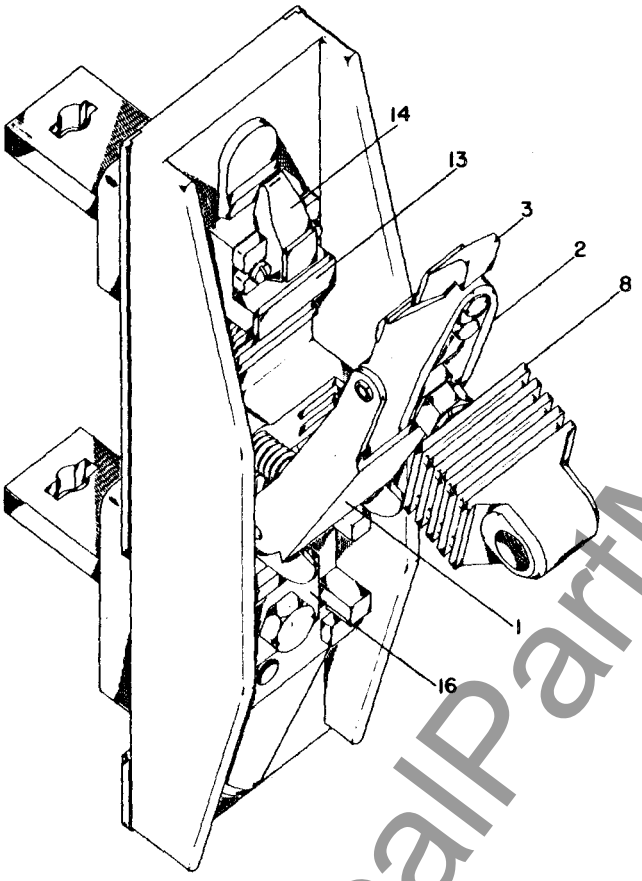
Order Part by Name and Identification Number - Give Complete Nameplate Reading.

renewal parts illustration

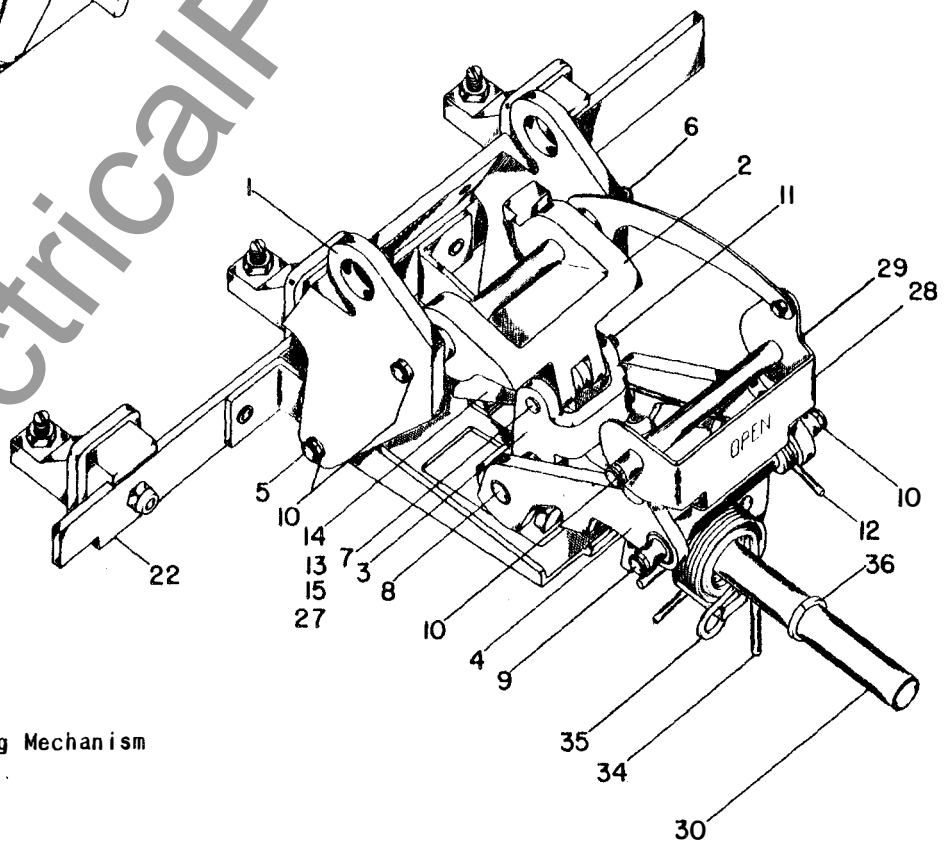
33-850

DB-25

TYPE DB-25 DE-ION AIR CIRCUIT BREAKER



Pole Unit



Operating Mechanism

Westinghouse Electric Corporation • Assembled Switchgear & Devices Department
East Pittsburgh, Pennsylvania

TYPE DB-50 DE-ION AIR CIRCUIT BREAKER
1600 Ampere Frame - 250/600 Volts - D-c/A-c - 3 Pole

Refer to I.B. 33-850-3 for Maintenance and Parts Identification

For Typical Illustration, See Reverse Side

the following parts are most subject to wear in ordinary operation:

Ref. No.	name of part	identification number	number required
	POLE UNIT		
1	Moving Main Contact	200B570G01	6#
4	Auxiliary Contact	1611 768	12#
6	Moving Arcing Contact	1584 472	3#
15	Operating Link	1611 758	3
18	Stationary Main Contact and Upper Stud	1611 764	3#
19	Stationary Arcing Contact	1611 748	3#
27	Lower Stud	1611 767	3
..	Retaining Ring Assortment	497A346G03	1#
	OPERATING MECHANISM		
1	Breaker Lever	1589 689	1
17	Roller Lever	1589 692	1
18	Roller Lever Spring	300P220H01	1
19	Pawl	1589 691	1
20	Pawl Spring	1584 520	1
23	Latch Segment	1589 682	1
28	Tripping Lever	....	1

COILS

Volts	Cycles	Closing	Shunt Trip		Elec. Lockout U.V. Trip	Relay Plus Blowout Coil if D.C.
			Without Alarm Sw.	With Alarm Sw.		
24	D-c	When ordering	1589 312	1589 312	When ordering	When ordering
48	D-c	specify	1589 313	1589 313	specify	specify
125	D-c	ident. no. on	1589 314	1589 314	ident. no. on	ident. no. on
250	D-c	coil & give	1589 315	1589 315	coil & give	coil & give
110	25	complete	1589 313	1589 312	complete	complete
220	25	nameplate	1589 314	1589 313	nameplate	nameplate
440	25	reading of	1589 315	1589 314	reading of	reading of
550	25	breaker	1589 315	1589 314	breaker	breaker
110	60		1589 312	1589 311		
220	60		1589 313	1589 312		
440	60		1589 314	1589 313		
550	60		1589 314	1589 313		

Auxiliary Switch	4 Stage-Drawout	8 Stage-Drawout	12 Stage-Drawout	4 Stage-Fixed	8 Stage-Fixed
	1718 462	1718 463	1718 464	1718 465	1718 466

#Minimum Recommendations for Stock Are: Contacts & Retaining Rings - 1 Breaker Order 1 Set, 2 to 5 Breakers - 2 Sets, 6 to 10 Breakers - 4 Sets. Coil & Auxiliary Switches - 1 Breaker Order 0, 2 to 5 Breakers - 1 Each, 6 to 10 Breakers - 2 Each.

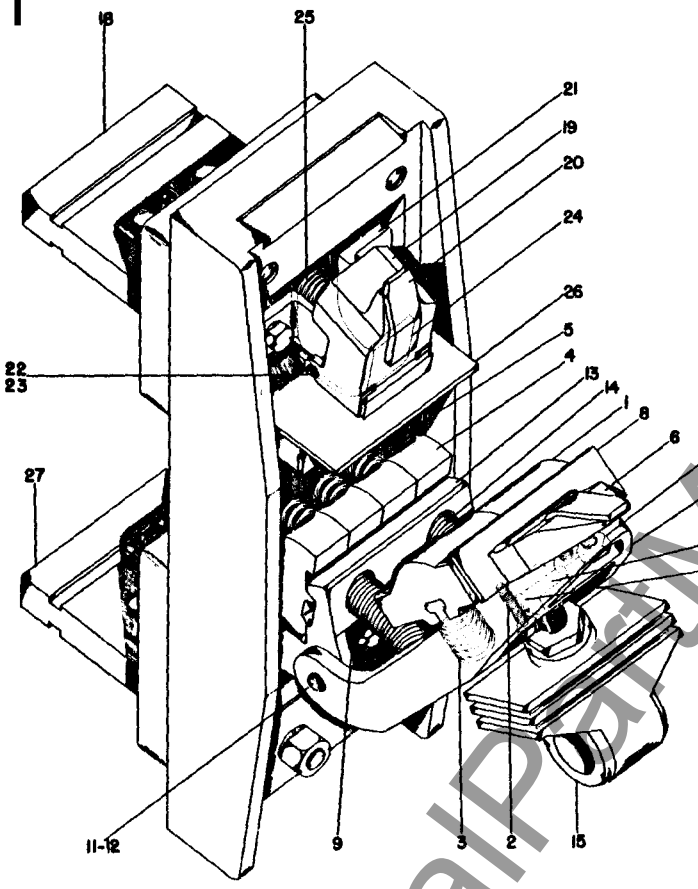
Order Part by Name and Identification Number - Give Complete Nameplate Reading.

renewal parts illustration

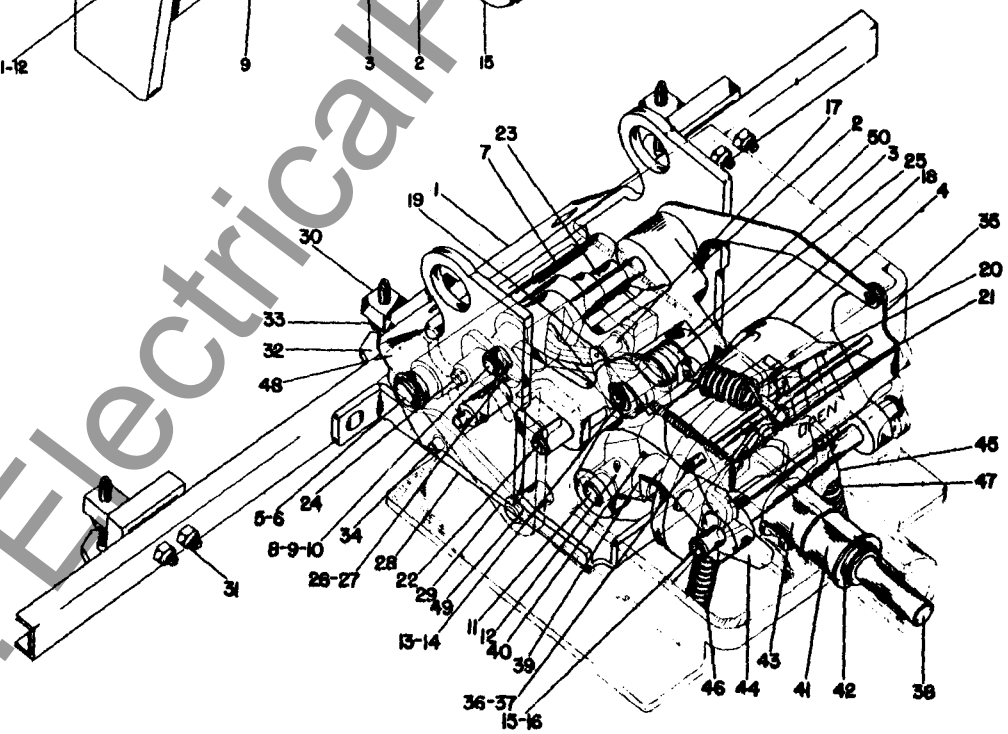
33-850

DB-50

TYPE DB-50 DE-ION AIR CIRCUIT BREAKER



Pole Unit



Operating Mechanism

CURRENT LIMITING-FUSES
POWER

600 Volts to 34.5 Kv Indoor

fuse units

type	amps	nominal voltage rating	interrupting rating rms amps	style number
non-indicating only				
BAL-1△	1♦	600	100,000	1585 343
	5♦	600	100,000	1585 344
	1♦□	850	100,000	1594 855
	6♦□	850	100,000	1733 537
	2E♦	600	100,000	1254 953
	5E♦	600	100,000	1254 955
	7E▲	600	100,000	1533 754
	10E▲	600	100,000	1533 755
BAL-PT△	½E♦	2400	60,000	1196 143
	1E♦	2400	60,000	1251 138
	2E▲	2400	60,000	1585 319
indicating				
BAL-PT 25/60 cy	½E	4800	80,000	1247 217
		7200	80,000	1247 218
		14400	130,000	1247 219
		23000	70,000	1247 220
		34500	70,000	1534 678
BAL-10 25/60 cy	5E	4800	60,000	1291 963
		7200	80,000	1291 964
		14400	130,000	1291 965
	10E	4800	60,000	1291 968
		7200	80,000	1291 969
		14400	50,000	1291 970
BAL-25 50/60 cy	15E	2400	60,000	1332 763
		4800	60,000	1332 766
		7200	80,000	1332 769
		14400	50,000	1332 772
	20E	2400	60,000	1332 764
		4800	60,000	1332 767
		7200	80,000	1332 770
		14400	50,000	1332 773
	25E	2400	60,000	1332 765
		4800	60,000	1332 768
		7200	80,000	1332 771
		14400	50,000	1332 774
BAL-200 50/60 cy	30E	2400	60,000	1576 468
		4800	60,000	1576 470
		7200	80,000	1576 472
		14400	50,000	1576 474
	40E	2400	60,000	1576 469
		4800	60,000	1576 471
		7200	80,000	1576 473
		14400	50,000	1576 475
	50E	2400	60,000	1318 710
		4800	60,000	1318 720
		7200	80,000	1318 727
		14400	50,000	1318 731
	65E	2400	60,000	1318 711
		4800	60,000	1318 721
		7200	80,000	1318 728
		14400	50,000	1318 732
	80E	2400	60,000	1318 712
		4800	60,000	1318 722
	100E	2400	60,000	1318 713
		4800	60,000	1318 723
	125E	2400	60,000	1318 714
		4800	60,000	1318 724
	150E	2400	60,000	1318 715
		4800	60,000	1318 725
	200E	2400	60,000	1318 716
		4800	60,000	418D565G31
BAL-300 50/60 cy	80E	7200	80,000	432D886G17
		14400	50,000	432D886G25
	100E	7200	80,000	432D886G18
		14400	50,000	432D886G26
	250E	2400	60,000	432D886G06

♦ d-c ♦ 25/60 cycles ▲ 50/60 cycles

△ All non-indicating fuses except those for 850 volts d-c are 4⅝" long and use BAL-1 fuse mounting.

□ The 850 volt fuses are 6⅝" long. Fuse clips only are available for them.

September, 1960