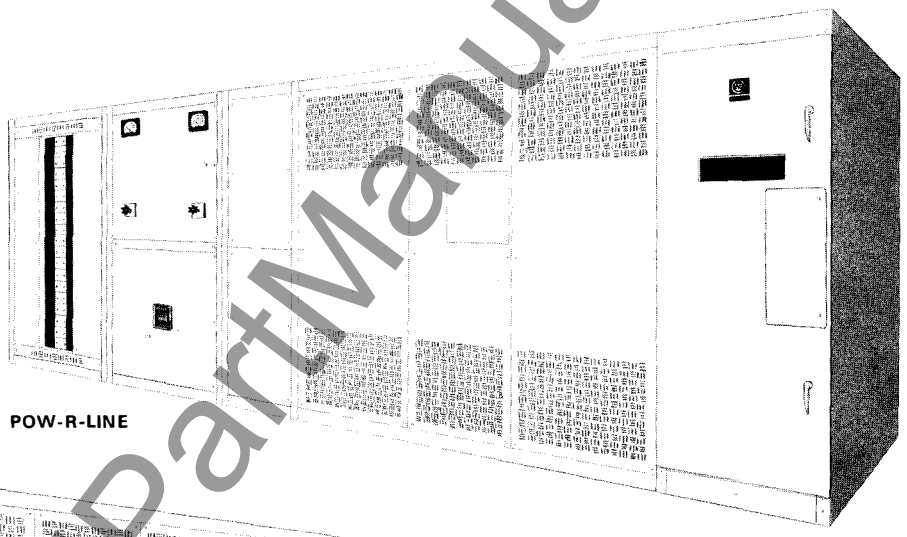
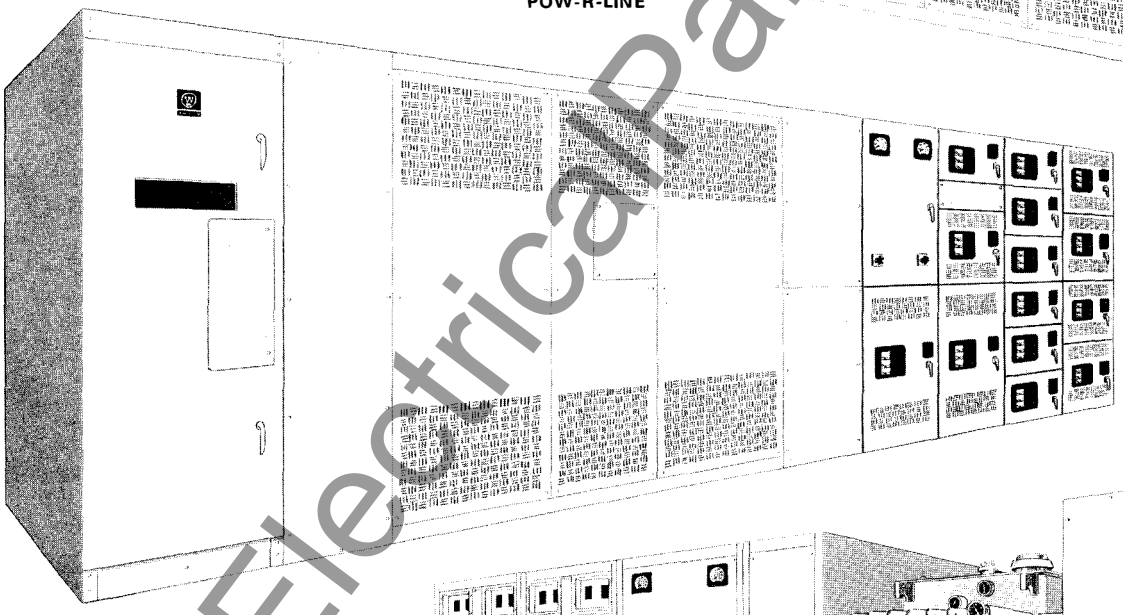
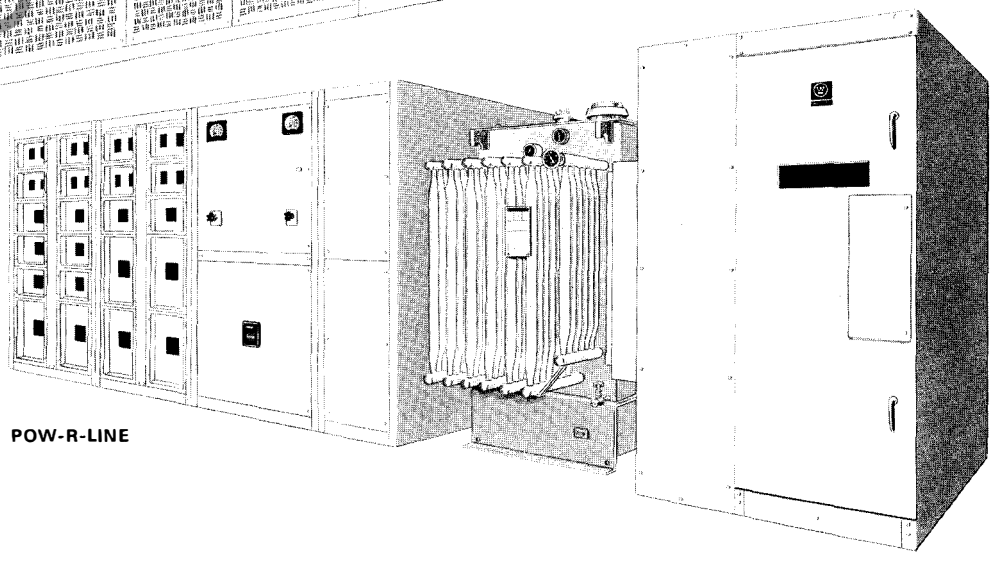
Power Centers, Switchboard Type



POW-R-LINE



POW-R-GEAR



POW-R-LINE

Power Centers, Switchboard Type

Index

Power Centers, Switchboard Type

Definition of Power Center

A coordinated secondary unit substation, sometimes called a Power Center, is a close-coupled assembly consisting of three phase power transformers, enclosed high voltage incoming line sections, and enclosed secondary low voltage outgoing sections. The following electrical ratings are applicable:

Transformer KVA: 112.5 thru 2500 (self-cooled rating)

Primary Voltage: 2.4 KV thru 34.5 KV

Secondary Voltage: 208, 240, 480, or 600 Volt (max.)

The term "Power Center" wherever used in this bulletin is synonymous with "secondary unit substation" as defined in NEMA Standards.

Advantages

As a result of locating power transformers and their close-coupled secondary switchboards as close as possible to the areas of load concentration, the secondary distribution cables or busways are kept to minimum lengths. This concept has obvious advantages such as:

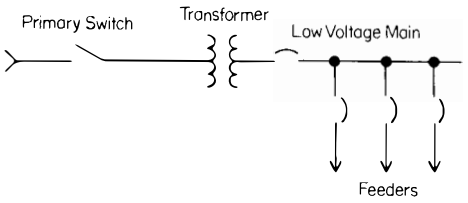
- Reduced power losses
- Improved voltage regulation
- Improved service continuity
- Reduced exposure to low voltage faults
- Increased flexibility
- Minimum installed cost
- Efficient space utilization

Additional advantages of Westinghouse power centers in this unified approach are:

- Single source responsibility
- Complete electrical and mechanical control over coordination of the three close coupled sections.
- Availability of all switchboard types as power center secondaries gives broad application flexibility.
- Modern design
- Composite assembly retains proven safety and integrity of each of its three major parts.
- Meets all applicable NEMA and UL Standards.

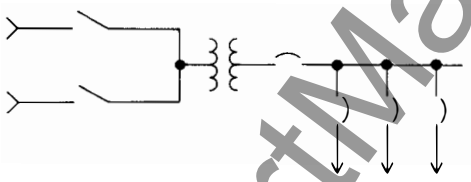
Types of Distribution Systems

A. Simple Radial



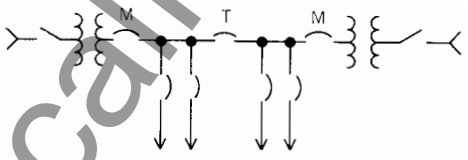
- Simplest and least costly
- Easy to coordinate
- No idle parts

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.

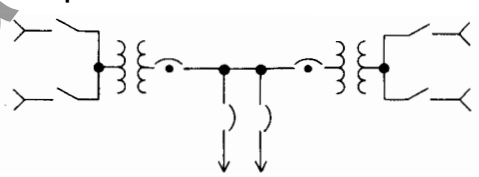
C. Secondary Selective



Normally operated as two electrically independent unit substations, with bus tie breaker (T) open, and with approximately half of the 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 the 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 paralleled, secondary fault currents and breaker application are similar to those on radial unit substations. Service continuity and substation capacity can be further improved by substituting selector type primary switches as in B.

D. Spot Network



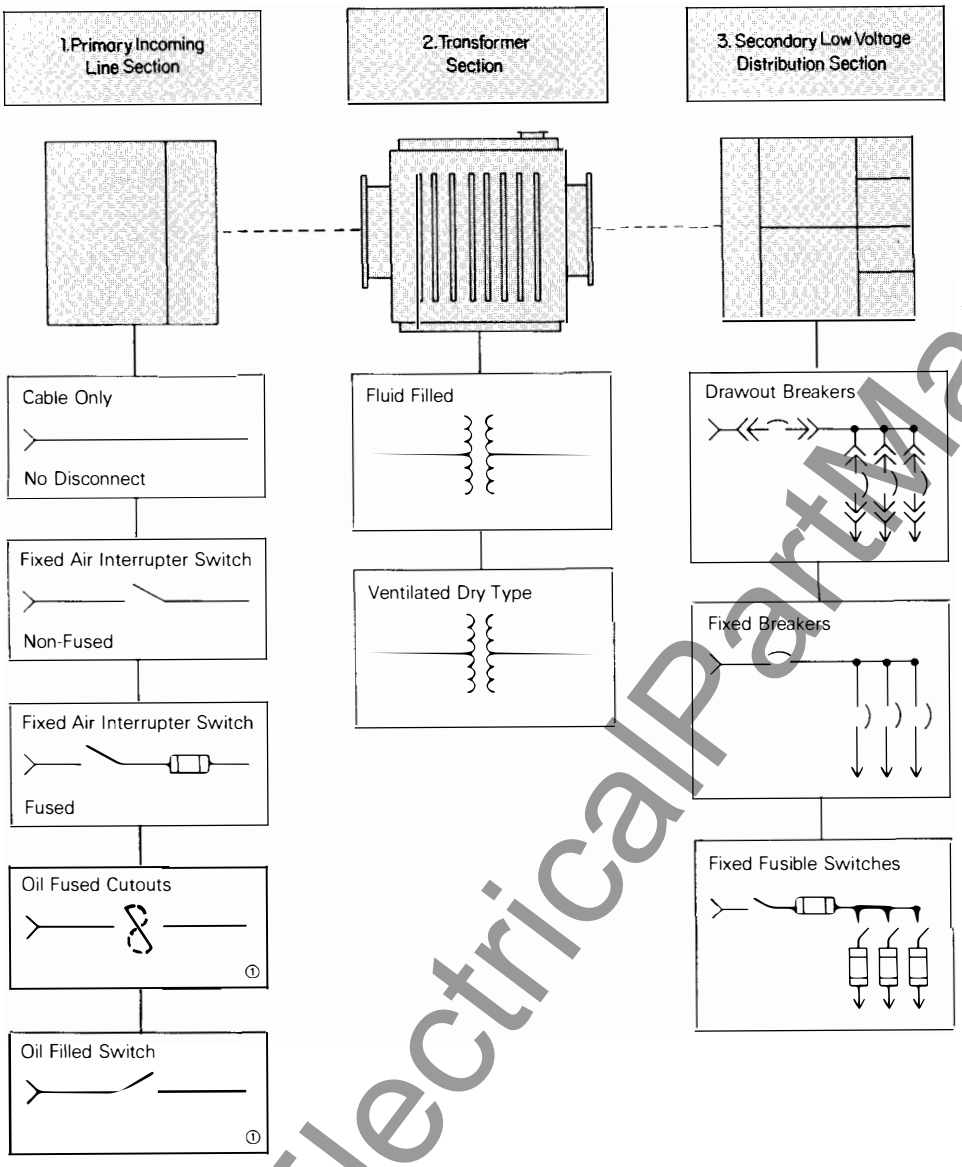
The transformers are paralled on the secondary sides through network protectors. In case of primary voltage failure, the associated protector automatically opens. The other protector remains closed, and there is no "dead time" on the bus, even momentarily. When primary voltage is restored, the protector 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 may be transfered to alternate live sources, thus shortening duration of overloads on the other transformer.

Power Centers, Switchboard Type

Apparatus Make-up of A Coordinated Power Center

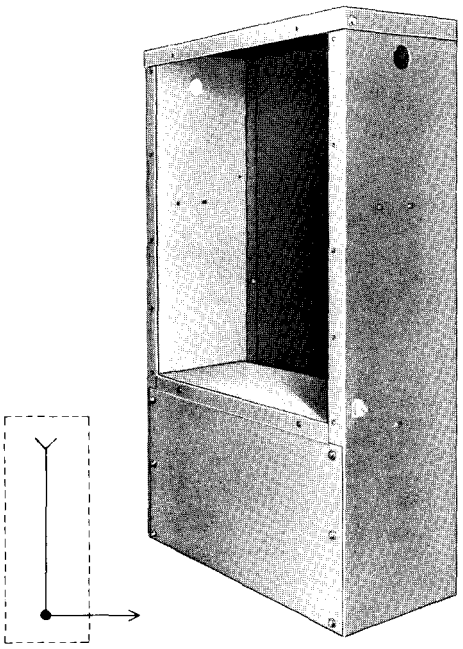


① For oil-filled transformers only.

Power Centers, Switchboard Type

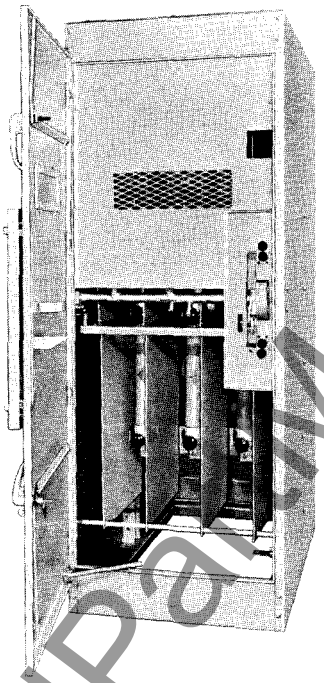
1. Primary Incoming Line Sections

Cable Terminal Compartment, Air Filled, No Disconnect



In order to accommodate the incoming line when primary circuit protection, or disconnection means, is located ahead of the power center and not close coupled with it, an air filled terminal compartment is furnished. This is a floor-standing, metal enclosure mechanically and electrically connected to the transformer on the primary side. It may house the termination equipment for cables entering from above or below, or serve as a pull section when cables can be connected directly to the transformer terminals.

Air Interrupter Switch, Type WLI, Unfused or Fused



Power centers requiring a primary disconnect are furnished with Type WLI, fixed, metal-enclosed, load interrupter switchgear. This switch assembly consists of a gang-operated air switch with full load air break characteristics. With power fuses incorporated into the assembly, the WLI provides overcurrent protection for the power center as well. WLI switchgear is furnished as standard high side disconnection equipment for all power centers, both dry and liquid types.

Ratings (See Electrical Application Data for Standard Ratings, Page 41).

Voltage: 4.8 Kv thru 34.5 Kv

Impulse Withstand: 60 Kv at 4.8 Kv, 95 Kv at 13.8 Kv, 150 Kv at 34.5 Kv.

Continuous Current: 600A and 1200A

Load Current Interrupting: 600A and 1200A

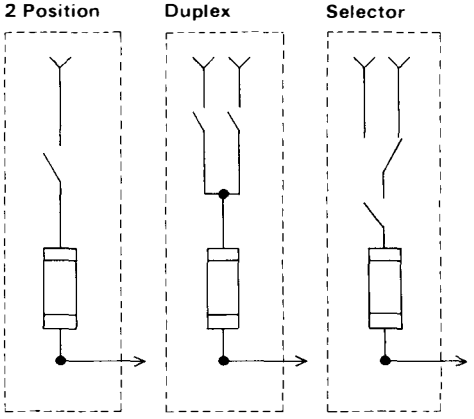
Momentary (10 Hz) Switch Closed: 40 Ka thru 80 Ka Rms Asym.

Fault Close: 20 Ka thru 61 Ka Rms Asym.

Features

- Quick-make, quick-break stored energy manual or optional electric mechanism
- Removable operating handle conveniently and attractively stored
- De-ion arc interruption
- Positive position indication
- Standard insulated cable connections to transformer – bare or insulated bus is optional
- Available with Type RBA, CXN or CLE fuses, or unfused.
- Proven reliability

Switch Arrangements



In addition to the single, two position switch for simple "On-Off" operation from a single primary feeder, other standard arrangements are available for use with primary selective power centers involving two primary alternate sources. These arrangements are shown above.

Other Available Primary Incoming Line Equipment②

1. Oil Fused Cutouts: Oil Filled Transformers only
2. Liquid Filled Disconnect Switch: Oil Filled Transformers only.

② Refer to Westinghouse.

Power Centers, Switchboard Type

Fuses

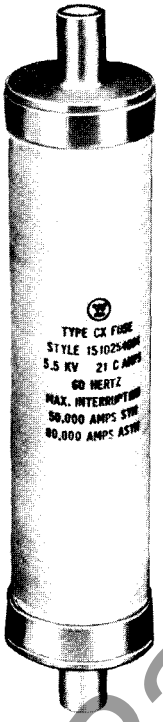
Current Limiting Type
Westinghouse CX and CXN

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.

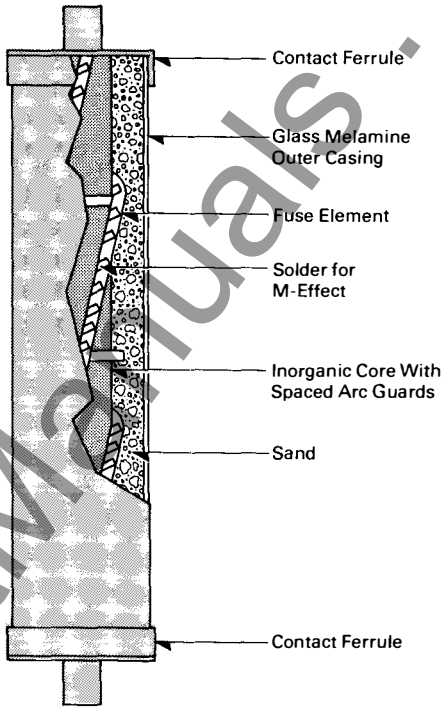
Type CX and CXN are constructed with pure silver fuse elements, a high-purity silica sand filler, an inorganic core with spaced arc guards, and a glass melamine outer casing.

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.

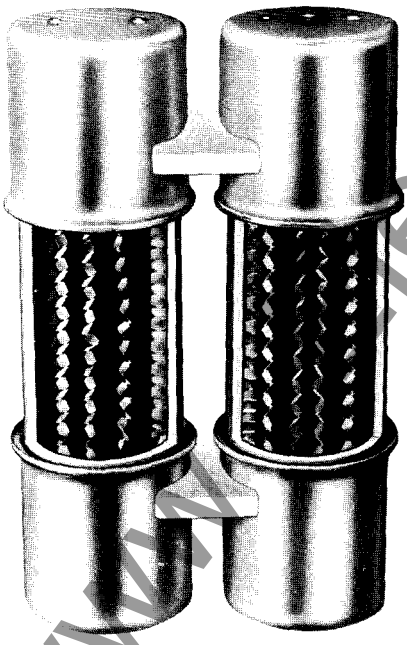


CX Fuse



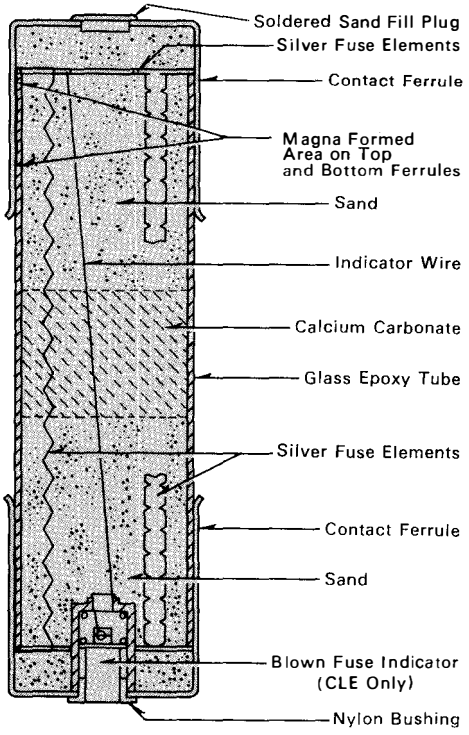
Cross Section Showing Component Parts of a CX Fuse

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.

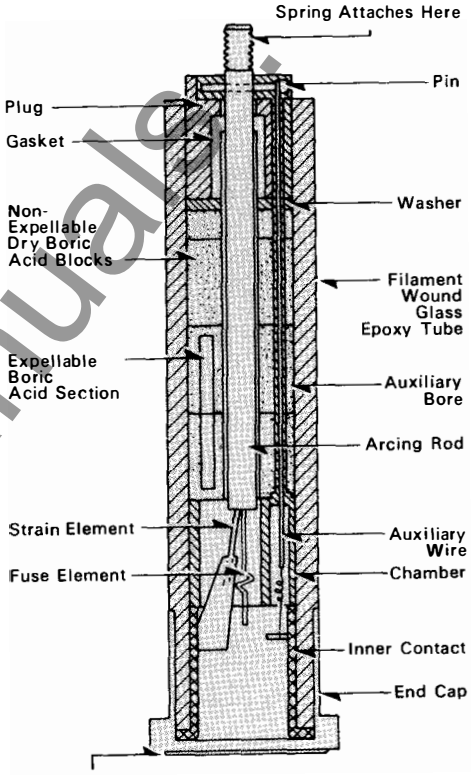
Power Centers, Switchboard Type

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, Switchboard Type

2. 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.

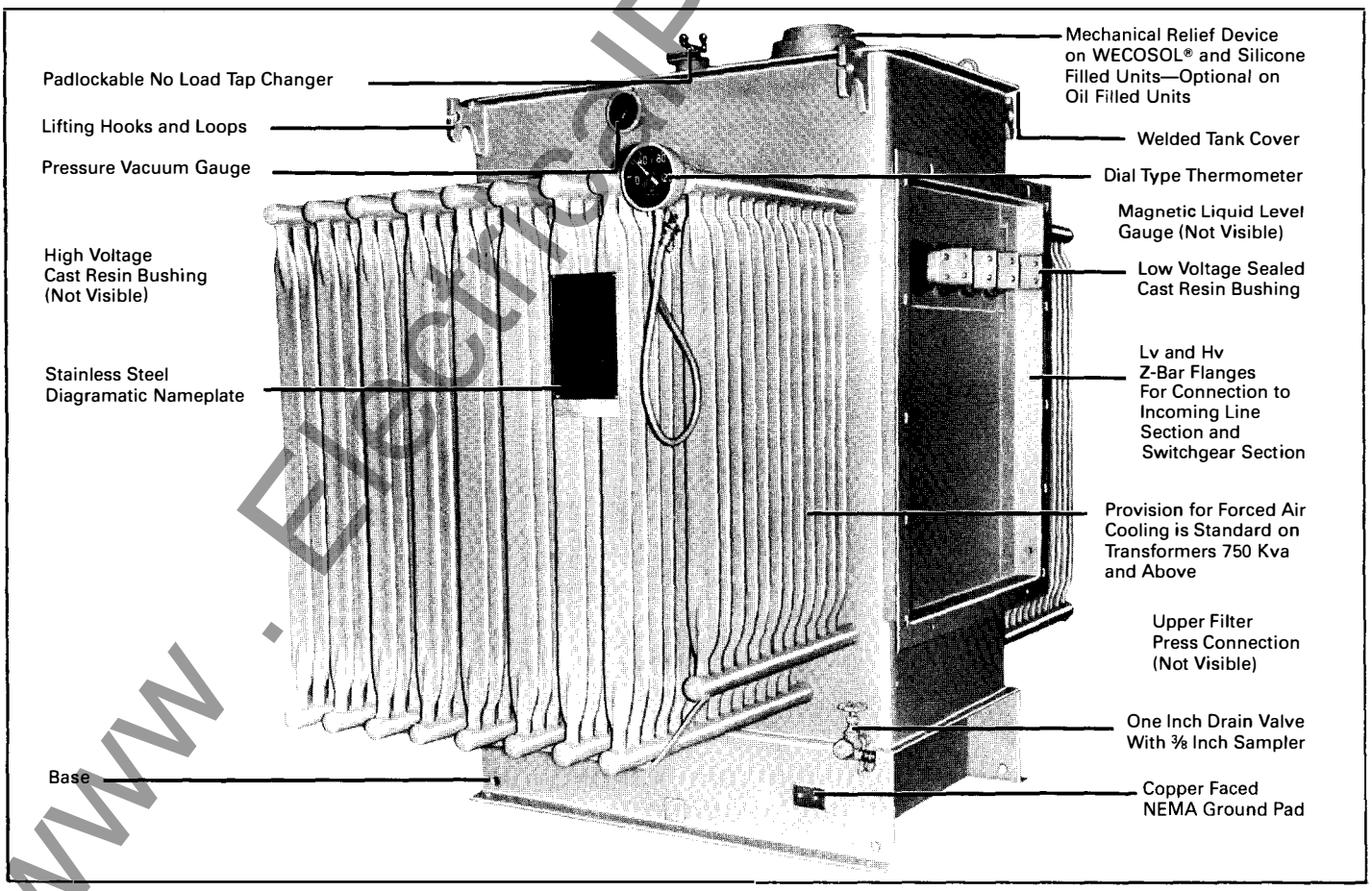
Lifting hooks are provided for lifting the entire unit and lifting loops for lifting the tank cover. The base is designed for skidding in any direction.

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



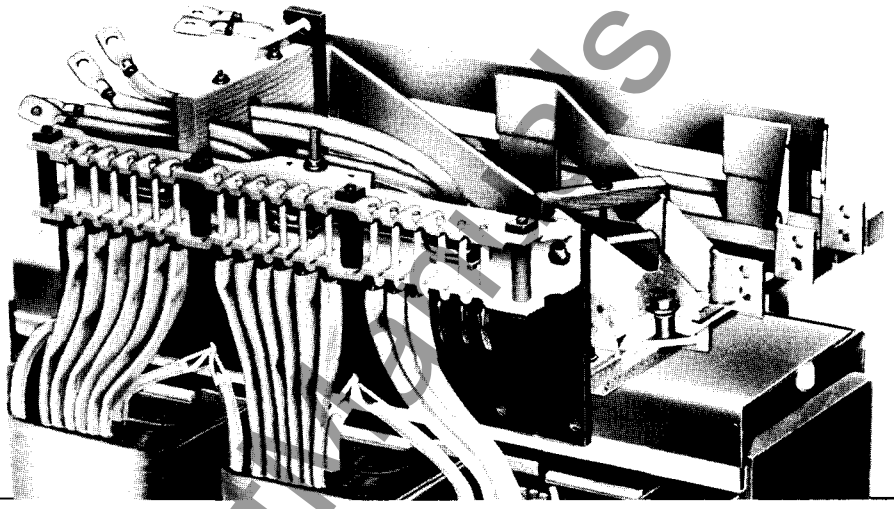
Power Centers, Switchboard Type

WSS Tap Changer

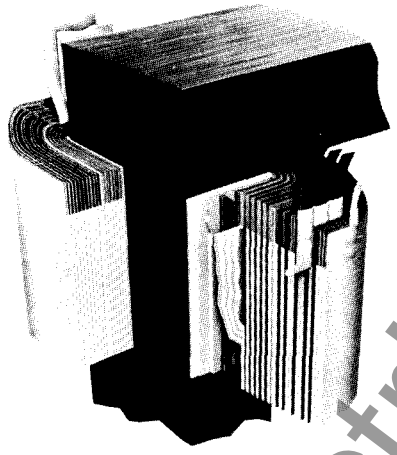
The Westinghouse externally operated WSS tap changer provides positive sequence line voltage changes under de-energized conditions. An in-line assembly, the WSS features through-type stationary contact studs rigidly supported by a molded plastic channel. Moving contacts are spring loaded, silver plated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



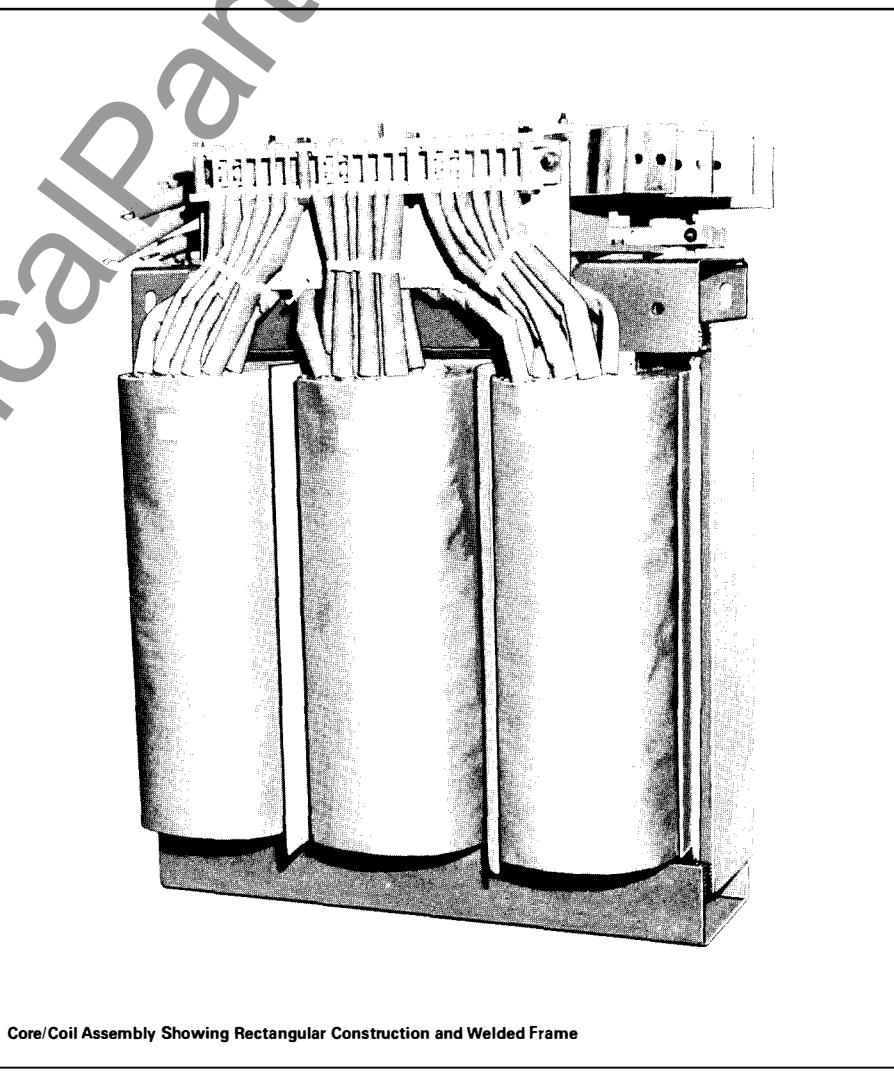
Rectangular Aluminum Wound Coils



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.

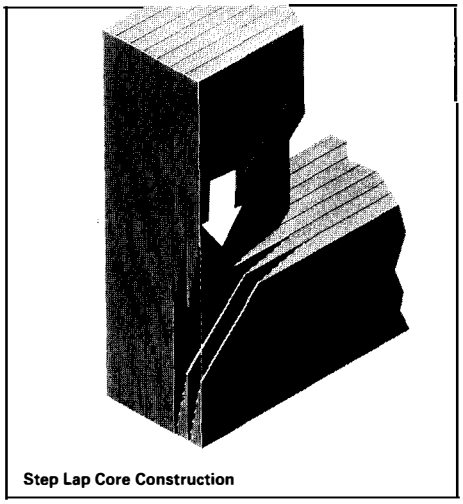


Core/Coil Assembly Showing Rectangular Construction and Welded Frame

Power Centers, Switchboard Type

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.

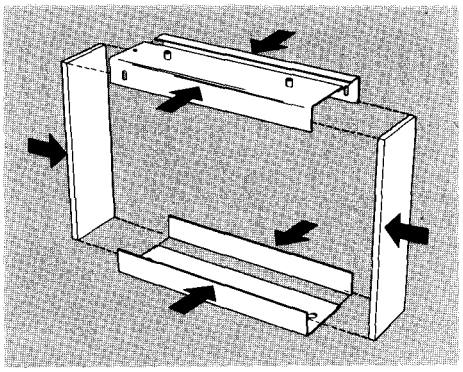
The user can benefit through reduced sound levels, lowered iron and total losses, and decreased exciting current to lower total operating cost.

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.

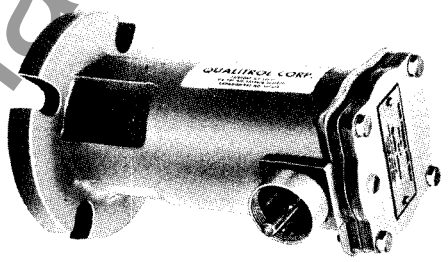
Super Insuldur Insulation

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

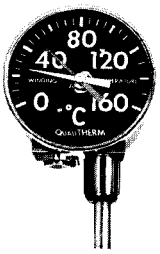
Optional Accessories

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, Switchboard Type

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

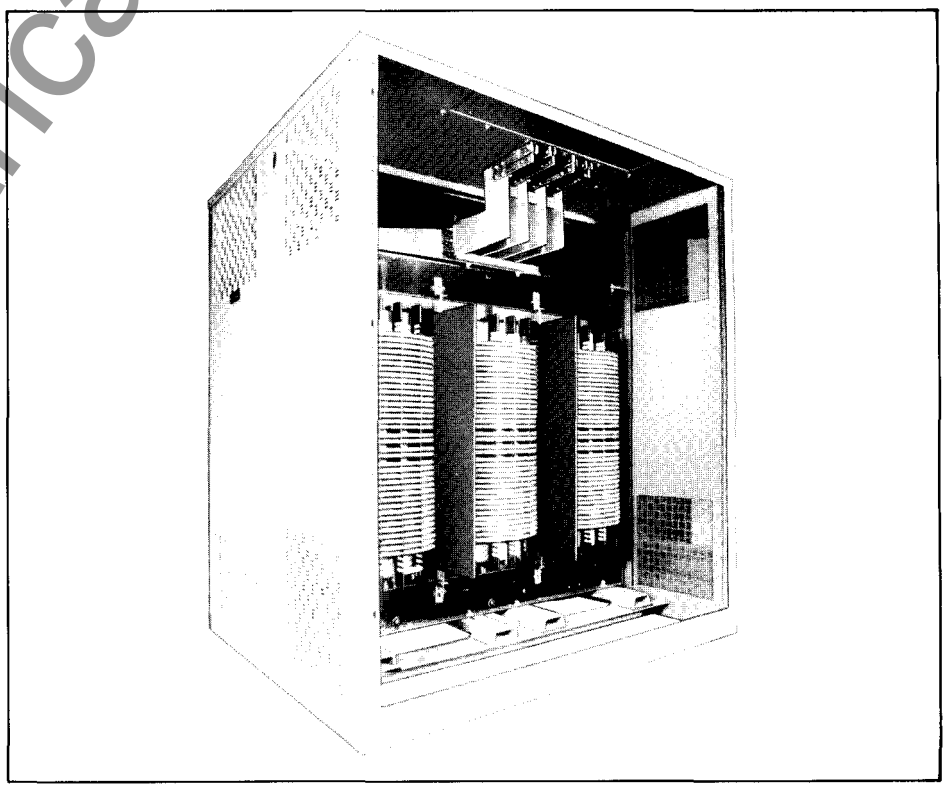
Vacuum Pressure Impregnated (VPI) Encapsulation

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.

Power Centers, Switchboard Type

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.

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

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.

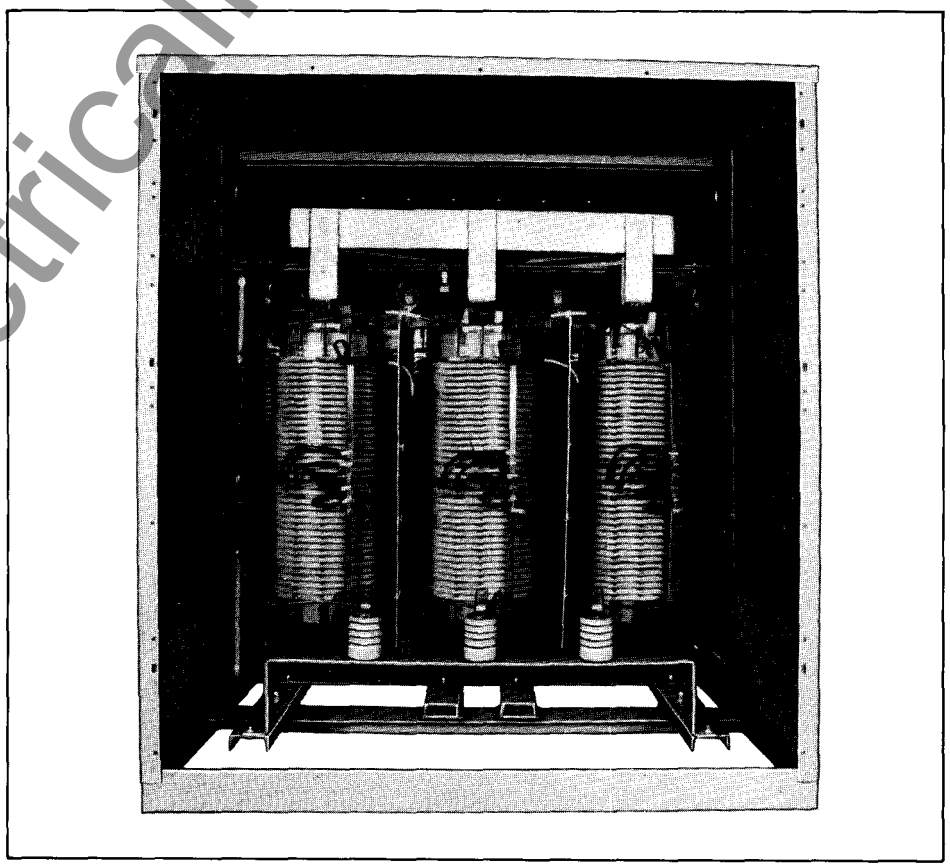
Taps
The taps can be reached from the front or back by removing a panel which also protects against tampering with the taps.

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.



Power Centers, Switchboard Type

3. Secondary Low Voltage Distribution Section

Secondary sections of Westinghouse Power Centers consist of various types of metal-enclosed, dead-front switchboards, electrically and mechanically close coupled to the secondary side of the power transformer.

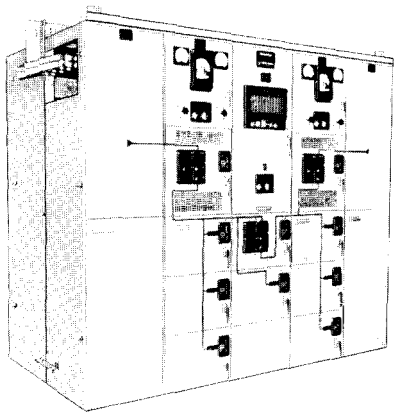
A choice of two distinct assembly types is available, based on the type of secondary overcurrent protective devices that are incorporated in their design. Proper selection can be made after evaluation of system requirements, as well as economic, environmental and safety considerations.

The two low voltage dead-front switchboards available for use as secondary distribution sections and defined below are:

- Pow-R-Gear® Switchboards①
- Pow-R-Line® Switchboards②
  Type WRP: Group Mounted Feeder Devices
  Type WRI: Individually Mounted Feeder Devices

① Refer to page 15 for description.
② Refer to page 23 for description.

Pow-R-Gear® Switchboards

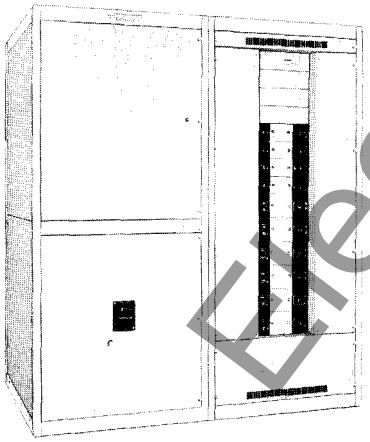


Construction Details
- 4000 Ampere Main Bus Capacity
- Accessible All Around
- All Devices Individually mounted and compartmentalized
- Sections flush front and rear
- All Units Drawout type
- Designed for mounting away from wall

Main Devices – Individually Compartmentalized
- Type SPB encased Systems Pow-R-Breaker, with adjustable solid state trip devices and stored energy manual or electrical operating mechanism – 800 – 4000A – drawout cell mounted

Branch Devices – Individually Compartmentalized
- Type SPB Encased Systems Pow-R-Breaker with adjustable solid state trip devices and stored energy manual or electrical operating mechanism. 250 – 4000A. Drawout cell mounted.

Type WRP Switchboards



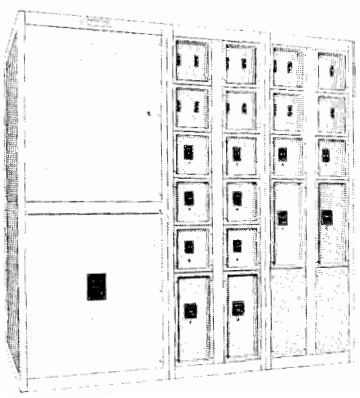
Construction Details
- 4000 Amp main bus capacity
- Rear (and front) accessible – end sections also side accessible
- Branch devices panel mounted
- Sections flush at front and rear
- Designed for mounting away from wall

Main Devices, Individually Mounted
- Molded case breaker, 225-3000 Amps, fixed
- SELTRONIC™ breaker, 600-3000 Amps, fixed
- MARK 75® circuit breaker, 225-1200 Amps, fixed
- TRI-PAC® circuit breaker, 225-1600 Amps, fixed
- DS power circuit breaker, 800-4000 Amps, fixed or drawout
- SCB-II circuit breaker, 600-3000 Amps, fixed, drawout or fixed/front removable
- SPB Systems Pow-R Breaker, 800-4000 Amps, fixed or drawout
- FDP fusible switch, 800-1200 Amps, fixed
- Bolted pressure contact switch, 800-4000 Amps, fixed

Branch Devices, Panel Mounted
- Molded case breaker, 15-1200 Amps
- SELTRONIC™ breaker, 75-1200 Amps
- MARK 75 circuit breaker, 15-1200 Amps
- TRI-PAC circuit breaker, 15-800 Amps
- FDP fusible switch, 30-1200 Amps
- Combination motor starter unit, full voltage, non-reversing or reversing:
- Mac B circuit breaker type, sizes 0-4
- Mac F fusible switch type, sizes 0-4

Power Centers, Switchboard Type

Type WRI Switchboards



Construction Details

- 4000 Ampere Capacity
- Rear (and front) accessible – end sections also side accessible
- Branch devices individually mounted
- Sections flush front and rear.
- Designed for mounting away from wall

Main Devices — Individually Mounted

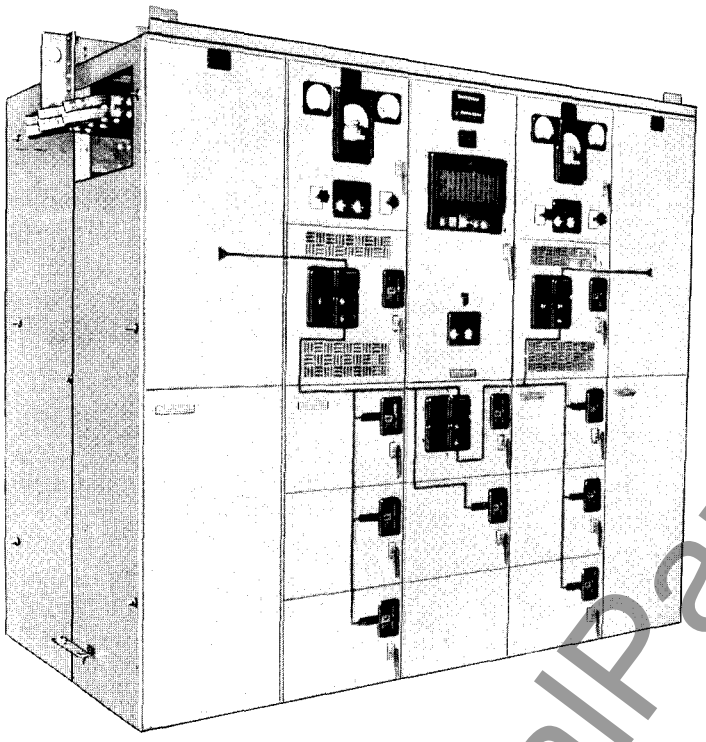
- Molded case breaker, 225-3000 Amps, fixed
- SELTRONIC™ breaker, 600-3000 Amps, fixed
- MARK 75® circuit breaker, 225-1200 Amps, fixed
- TRI-PAC® circuit breaker, 225-1600 Amps, fixed
- DS power circuit breaker, 800-4000 Amps, fixed or drawout
- SCB-II circuit breakers, 600-3000 Amps, fixed, drawout, or fixed/front removable
- SPB Systems Pow-R Breaker, 800-4000 Amps, fixed or drawout
- FDP fusible switch, 800-1200 Amps, fixed
- Bolted pressure contact switch, 800-4000 Amps, fixed

Branch Devices — Individually Mounted

- Molded case circuit breaker, 100-3000 Amps, fixed
- SELTRONIC™ breaker, 150-3000 Amps, fixed
- MARK 75® circuit breaker, 100-1200 Amps, fixed
- TRI-PAC® circuit breaker, 100-1600 Amps, fixed
- SCB-II circuit breakers, 600-3000 Amps, fixed or drawout
- SPB Systems Pow-R Breaker, 250-4000 Amp, fixed
- FDP fusible switch, 100-1200 Amps, fixed
- Bolted pressure contact switch, 800-4000 Amps, fixed

Power Centers, Switchboard Type

Pow-R-Gear® Switchboard



General

Pow-R-Gear switchboards are designed exclusively for the systems Pow-R Breaker line of encased power circuit breakers. They embody the most modern design concepts consistant with the ever expanding need for safe, dependable and continuous low voltage power in commercial and industrial applications. Since facilities for testing and ease of maintenance are so important in these applications, Pow-R-Gear switchboards feature the drawout breaker design throughout the line. Safety through compartmentalization is also a distinguishing feature of Pow-R-Gear switchboards.

Standards and Ratings

Pow-R-Gear switchboards are constructed in accordance with all applicable provisions of U.L. 891 and NEMA PB-2 covering low voltage distribution switchboards. Many of their features exceed these two governing standards. Pow-R-Gear switchboard ratings are based on the ratings of the drawout Systems Pow-R Breakers mounted in the assemblies:

Voltage: 120 to 600 volts Ac, single phase/ 3 phase, 3 wire or 4 wire.

Main Bus Ampacity: 800-4000 amps. continuous.

Short Circuit Rating: 100,000 amps. Rms Sym at 480 volts Ac. (circuit breaker and bus rating) non-fusible.

Power Centers, Switchboard Type

Pow-R-Gear Switchboards, *Continued*

Standard Features

Three Position Drawout All breakers are drawout-mounted and can be in the engaged, test, or disengaged position with the compartment door closed.

Individual Breaker Compartmentalization Each breaker is housed in a drawout-equipped cell having isolating barriers on sides, rear, top and bottom, in addition to a hinged front steel cover.

In-gear Breaker Inspection Breakers, when drawn out to the extreme ends of their self-contained rail extensions, may be rotated 180° for complete access to primary and secondary contacts.

Recessed Fixed Contacts Primary contacts fixed in the breaker cell rear wall are recessed behind an insulating barrier such that no live parts extend into the cell interior space with breaker removed.

Minimum Floor Space Front cell compartments accommodate up to six-high stacking of 800 ampere drawout breakers, four-high for 1600A frames and two-high through 2500 ampere frames.

Automatic Drawout Interlock Drawout mechanism is mechanically interlocked with the breaker mechanism such that no breaker can be racked into or out of the engaged position unless its contacts are open.

Padlocking of Breakers Breakers may be padlocked in any of the three drawout positions as well as in a tripped-open position.

Welded Aluminum Bus All principal main bus connections are welded. Where connections must be bolted as at shipping splits and connections to external equipment, bus bars are sliver plated. Bolted copper bus systems are available.

Door-mounted Instrumentation Feeder breaker load current can be monitored, when required, right at the breaker cell door by three-phase ammeters mounted on the door itself.

Positive Secondary Contact Engagement Secondary contact engagement uses the connector plug principle providing automatic self-alignment of mating parts and positive contact.

Removable Cable Compartment Rear cable compartment design facilities removal and replacement of framework independent of other portions of the section. Thus, sections may be moved through smaller entrance ways during installation.

Finish Standard electro-deposition process epoxy for both indoor and outdoor enclosures.

Optional Features

Closed Door Drawout A modified version of the drawout mechanism and door interface enables the breakers to be racked outward or inward into the three basic positions with the door remaining closed.

Bus Insulation/Isolation System Main and vertical busses are completely enclosed phase by phase with clip-on insulation shapes applied after assembly.

Anti-paralleling Interlock Two adjacent breakers may be mutually interlocked by means of a mechanical connection to prevent them from being in the closed position simultaneously.

Cell Mounted Auxiliary Switch An auxiliary switch is mounted in the breaker drawout cell and operated by the motion of the drawout element as it moves from "engaged" to "test" to "disengaged" positions.

Enclosure Construction

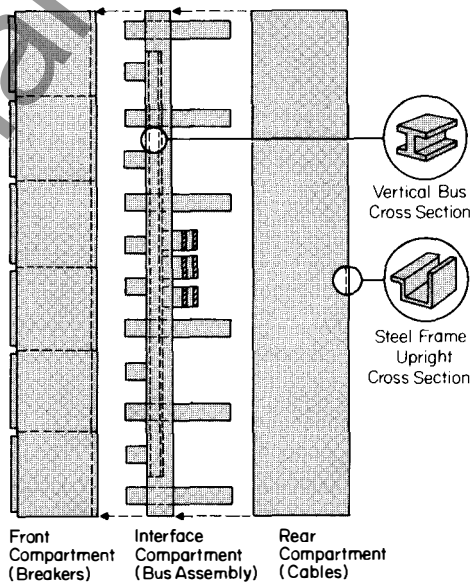
To equip Pow-R-Gear with its many advanced safety features, the enclosure is designed in three separate parts that are bolted together in final assembly to form each vertical section of the switchboard.

The front section consists of the framing and all cell parts necessary to house the drawout breakers in a standard, modularized, vertical stacking arrangement. This fixed-depth section, independent in its construction from other sub-structures, is 90 inches high by 21 inches wide and complete with a full height insulated rear barrier which forms its rear wall. This barrier contains the mounting details for the drawout breaker stationary contacts and serves as a solid barrier isolating all front cell mounted equipment from the live bus located in the compartment immediately behind it. Horizontal and vertical steel barriers segregate each breaker cell from adjacent cells. The front compartment also contains the front formed steel doors which provide front access to each drawout module.

The intermediate section is also an independently constructed shallow-depth full height structure which functions as the supporting frame for the horizontal and vertical bus assembly. Its dimensions are constant for all bus ratings and it has its own front and rear flange for bolting it to the front cell structure and the rear cable compartment. The rear flange of this bus compartment provides a mounting surface for the addition of an optional full height barrier to isolate the entire bus assembly for added safety.

The rear section consists of a third independent frame whose primary purpose is to enclose and protect the rear cable space and breaker load bus extensions. Its depth varies depending on the number and size of feeder cables that have to be pulled in and terminated. The design of the rear compartment is such that it supports a minimum amount of internally mounted equipment and, therefore, it's removal in the field, to facilitate passage through building openings, is feasible.

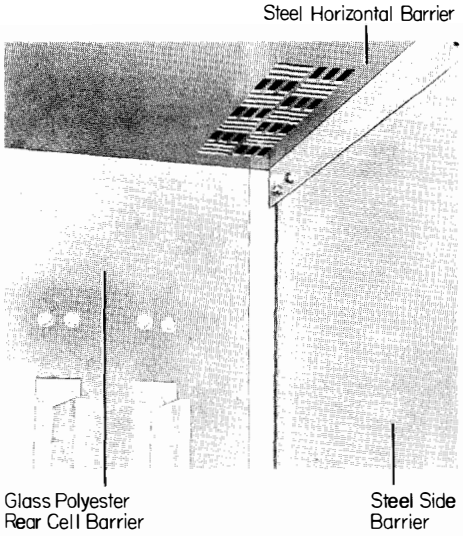
Formed, removable covers are supplied on top, rear and sides to totally enclose the switchboard assembly.



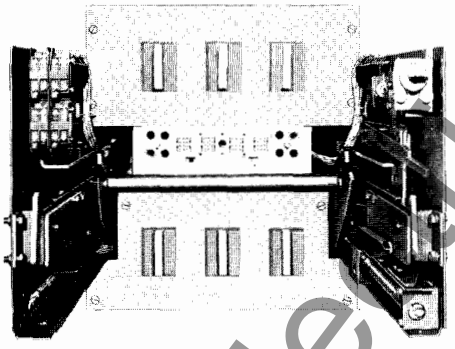
Power Centers, Switchboard Type

Pow-R-Gear Switchboards, *Continued*

Drawout Breaker System



Each drawout, breaker-equipped cell is completely segregrated from other cells of the same and adjacent sections. In the rear, a double wall of glass polyester segregates the compartment from the bus assembly. On the sides, top and bottom, the cell barriers are of steel.

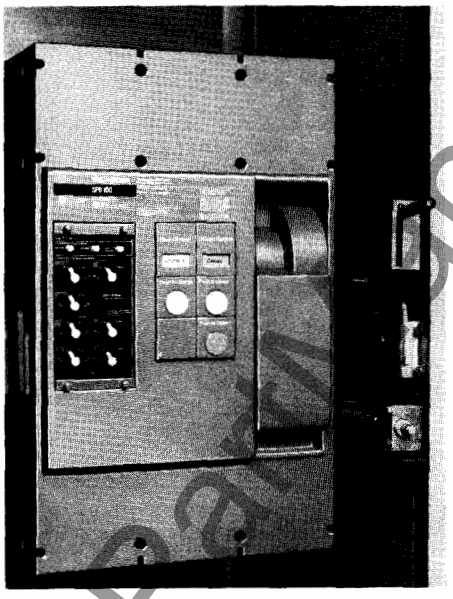


The fixed primary contacts are individually replaceable and accessible from the front. These contacts, both line and load, are recessed behind a glass polyester barrier so that no energized primary parts extend into the cell space when the breaker is removed. CT's, as required for feeder circuit instrumentation are front accessible.

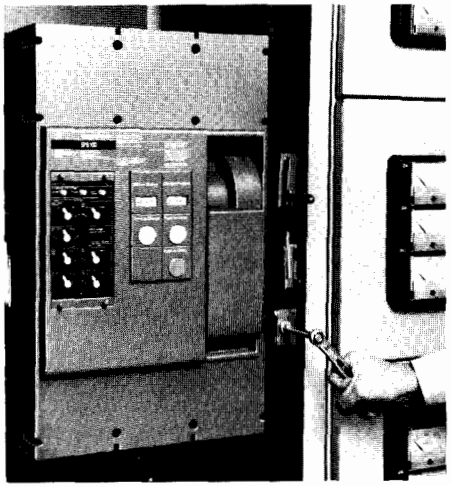
The breaker drawout mechanism is simple, yet rugged in construction. Breaker pull-in is through worm-and-lever action imparted through the rotation of a manual handle.

Handle shaft extends forward for clearance when rack out is desired. It retracts into the cell when racking operation is completed.

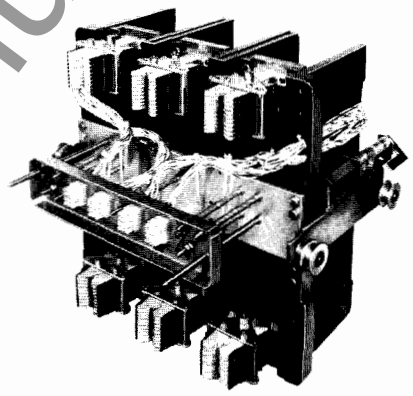
The mechanism is identical for all breaker frame sizes. When not used for complete breaker rollout and removal, the captive rail extensions retract into the cell as integral parts of the mechanism.



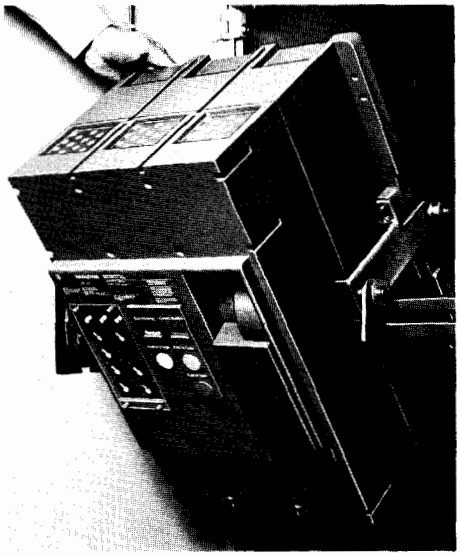
The Pow-R-Gear switchboard drawout-breaker design makes it possible to place the breaker, in "Engaged", "Test" or "Disengaged" positions without interferring with the closing and latching of the front cell door. In the engaged position, sufficient space is provided in front of the breaker to make this possible. No need for doors to be left open when breakers are being tested or stored disengaged in their cell.



Breaker primary and secondary contacts are full-floating and precisely self-aligning with their fixed counterparts in the drawout cell. The secondary contacts utilize a plug-in, plug-out system whereby the plug contact is maintained in both the "Engaged" and the "Test" positions. It is not subject to gradual un-plugging as the breaker is moved out to "Test". The movable portion of the plug remains motionless until the breaker is racked beyond the "Test" position.

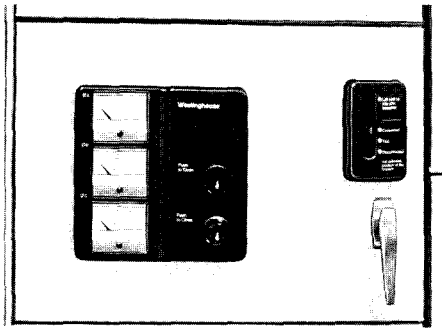


Inspection of moving primary and secondary contacts can be accomplished without removing the breaker to the work bench. The facility to rotate the breaker for this purpose is built into the drawout rail design.



Power Centers, Switchboard Type

Pow-R-Gear Switchboards, *Continued*



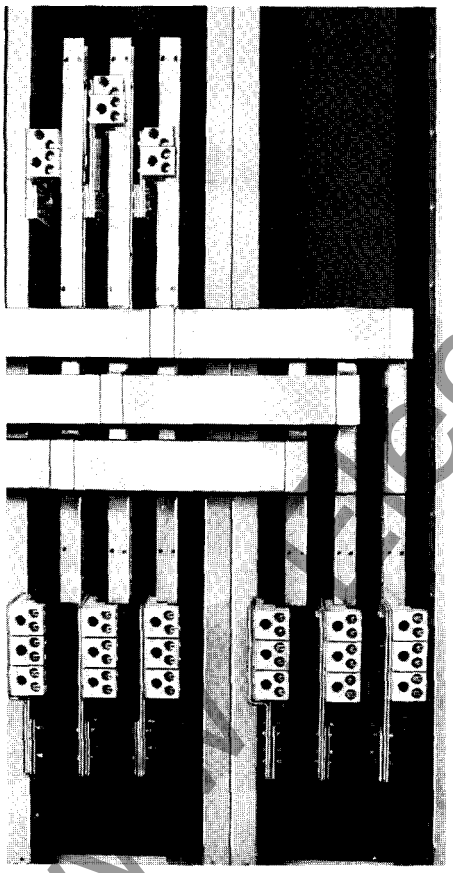
Cell door of electrically operated breakers contains control devices necessary to close and trip the breaker, as well as to pre-charge the stored energy mechanism. On manually operated breakers, tripping can be accomplished without opening the cell door, by lifting a mechanical lever which is front accessible but protected against inadvertent operation.

The position of each breaker in a switchboard lineup can be easily determined with all doors closed. A position indicating lever and escutcheon assembly is located on each breaker door with the lever traveling in a vertical slot as the breaker is racked in and out. In addition, this indicator lever serves as the external mechanical tripping means. Lifting the lever trips the breaker regardless of the position of the breaker: "Engaged," "Test," or "Disengaged." The lever is recessed in the escutcheon to prevent its being accidently operated.

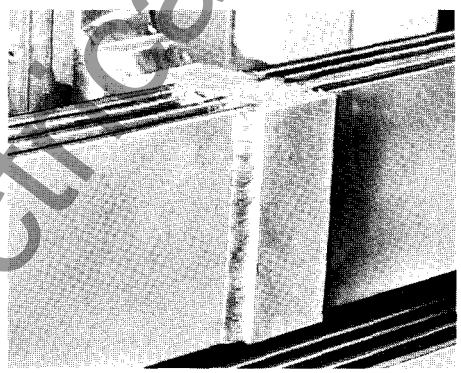
Individual feeder ammeters, when required, are door mounted.

The main bus is in a fixed location centered about the horizontal centerline of each section for normal arrangements. Conventional rectangular busbar is used with phases located one above the other, edge to edge, in a common plane. This configuration makes the assembly extra resistant to short circuit forces and minimizes inadvertent bridging of uninsulated phase bars during maintenance. The vertical bus in each section is secured directly to the heavy glass polyester vertical barrier that isolates it from the front breaker cell assemblies. Extra short circuit bracing is achieved through this construction.

Load cable termination points are extended rearward to safe areas behind live bus assemblies using insulated copper bus bar extensions. The rear compartment of each vertical section (removed in photo at left) provides a safe space for the installation of load cables. As an option this rear compartment can be isolated from the bus assembly by means of a full height vertical insulating barrier.



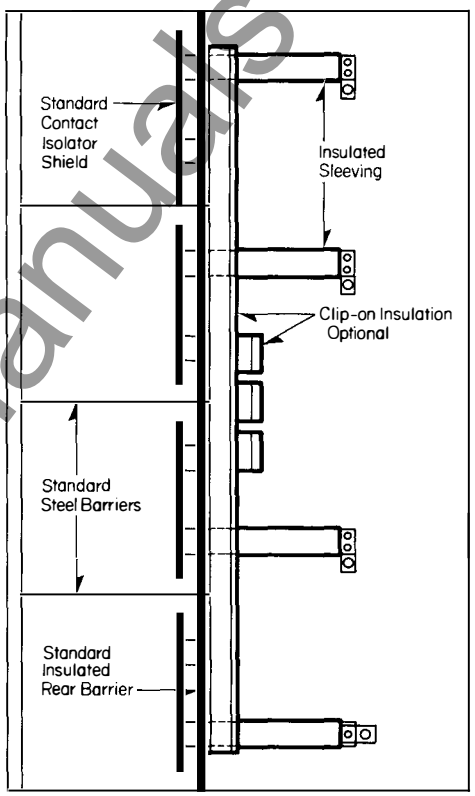
Rear View, Typical Bus System



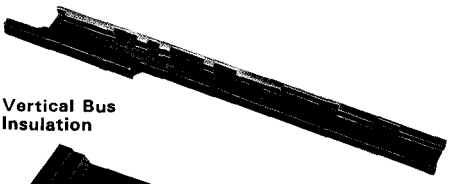
All principal main bus to section bus connections are welded aluminum in standard construction. No maintenance of these joints is ever required, and welding provides joints of maximum permanent conductivity.

Insulation/Isolation System

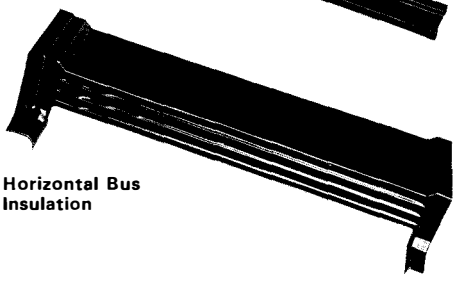
A standard option in Pow-R-Gear Switchboards involves a system by which virtually all internal parts energized at bus voltage are enclosed in insulating material. This system utilizes formed insulation shapes securely clamped onto the bus bars, fitting them snuggly for their entire length. In enclosing each phase conductor, this system accomplishes phase isolation as well as individually insulating each live surface. The probability of phase to phase or phase to ground faults being initiated within the switchboard is practically eliminated.



Cutaway View, Insulation/Isolation System



Vertical Bus Insulation



Horizontal Bus Insulation

As a complementary part of the totally insulated bus, an additional option is available which protects against the danger of contacting the live primary fixed parts in the drawout cell with the breaker removed. This option is an automatic shutter system which completely closes off the line and load fixed primary contacts as the breaker is racked out of the engaged position. With this feature, the total insulation/isolation safety concept is maintained throughout the switchboard, including the breaker cells.

Power Centers, Switchboard Type

Pow-R-Gear Switchboards, *Continued*

SPB Systems Pow-R-Breaker
Pow-R-Gear low voltage secondary switching equipment utilizes the SPB Systems Pow-R-Breaker exclusively in its assemblies. The SPB is an encased power breaker having operational features and tripping characteristics tailored specifically for use on higher fault capacity distribution systems, whether or not coordination is required.

The technical capabilities of the SPB Systems Pow-R-Breaker greatly exceed those of molded case breakers and enables them to safely handle many heavy duty circuits whose protection is commonly associated with the larger, open type power circuit breakers.

Standard Breaker Features
UL Listed 100% Rating All SPB frames sizes, when applied in their respective drawout cells, are UL listed at 100% of their continuous ampere rating.

Uniform Dimensions All SPB's through 3000 amps have the same width, depth and pole spacing. Manually and electrically operated breakers are the same physical size.

Two-Step Stored Energy Closing Closing mechanism is energized by a charged spring in two steps: 1) Spring Charge, and 2) Spring Release. These are independent motions which give positive control of the closing instant. Electrically operated breakers have a motor driven spring charger and solenoid release.

Solid State Trip Devices All SPB breakers are equipped with a solid state trip module which can be removed from and re-inserted into a cavity in the front face of the breaker. Three distinct trip modules having different degrees of functional capability are available for use with the SPB breaker:
- Pow-R Trip®
- Pow-R Trip 7®
- Pow-R Digitrip®

Two of these types featuring the highest degree of system coordination capability are described on pages 20 and 21.①

Interchangeable Ampere Rating Plugs Each SPB breaker solid state trip module contains a removable, solid state ampere rating plug which, when inserted into the trip module, establishes the breakers full load ampere rating.

Internal Self-Contained Ground Fault
Ground fault logic components, when used, are mounted within the breaker case.

Functional Testing in Service Test points are provided on all breaker trip devices for use with an accessory test device to test the tripping device function in service.

Breaker Contacts Field Replaceable

Optional Breaker Features
Selective Override This permits short time delay tripping and in conjunction with high IC, enables these breakers to be applied in fully rated systems and provide coordination as well.

Ground Fault Protection All SPB breakers can be equipped with adjustable ground fault pick up and time delay devices as part of their integral solid state tripping package.

Visual Trip Indicators The SPB Systems Pow-R-Breaker through its Pow-R-Trip 7 solid state trip device can be equipped with visual indicators which show the reason for a tripping action – "Overload", "Short circuit" or "Ground Fault".

SPB Systems Pow-R-Breaker Accessories②
Undervoltage Release – Instantaneous.

Undervoltage Release – Time delay.

Remote Spring Release Manually operated breakers with precharged spring may be closed from a remote location through action of an unlatching solenoid.

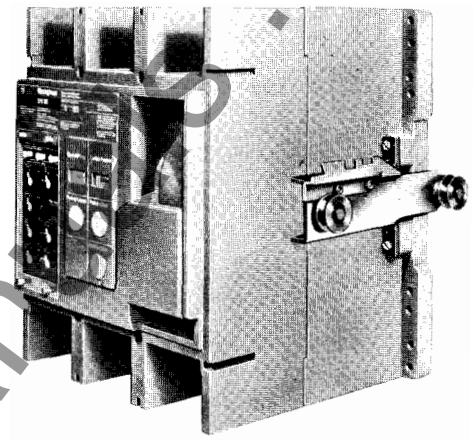
Spring Condition Auxiliary Switch
An auxiliary switch whose action is dependent upon the movement of the spring charging mechanism can be used to give remote indication of the "Spring Charged" condition.

Remote Trip Signalling Visual trip indicators on the breaker can be wired out to remote alarm or annunciator.

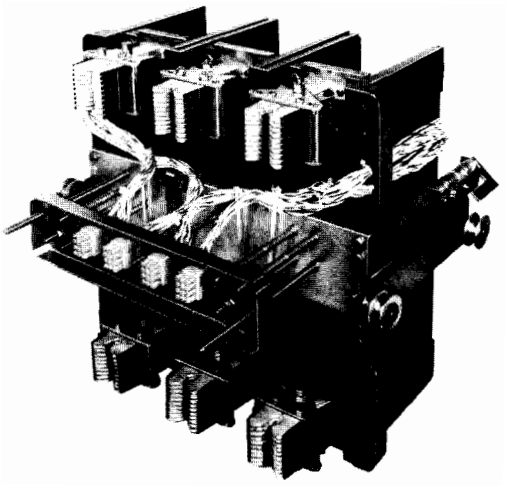
Remote Ground Fault Test Panel Enables operability test of integral ground fault components from remote location.

Mechanical Interlocks Two breakers interlocked so that only one may be closed at one time, but both may be open concurrently.

Automatic Trip Relay Provides alarm and lockout contacts in response to automatic breaker tripping.



Systems Pow-R Breaker



Primary and Secondary Contacts, Rear View

① Refer to AD 29-860 for information on the Pow-R Trip unit.
② Refer to AD 29-860 for further information on these and other available SPB accessories.

Power Centers, Switchboard Type

Pow-R-Gear Switchboards, *Continued*

Pow-R-Trip 7 Solid State Tripping System
SPB breakers are equipped with the Pow-R-Trip 7 tripping system having a complete range of tripping functions and characterisitics built into its solid state module. The module itself is common to all frame sizes and is designed to plug into the breaker frame. A transparent plastic window cover is secured in place to prevent unintentional or unauthorized changes in trip settings. All adjustments are by means of rotary knobs which operate switching plugs in discrete steps. Within a given frame size, several ampere ratings are available through the use of rating plugs. When inserted in the trip module, these plugs set the breaker up for the full load rating marked on the plug. See page 42 for rating plugs and trip settings.

A fully equipped Pow-R-Trip 7 trip module consists of the following adjustable tripping functions affecting the breakers overall time/current characteristic:

- Ampere Setting (O.C. Pickup)
- Long time delay
- Short time pickup
- Short time delay
- Instantaneous pickup
- Ground Fault pickup
- Ground Fault delay

The Pow-R-Trip 7 tripping system incorporates the following technical refinements of the seven basic adjustable characteristics, either as standard feature or as available options:

Ground Fault Zone Selective Interlocking-Standard provisions on all ground fault packages.

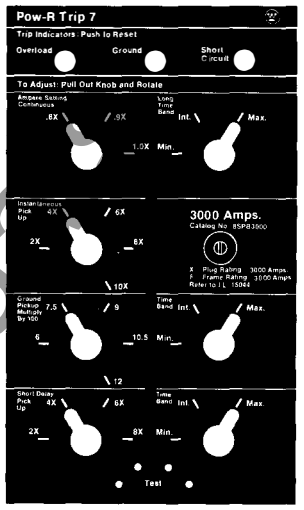
Remote Ground Fault Test Panel – Optional

Ground Fault Memory Characteristic – Standard

Built-in Trip Indicators for Overload, Short Circuit and Ground Fault – Optional

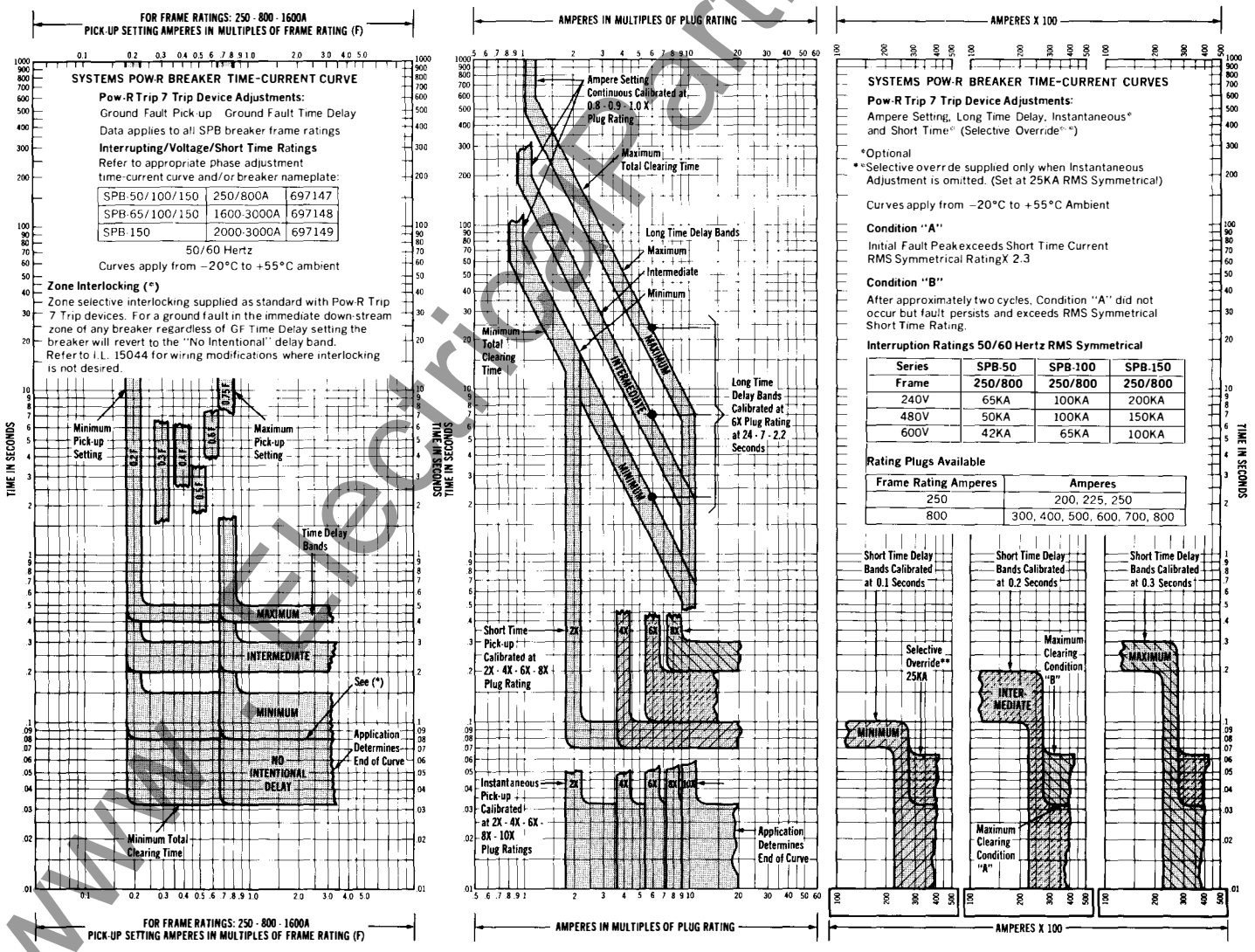
Selective Override Circuit – Standard when trip complement includes adjustable short time delay, but no adjustable-instantaneous trip.

Built-in Provisions for In-Service, Functional Testing of the Breaker – Standard



Trip Module

Pow-R-Trip 7 Time/Current Curves①



① Curves illustrated are for the 250/800 amp frame SPB breaker only, and are typical of other frame sizes in makeup and detail. All three curves shown are required for complete definition of characteristics of a given breaker frame.

Power Centers, Switchboard Type

Pow-R-Gear Switchboards, *Continued*

Digitrip Solid State Tripping System

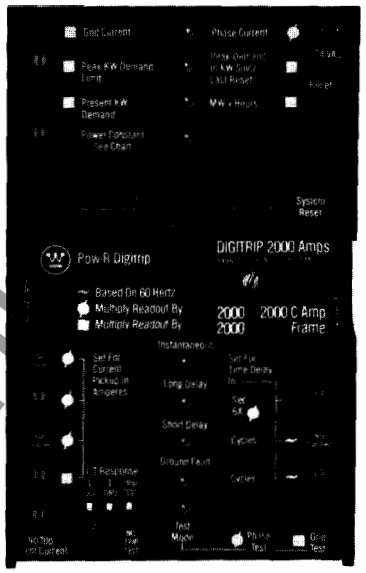
The Pow-R Digitrip is a microprocessor-based trip unit that encompasses all of the circuit protection features available in the Pow-R Trip 7 trip unit. In addition, it has available an information system that provides circuit analysis, data energy monitoring, controls and mode of trip indication, with visible digital readout of tripout current values. It also provides a self-contained means to conduct circuit breaker tests in either a trip or no trip test mode.

The Pow-R Digitrip is equipped with a digital display panel that continuously displays, on a sequencing basis, protective function settings, phase and ground current values, and, when selected, energy monitoring parameters including peak demand and approximate power consumption values.

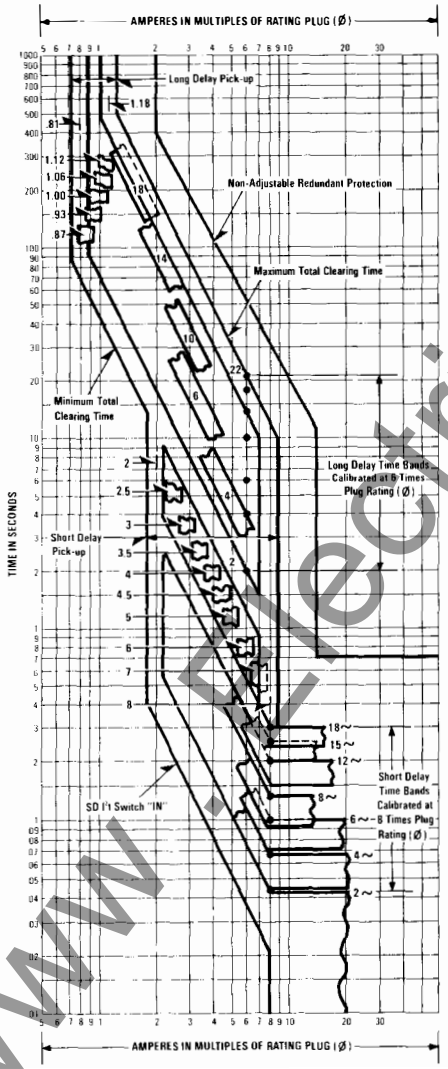
The Digitrip trip unit is completely self-contained. When the circuit breaker is closed and carrying current, the unit requires no external control power to operate its protection and information systems.

In the event of an automatic trip operation when the internal current sensors cannot power the digital displays and information system, a separately mounted automatic trip/demand relay can be furnished to supply the necessary control power. This relay also provides contacts that can be used for alarm and lockout circuitry and other contacts for load control and/or alarm in response to peak loads in excess of the Digitrip demand setting.

Automatic Trip/Demand relays may be supplied with or without provision for an integrally mounted battery package to provide temporary back-up power for the visual displays.



Digitrip Time/Current Curves



SYSTEMS POW-R BREAKER WITH DIGITRIP TIME-CURRENT CURVES

Frame Current Rating	Breaker Type	Breaker Short Time Current Rating	Short Delay Pickup Settings
250-800	SPB-50 SPB-100 SPB-150	25KA	
1200	SPB-65 SPB-100 SPB-150	35 KA	
1600-2000	SPB-65 SPB-100	35 KA	2, 3, 4, 5, 6, 7, 8
1600-2000	SPB-150	51 KA	
2000 2500-3000	SPB-100	35 KA	
2000 2500-3000	SPB-150	51 KA	
4000-5000	SPB-100	65 KA	2, 2.5, 3, 3.5, 4, 4.5, 5
4000-5000	SPB-150	85 KA	

Ground Fault Pick-up Settings

A. 250-800-1200 Amp Frames
0.20, 0.25, 0.4, 0.5, 0.59, 0.75, 1.0 X (□)

1600 and 2000 Amp Compact Frame
0.20, 0.29, 0.4, 0.5, 0.59 X (□)

2000-2500-3000 Amp Frames
0.20, 0.23, 0.26, 0.29, 0.32, 0.37, 0.4 X 3000 ③

4000 Amp Frame
0.20, 0.21, 0.23, 0.25, 0.26, 0.28, 0.29 X 4000 ②

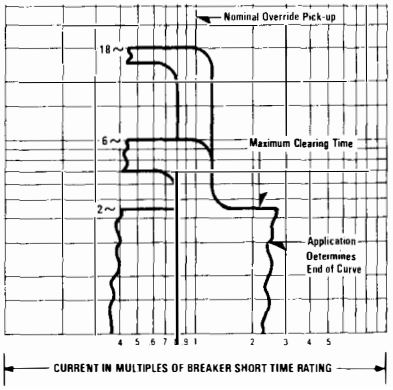
5000 Amp Frame
0.2 X 6000 ③

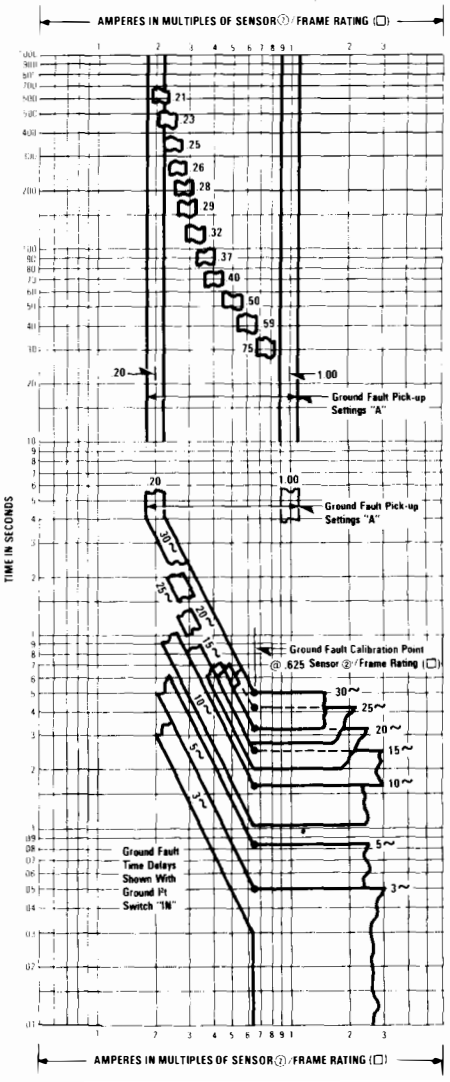
B. ①Ground Fault Time Delay Bands on 60 Hertz Time Basis (~)
.3, .5, .10, .15, .20, .25, .30, .3 Cycles

①With Zone Interlocking, Time Band Will be (.3) Unless Defeated Regardless of Setting. (See IS 15262, Sheet 31)

②Use Sensor Rating as Frame Rating (□) Where Noted

(□) Frame Rating in Amperes





③ Available time/current curves:
SC 3655-81: Long Time and Instantaneous (includes interrupting ratings)
SC 3656-81: Long Time, Short Time with Short Delay I^2T switch "out".
SC 3657-81: Long Time, Short Time with Short Delay I^2T switch "in".
SC 3658-81: Ground Fault with I^2T switch "in" and "out".

Power Centers, Switchboard Type

Pow-R-Gear Layout Arrangements – Indoor Equipment①

Main Breaker Sections②

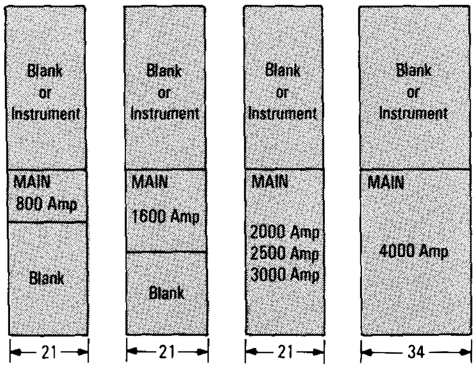


Figure 1 Figure 2 Figure 3 Figure 4

Feeder and Tie Breaker Sections③ ④ ⑤

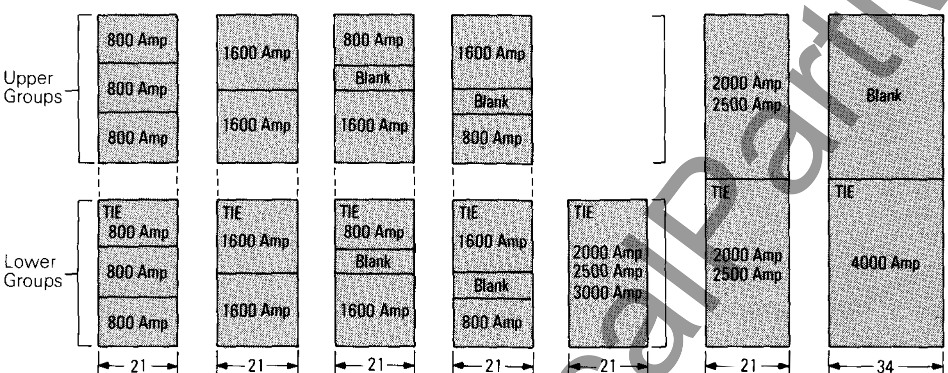
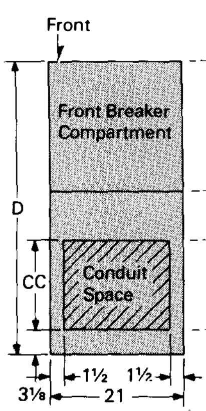


Figure 5 Figure 6 Figure 7

Type SPB Breakers
Weight in Lbs. (Approximate)

Breaker Frame	Drawout Element	Rackout Assembly	Total
800 Amp	110	85	195
1600 Amp	133	85	218
3000 Amp	207	85	292
4000 Amp	475	350	825

Floor Plan and Conduit Space Dimensions (Indoor Sections)

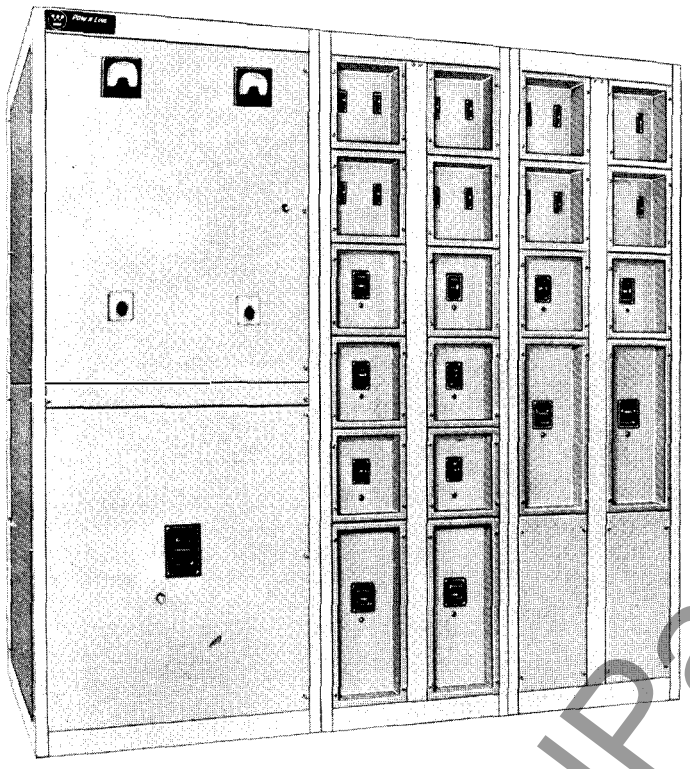


Breaker Frame Amps (Maximum)	Quantity and Mix of Frame Sizes in Each Vertical Section																						
	Vertical Sections				Vertical Sections				Vertical Sections					Vertical Sections									Vertical Section
800	3			1	4		2	1	5	3	1	2		6			4	3	1	3		1	
1600		1		1		2	1			1	2		1		3		1	2	3		2	1	4
3000			1					1				1	1			2				1	1	1	
⑥ Structure Depth "D"	54 ⑦				54 ⑦				60					66									72
⑥ Conduit Space Dim. "CC"	13½				13½				19½					25½									31½
Approx. Struct. Wt. Less Breakers	1125				1200				1275					1350									1450

① Maximum shipping group is 5 vertical sections including transition section. See page 32 for outdoor enclosures.
② The addition of feeder breakers to main sections in Figures 1, 2 or 3 requires special construction. Refer to Westinghouse.
③ Tie breakers must be located in positions marked TIE.
④ Feeder breakers when located in same vertical section as a Tie breaker are line connected to left hand bus section facing the front of the line-up.
⑤ In Figure 5, any lower grouping may be mixed with any upper grouping.
⑥ Dimensions are recommended only, based on average loading of feeder breakers. Actual loading may result in increased or decreased dimensions.
⑦ If transformer is ventilated dry type, minimum depth of secondary section is 60 inches.

Power Centers, Switchboard Type

Pow-R-Line® Switchboards



General
Pow-R-Line switchboards represent a family of designs and types each of which embodies the universal steel frame method of enclosure construction. This construction has a uniform and distinctive appearance throughout the product line due to the shape of the universal frame members used.

The flexibility of the Pow-R-Line design enables it to accommodate the various low voltage protective devices commonly used in power center secondary distribution, including non-fusible and fusible circuit breakers, fusible switches and combination motor starters.

Ratings
Pow-R-Line switchboards are built in accordance with all applicable provisions of U.L. 891 and NEMA PB-2 covering low voltage distribution switchboards.

120-600 volts Ac, 1 ph., or 3ph., 3 wire/4 wire 800-4000 Amps. continuous Ac. main bus ampacity.

50 kA thru 2000 kA Rms Sym. bus short circuit rating.

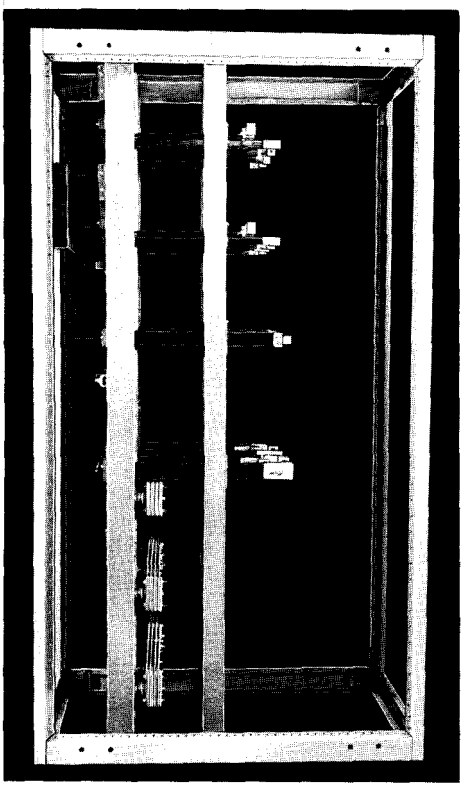
Type WRI
This type Pow-R-Line switchboard has its feeder or branch protective devices mounted individually in vertically arranged modules as shown in the photo at left. See page 14 for standard devices available.

Type WRP
This type of Pow-R-Line switchboard has all feeder and branch devices mounted in panelboard-type construction, taking advantage of the space saving compactness inherent in this design. The main section of the WRP is identical to that of the WRI, having the same availability of main devices and the same construction details. See page 13 for standard devices available.

Power Centers, Switchboard Type

Pow-R-Line® Switchboards, *Continued*

Standard Features



Three Section Construction
Extra safety to maintenance personnel is made possible in the Pow-R-Line type WRI design through a segregation of each vertical distribution section into compartments, thus establishing safe areas for maintenance.

The compartments consist of (a) a front compartment in which the various distribution devices are individually mounted; (b) an intermediate compartment housing the distribution bus bar system; and (c), a rear compartment specifically set apart for cable terminations.

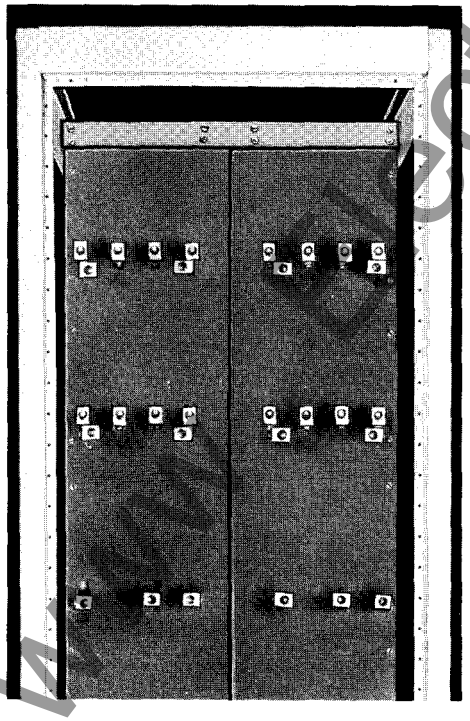
Compartmentalization
The three compartments, in addition to being separated from each other physically are fitted with vertical barriers made of glass polyester material to mutually isolate them. The barrier between the front and bus compartments is furnished as a standard feature. It prevents access to the bus system from the front of the switchboard. The barrier isolating the rear cable compartment from the bus compartment is a standard option which prevents access to the main bus system from the rear or the switchboard. When bus maintenance is required, these rear barriers being easily removable, provide the necessary access.

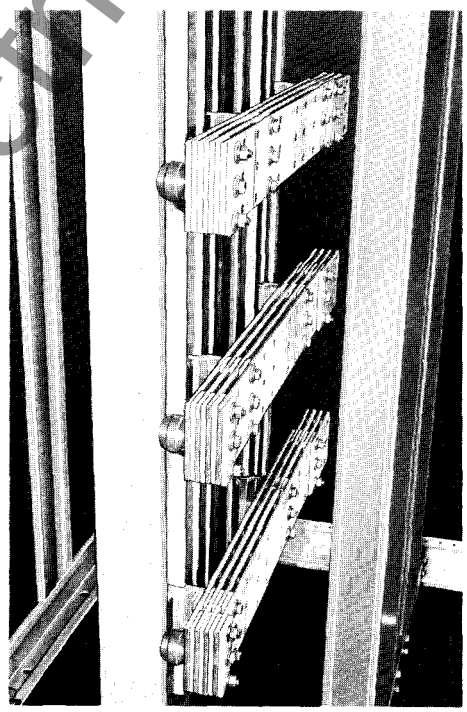
The load terminals of each front mounted device are extended by means of insulated bus bars through the bus compartment into the rear cable compartment. The likelihood of maintenance personnel coming into contact with live bus in the bus compartment while installing load cables is minimized by the use of these standard load extensions. The hazard is practically eliminated by the use of the optional barrier.

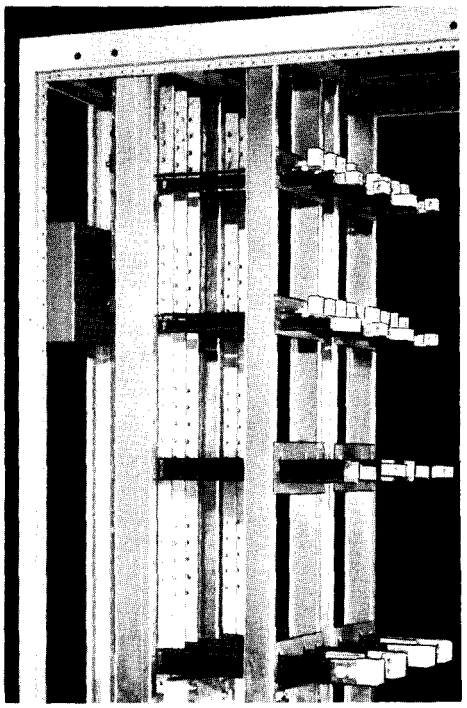
Main Bus Orientation
The Pow-R-Line main bus is constructed with the phase bars positioned one above the other in a vertical plane parallel to the switchboard front. This vertical edge-to-edge arrangement increases safety in several ways: it minimizes the destructive effect of short circuit forces on the main bus; it prevents accidental bridging of bus bars of opposite phase by falling metallic objects during maintenance; and it permits better natural ventilation for the bus assembly. This vertical arrangement produces a non-congested bus structure and frees up more space in the switch for roomier cable compartments.

Molded Case Breaker Modular Construction
The molded case breakers in Pow-R-Line Type WRI are close coupled, both physically and electrically, to the rigid vertical section bus bars in a choice or standard locations within each enclosure. The electrical connection between the breakers and the bus is so short as to virtually eliminate the possibility of developing breaker line side bus faults after assembly.

Each breaker unit, with its fixed mounting parts and connectors, constitutes a module in each frame size. These modules fit into the front compartment in locations compatible with their various sizes. The rear faces of all mounted breakers are in the same vertical plane.





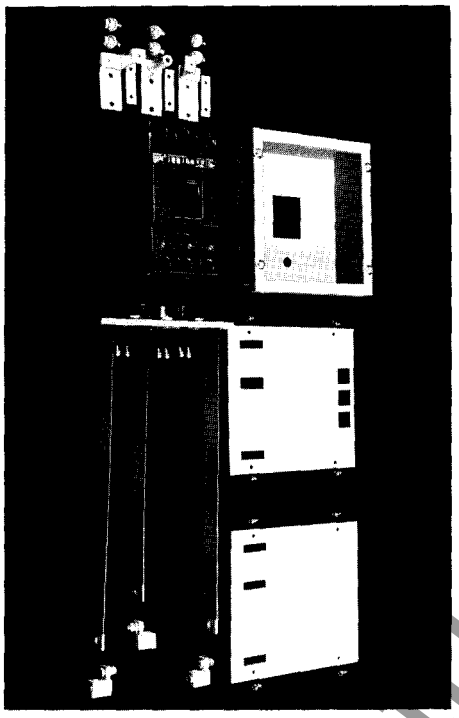


Power Centers, Switchboard Type

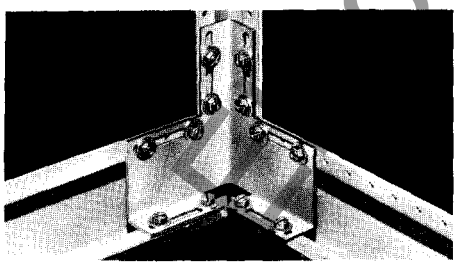
Pow-R-Line Switchboards, *Continued*

Individual Breaker Modules

The parts package illustrated in the photo below becomes the module when mounted and connected in the switchboard section. It consists of the breaker itself, front and rear insulating barriers, line connectors, load extensions and formed steel front cover. The standardization of this parts package for each frame size breaker simplifies field maintenance and modification. Modules can be supplied complete for installation in existing WRI switchboards where space is available.

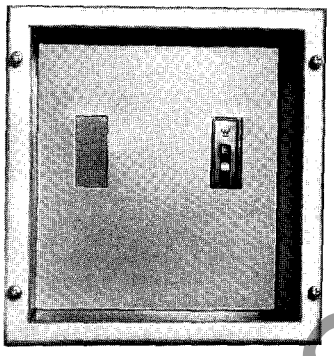


Built-in Structure Rigidity



Pow-R-Line frame access covers and breaker front covers are made of code gauge steel punched, die-formed and bolted together in an extra rigid assembly. The construction resists damage in shipment, installation and operation. Heavy steel reinforcing members are used in each of the eight corners of the frame contributing greatly to over-all rigidity. The bottom frame members, being of semi-box cross section, provide sufficient strength for rolling the switchboard into position during installation.

Standard molded case breaker modules are covered on the front by a steel picture frame

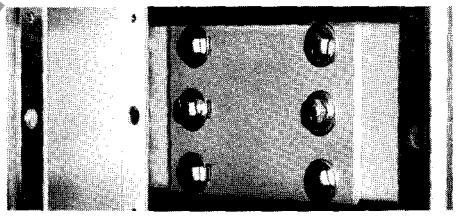


type cover having a recessed center. Breaker handles are protected from damage by being recessed in the cover. All device covers as well as access covers in Pow-R-Line switchboards are attached to the frame by means of selfthreading screws which are virtually shakeout proof.

Tin-Plated Aluminum Bus With Bolted Joints

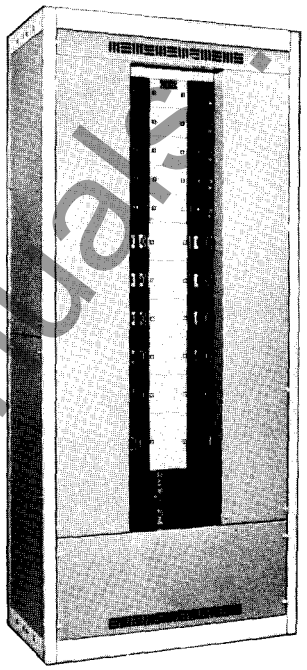
Standard bus work in Pow-R-Line switchboards is high strength tin plated aluminum with all-bolted joints. The bus system is assembled using zinc coated steel bolts properly torqued to product high intergrity joints requiring minimum maintenance.

Tin plated aluminum splice plates are furnished at each section to extend the main bus to the adjacent section. Sections can be removed from a switchboard line-up without having to dismantle the entire main bus assembly. Onsite alignment of shipping sections is also simplified.



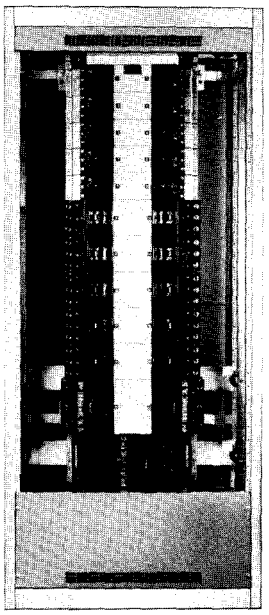
Panel Mounted Construction

Type WRP Pow-R-Line switchboards feature branch and feeder devices mounted in distribution panelboard fashion. This type of construction offers economy of total power center space when all distribution devices can be mounted in this manner such as quick-make, quick-break fusible switches, molded case breakers through 1200 amps, and fixed-mounted motor starter units. Enclosures are constructed using the same frame and cover designs as the Type WRI and they present the same modern family appearance. Panel mounted sections may be mixed in the same lineup with individually mounted sections with electrical and mechanical compatibility.



Distribution Section, Panel Mounted

A conventional distribution panel chassis is supplied having a vertical mounting space up to 66 inches for front accessible devices. Vertical sections contain extra wide wiring gutters to facilitate wiring to the horizontally mounted devices. The switchboard main bus is bolted to the chassis main bus without sacrificing device mounting space.

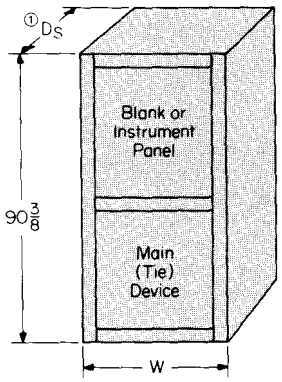


Distribution Section, Front Covers Removed

Power Centers, Switchboard Type

Pow-R-Line Layout Dimensions, Indoor

Main and Tie Sections – Type WRI/WRP

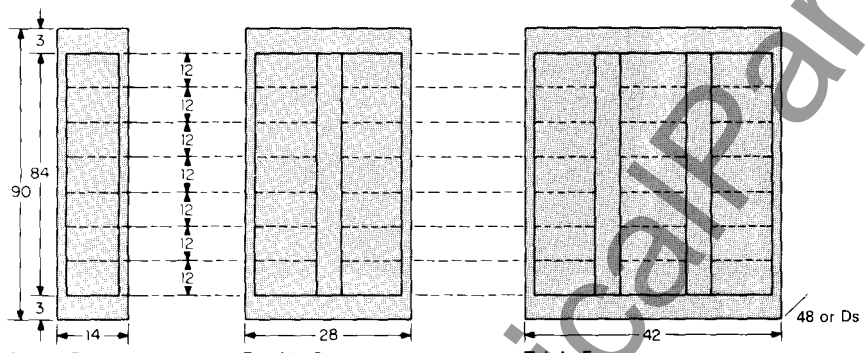


Minimum Width (W) and Depth (Ds) ① Dimensions

Type Mounting	Main or Tie Device	Maximum Frame Rating, Amperes															
		600		800		1200		1600		2000		2500		3000		4000	
		W	Ds	W	Ds	W	Ds	W	Ds	W	Ds	W	Ds	W	Ds	W	Ds
Fixed or Drawout	Systems Pow-R Breaker	..	..	30	48	..	..	34	48②	38	48③	38	48③	38	48③	34⑤	48②
	SCB-II Breaker	30	48	..	..	34	48	..	..	34	48	38	48	38	48	..	..
	DS Power Circuit Breaker	..	..	..	..	..	..	38	48②	38	48②	..	..	38	48③	50	54③
Fixed Only	Molded Case Breaker	30	48	30	48	34	48	34	48	34	48	38	48	38	48	..	..
	TRI-PAC® Breaker	..	..	30	48	..	..	34	48	..	..	..	..	..	..	..	..
	FDP Fused Switch	38	48	38	48	38	48	..	..	..	..	..	..	..	..	..	..
	Bolted PressureSwitch	..	..	38	48	38	48	38	48	38	48	42	48	54	48	54	48

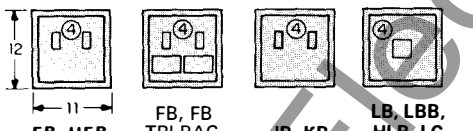
Feeder Sections, Type WRI

Fixed-Mounted Molded Case Breakers
1200 Amperes and Below, Modular Construction Structure Frame

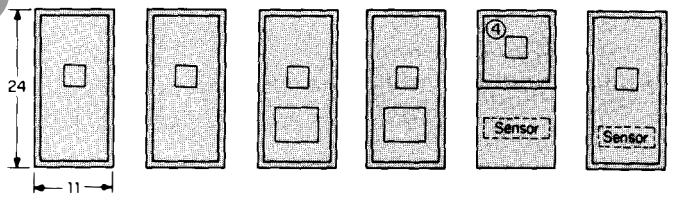


Molded Case Breaker Modules for Mounting in Single, Double or Triple Frame Sections, 1200 Amperes Maximum

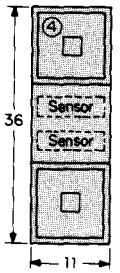
12 Inch Modules



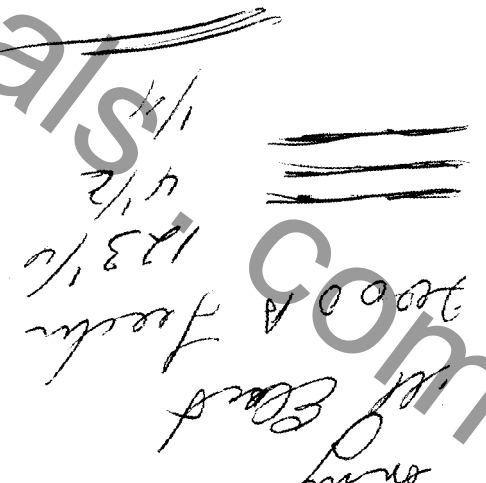
24 Inch Modules



36 Inch Modules



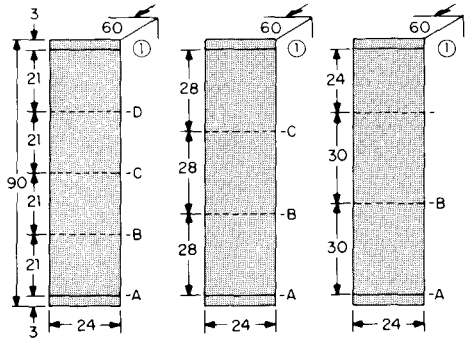
① Dimension D_S is as shown except that it will match either the adjacent distribution section or dry type transformer, whichever is deeper.
② Add six (6) inches for drawout mounting.
③ Add 12 inches for drawout mounting.
④ Cannot be mounted in topmost position in section. Ref. NEC 380-8 (a).
⑤ Drawout unit is 42 in. wide.



Power Centers, Switchboard Type

Pow-R-Line Switchboards, Feeder Sections, Type WRI, *Continued*

Molded Case and SCB-II Breakers Drawout Mounted



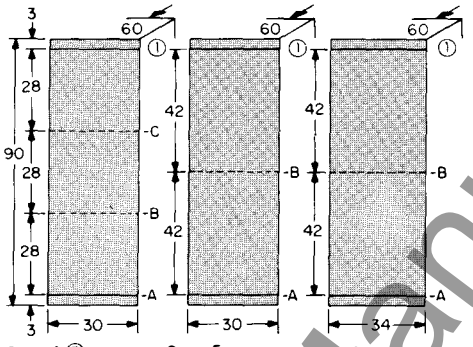
Group 1 ③
LA
SPCB-600

Group 2
MC
NC
SPCB-1200

Group 3
SPCB-2000
FFR-2000(PCC)
PCC-2000

Figure 1 ④

Bolted Pressure Contact Switches Fixed Mounted



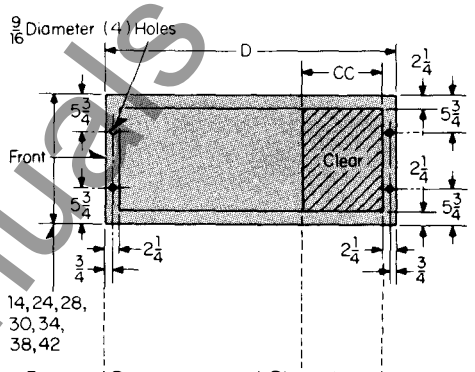
Group 4 ③
800 Amp Pringle
Type QA

Group 5
1200 Amp QA-CBC
1600 Amp QA-CBC
2000 Amp QA-CBC

Group 6
2500 Amp QA-CBC

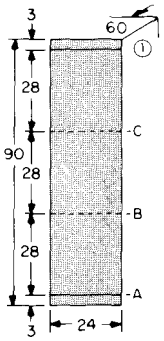
Figure 2 ④

Floor Plan – Feeder Sections



Type Section	Devices in Section	Dimensions D	Dimensions CC
WRI Sections	Molded Case Modular Units Thru 1200 A	48 54 60	13 19 25
	Molded Case Breakers, Fixed, Above 1200 A	60	19
	Molded Case Breakers, Draw-out, Above 1200 A	60	14
	SCB-II, Fixed Above 1200 A	60	19
	SCB-II, Draw-out, Above 1200 A	60	14
	Systems Pow-R Breaker, Fixed	60	14
	Bolted Pressure Switches	60	21
	FDP Switches	48	16
WRP Sections	CDP, FDP, Mac B, Mac F	36 48 54 60	18 30 36 42

Molded Case and SCB-II Circuit Breakers, Fixed Mounted, Above 1200 Amperes

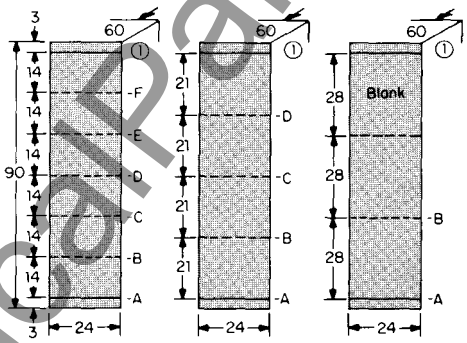


PC, PCC-1600
PC, PCC-2000
PC, PCC-2500 ②

SPCB-2000
SPCB-2500②
PB TRI-PAC 1600

Figure 3

System Pow-R-Breakers Fixed Mounted



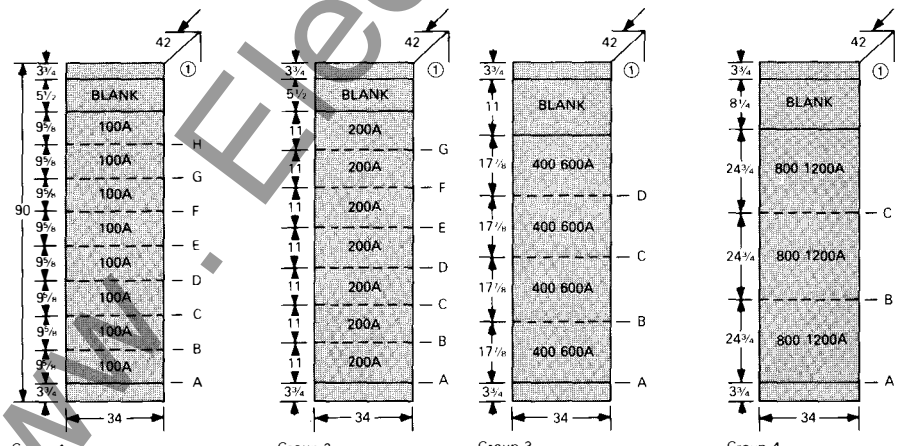
Group 10 ●
SPB-250Amp
SPB-800Amp

Group 11
SPB-1600Amp

Group 12
SPB-2000Amp
SPB-2500Amp ②
SPB-3000Amp ②

Figure 4 ④

FDP Fusible Switches, Fixed Mounted



Group 1
FDP 100 Amp

Group 2
FDP 200 Amp

Group 3
FDP 400 Amp
FDP 600 Amp

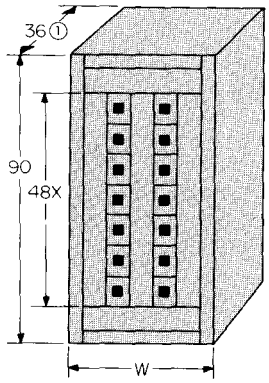
Group 4
FDP 800 Amp
FDP 1200 Amp

Figure 5 ④

① Depth is as shown unless main section or dry type transformer is deeper, then depth is increased to match main section or dry type transformer.
② One high only in each vertical section.
③ May not be mounted in topmost position of vertical section. Ref. NEC Article 380-8(a).
④ Devices from different groups of the same figure may be intermixed in a vertical section provided the fixed location of each frame size, as shown, is maintained.

Power Centers, Switchboard Type

Feeder Sections, Type WRP, Panel Mounted Devices – Indoor

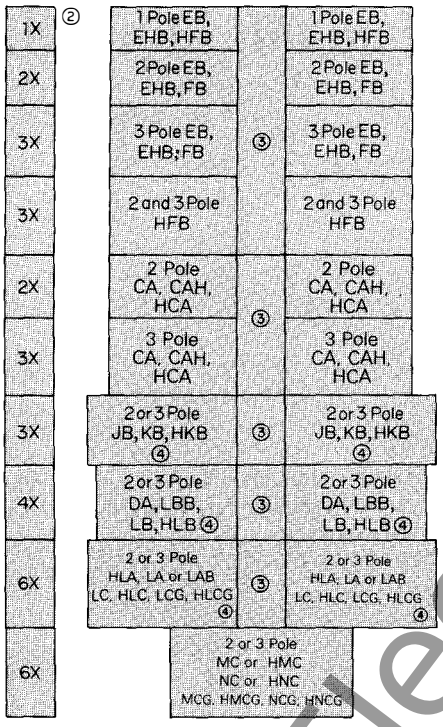


Width of Sections Containing Panel Mounted Devices

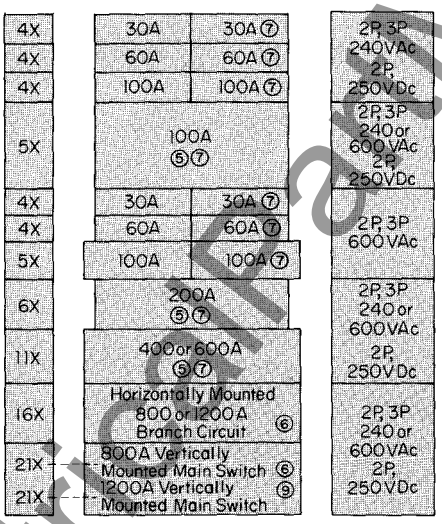
Panel Type	Largest Breaker or Switch Mounted in Panel	Dim. W Inches
CDP	EB thru MC	38
	NC, NB TRI-PAC	42
	LA TRI-PAC	48
FDP	All units 30-1200 amps except horizontally mounted 800 or 1200 amp units	38
	800A or 1200A horizontal mounted unit	42
Mac B Mac F	Any NEMA size 0-4	38

Layout Guides for Panel Mounted Devices, X Heights (1x = 1⅜ in.)

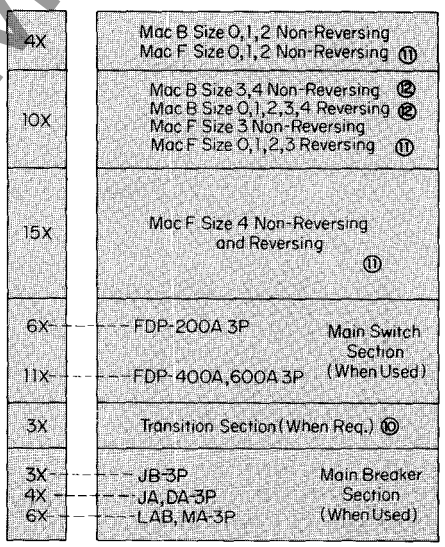
CDP Panel Layout Guide



FDP Panel Layout Guide ⑧



Mac Starter Units Layout Guide ⑬



① Depth is as shown unless main section or dry type transformer is deeper, then depth is increased to match.

② When only one EB, EHB or HFB single pole breaker is required in conjunction with other frame size breakers the single pole breaker space required changes from 1X to 2X.

③ Breakers of the same frame designation regardless of number of poles may be mounted opposite each other.

④ KB, HKB, LB, HLB, LA and HLA (interchangeable trip) breakers may not be used as main breakers.

⑤ May be used as main switches.

⑥ Available with provision for NEMA class "L" fuses only.

⑦ Fuse clips in these units may be provided which reject standard NEC fuses, but which will accept Class R fuses.

⑧ For FDP Switches 30 through 600 ampere with provision for "J" Type Fuses – use 600 volt dimensions for both 240 and 600 volts.

⑨ 800 and 1200 ampere vertical main switches may be mounted at bottom or top.

⑩ Mac B starter units may be mixed on same chassis with AB breakers by allowing a 3X space between starter units and breakers. No transition space is required between Mac F and FDP units.

⑪ All starters unit doors are provided with 4 knockouts for control pushbuttons and indicating lights.

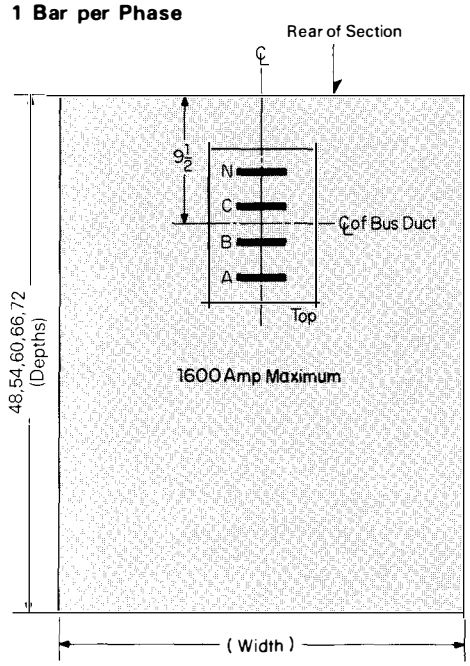
⑫ 10X size 4 units are for motors with 10 second starting time maximum. If longer starting time, use 15X size enclosure.

⑬ For starter types not shown, refer to Westinghouse.

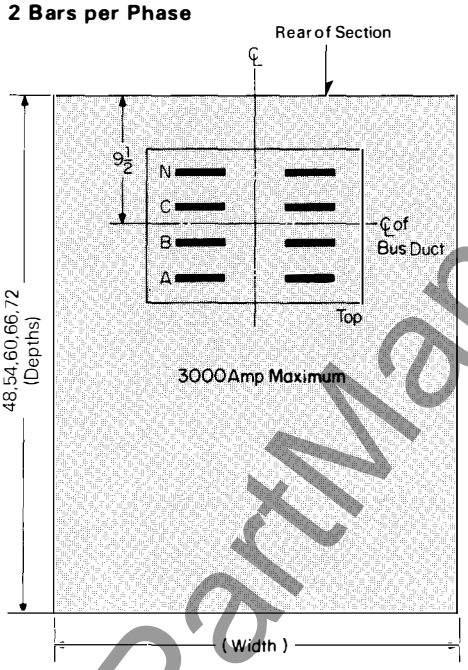
Power Centers, Switchboard Type

Pow-R-Way™ Busway Connection to Indoor Secondary Switchboards, Top Only ①

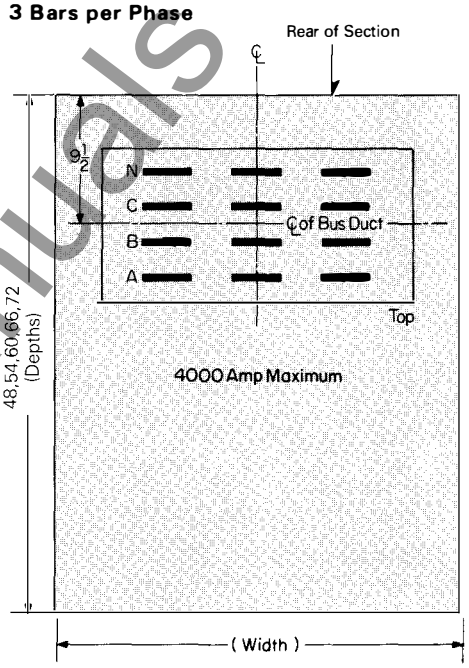
1 Bar per Phase

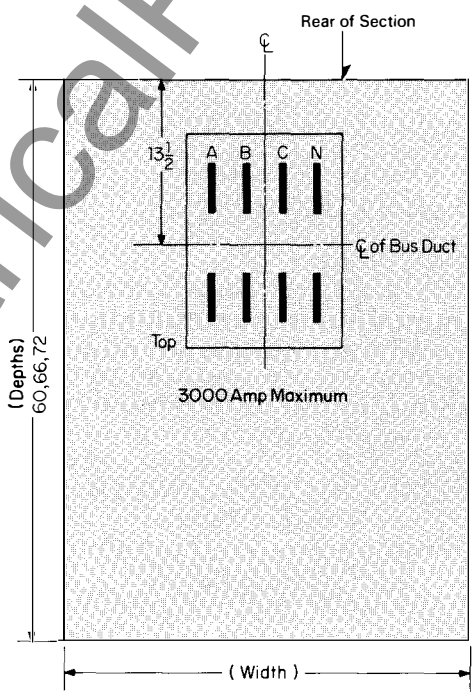


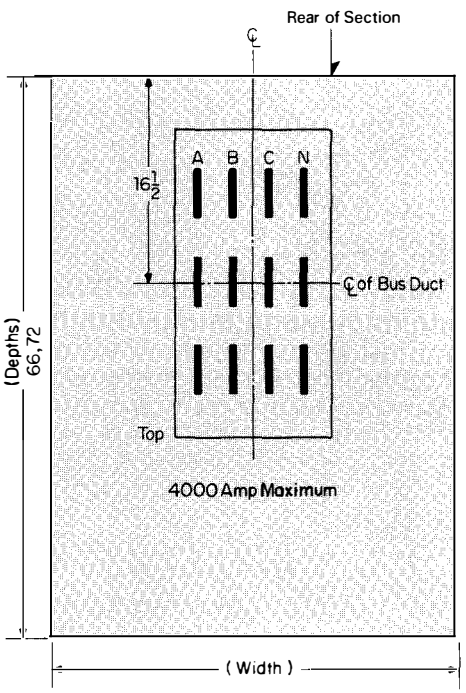
2 Bars per Phase



3 Bars per Phase







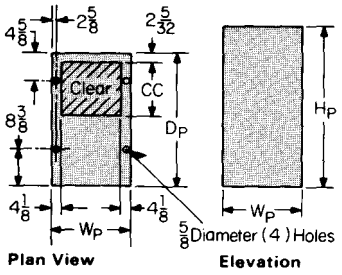
① Width and depth dimensions shown are those resulting from a complete and proper layout of the particular secondary switchboard using the appropriate layout information in this bulletin.

Power Centers, Switchboard Type

4. Physical Application Data

Dimensions and Weights Accurate for Estimating Purposes Only. Pages 26-34.

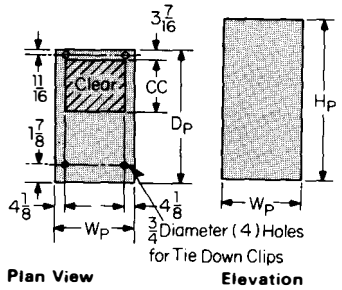
Indoor Unit



Primary Switching Equipment – Type WLI Switchgear – Indoor

Switch Arrangement	Ratings		Dimensions, Inches			
	Volt Class	Fault Close Asym.	Wp	Dp	Hp	CC
Two Position	5 Kv	Thru 61 Ka	33	55¼	90¾	22
	15 Kv	Thru 40 Ka	33	55¼	90¾	22
	15 Kv	61 Ka	36	55¼	90¾	22
	23 Kv	Thru 60 Ka	48	69	127	12¾
	34 Kv	Thru 30 Ka	48	69	127	12¾
Duplex (Two switches)	5 Kv	Thru 61 Ka	66	55¼	90¾	22
	15 Kv	Thru 40 Ka	66	55¼	90¾	22
	15 Kv	61 Ka	72	55¼	90¾	22
	23 Kv	Thru 60 Ka	96	69	127	12¾
	34 Kv	Thru 30 Ka	96	69	127	12¾
Three Position (Selector)	5 Kv	Thru 61 Ka	33	60	90¾	27
	15 Kv	Thru 40 Ka	33	62	90¾	29
	15 Kv	61 Ka	36	62	90¾	29

Outdoor Unit



Primary Switching Equipment – Type WLI Switchgear, Outdoor

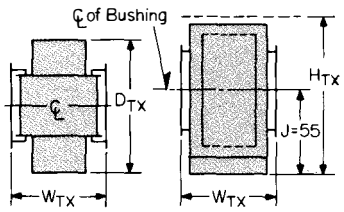
Switch Arrangement	Ratings		Non-Walk-in Encl.				Walk-in Encl.			
	Volt Class	Fault Close Asym.	Dimensions, Inches Wp	Dp	Hp	CC	Dimensions, Inches Wp	Dp	Hp	CC
Two Position	5 Kv	Thru 61 Ka	33	55¼	98¾	21	33	91¼	98¾	21
	15 Kv	Thru 40 Ka	33	55¼	98¾	21	33	91¼	98¾	21
	15 Kv	61 Ka	36	55¼	98¾	21	36	91¼	98¾	21
	23 Kv	Thru 60 Ka	48	69	135½	20	..	..	..	..
	34 Kv	Thru 30 Ka	48	69	135½	20	..	..	..	..
Duplex (Two switches)	5 Kv	Thru 61 Ka	66	55¼	98¾	21	66	91¼	98¾	21
	15 Kv	Thru 40 Ka	66	55¼	98¾	21	66	91¼	98¾	21
	15 Kv	61 Ka	72	55¼	98¾	21	72	91¼	98¾	21
	23 Kv	Thru 60 Ka	96	69	135½	20	..	..	..	..
	34 Kv	Thru 30 Ka	96	69	135½	20	..	..	..	..
Three Position (Selector)	5 Kv	Thru 61 Ka	33	60	98¾	26	33	96	98¾	26
	15 Kv	Thru 40 Ka	33	62	98¾	28	33	98	98¾	28
	15 Kv	61 Ka	36	62	98¾	28	36	98	98¾	28

Power Centers, Switchboard Type

Physical Application Data, *Continued*

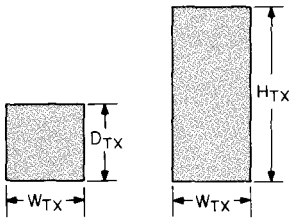
Power Transformer Equipment

Fluid Filled



Plan View Elevation

Ventilated Dry Type



Plan View Elevation

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_{TX}	65°C Rise W_{TX}	65°C Rise D_{TX}	65°C Rise Weight	55°C Rise H_{TX}	55°C Rise W_{TX}	55°C Rise D_{TX}	55°C Rise 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 Type①

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

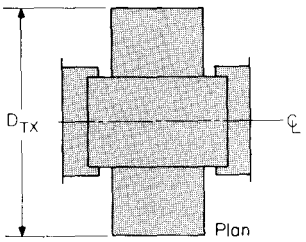
KVA	HV	HV-BIL	%Z	H_{TX}	W_{TX}	D_{TX}	Weight
150°C Rise							
300	5	30	4.50	90	60	54	2870
	15	60	4.50	90	60	54	3200
		95	5.75	90	60	54	3190
500	5	30	5.75	90	60	54	3250
	15	60	5.75	90	60	54	3580
		95	5.75	90	70	60	4080
750	5	30	5.75	90	60	54	3930
	15	60	5.75	90	70	60	4720
		95	5.75	90	70	60	4920
1000	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

① For outdoor applications, refer to Westinghouse.

Power Centers, Switchboard Type

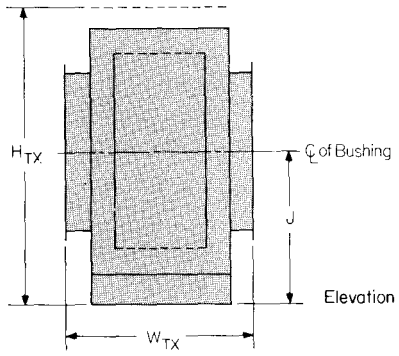
Physical Application Data, *Continued*

Fluid Filled, HV — 34.5 KV, Indoor and Outdoor



KVA Self-cooled (OA)	65°C Rise, 80°C Hot Spot						55°C Rise, 65°C Hot Spot					
	Dimensions				Weight, Lbs.		Dimensions				Weight, Lbs.	
	Htx	Wtx	Dtx	J	Wemco Oil	Silicone	Htx	Wtx	Dtx	J	Wemco Oil	Silicone
750	77	65	80	55	9,500	Same	77	65	86	55	10,200	Same
1000	84	73	86	55	10,400	as	84	73	92	55	11,500	as
1500	91	81	88	55	13,100	Wemco	91	81	94	55	14,100	Wemco
2000	96	87	97	57	14,850		96	87	103	57	16,000	
2500	102	91	110	59	16,600		102	91	116	59	18,000	
3750	108	98	126	64	19,500		108	98	132	64	21,000	

Note: Dimensions and weights in above table are for estimating purposes only. Refer to Westinghouse for actual data based on specific and detailed requirements.

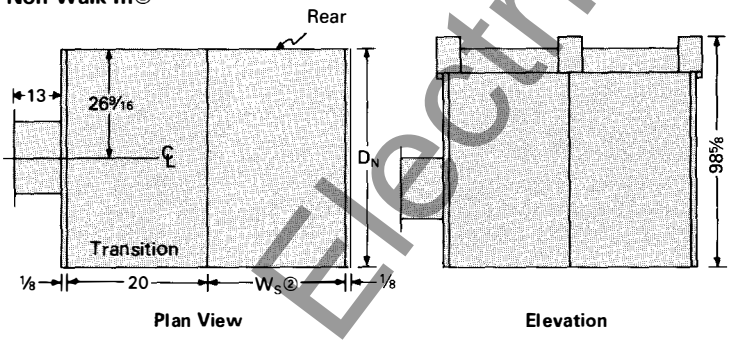


Secondary Equipment Enclosures — Outdoor

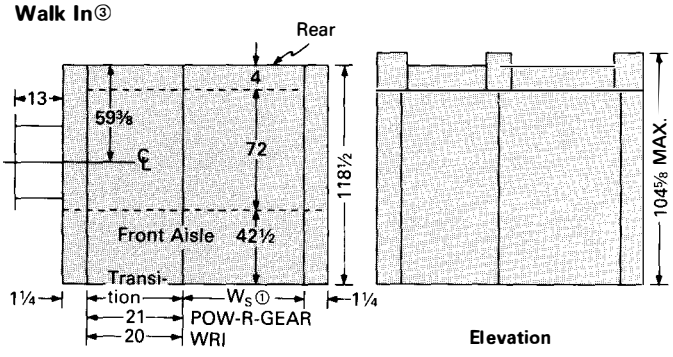
Applications

Switchboard Type	Non-Walk In	Walk In
WRI (Drawout)	No	Yes
WRI (Fixed)	Yes	No
WRP	Yes	No
Pow-R-Gear	No	Yes

Non-Walk In②



Walk In③



Dimensions, Inches

W_S	Same as Indoor Section				
Depth of Indoor Section	48	54	60	66	72
D_N	66⅝	72⅝	78⅝	84⅝	90⅝

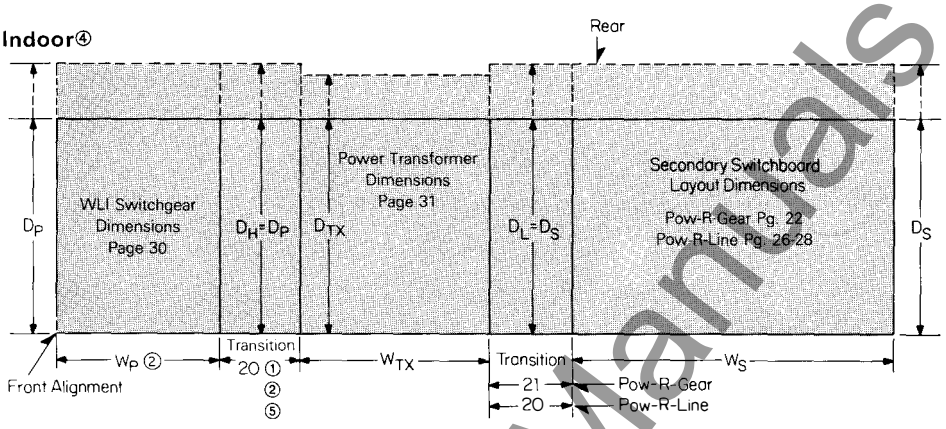
① W_S = width of indoor section.
② Non-walk in enclosures equipped with hinged, full height doors on front and rear of section.
③ Walk in enclosures equipped with hinged, full height front doors on each section and bolted-closed, full height, hinged covers on rear of each section.

Power Centers, Switchboard Type

Physical Application Data, *Continued*

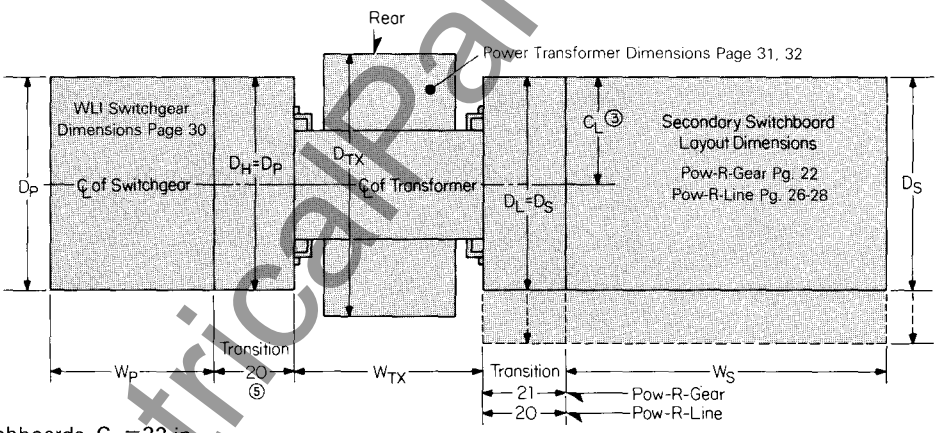
Composite Floor Plans

Ventilated Dry Type, Indoor④



Coordinating Notes
① No physical transition when switch is connected to transformer by cable (15 kV max.).
② In lieu of H.V. switch, a cable entrance compartment 15 inches wide may be furnished. Its height and depth match those of the transformer.

Fluid Filled, Indoor④



Coordinating Notes
③ For Pow-R-Line Switchboards, $C_L = 22$ in.

For Pow-R-Gear Switchboard, $C_L = \frac{D_S}{2}$

④ All lineups are shown L.V. right. L.V. left are opposite hand. For double-ended types, dimensions for other end are equal and opposite.

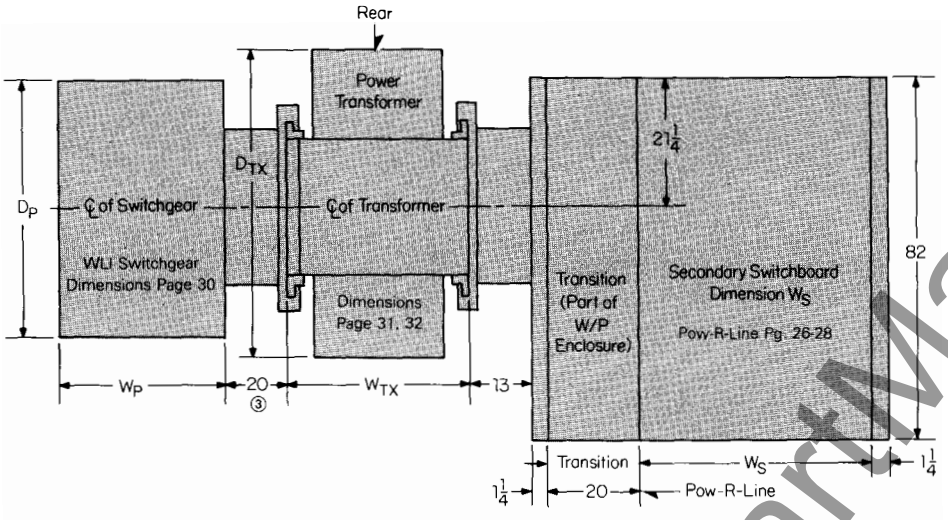
⑤ For 23 kV and 34.5 kV primary voltages, this dimension is 30 inches.

Power Centers, Switchboard Type

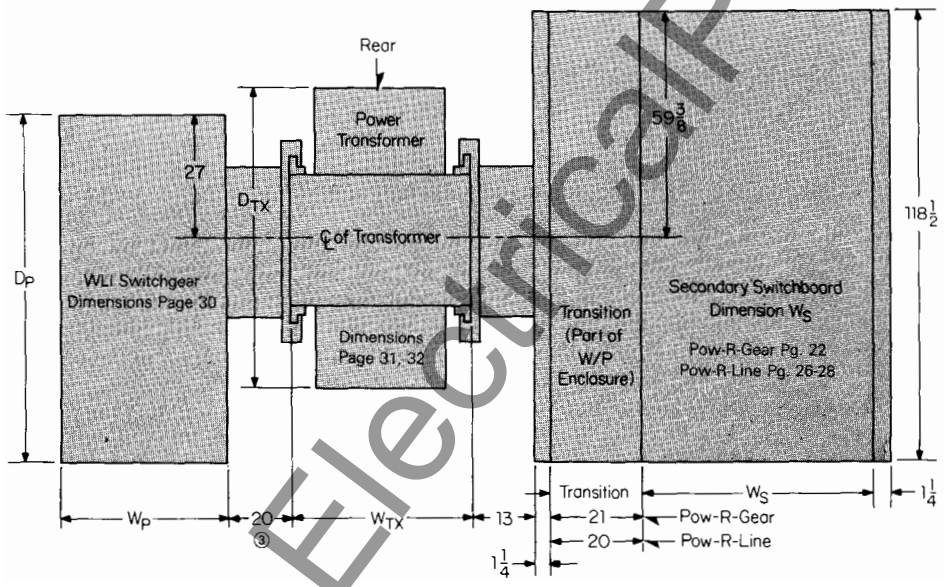
Physical Application Data, *Continued*

Composite Floor Plans

Fluid Filled, Outdoor Non-Walk-in Enclosure① ④



Fluid Filled, Outdoor Walk-in Enclosure①



Note: Walk-in secondary can be combined with non-walk-in primary switch, using the appropriate coordinating dimensions above.

Air Filled Terminal Chamber, Indoor or Outdoor, in Lieu of Primary Switch and Transition-Fluid-Filled Transformer

Max. Primary Voltage	Dimensions, Inches H	W	D
15 KV	65¼②	16½	35
34.5 KV	87	36	42

① All line-ups are L.V. right. L.V. left are opposite hand. For double-ended line-ups, dimensions for other end are equal and opposite.
② For cable entrance in top, H = 87 inches.
③ For 23 kV and 34.5 kV primary voltage, this dimension is 30 inches.
④ Non Walk-in outdoor enclosures not available for drawout secondary switchboards.

5. Electrical Application Data

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 △ also available.

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

Table 1: Standard Insulation Levels—Kv BIL

High Voltage Rating	Liquid Filled Transformer HV	LV (600 Max.)	Vent. Dry Transformer HV	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

Table 2: Standard Guaranteed Sound Levels—Decibels

Max. Base Kva (Self Cooled)	Liquid Filled Transformer OA	FA	Vent. Dry Transformer AA	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

Table 3: Impedances (±7½% Tolerance):

Kva	Vent-Dry Transformer	Fluid Filled Transformer
300	4.5%①	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.

Table 4: Transformer Kva Ratings, 3 Phase
In addition to their basic self-cooled (AA or OA, 100%) Kva ratings, modern Westinghouse standard Secondary Unit Substation Transformers of the liquid filled and ventilated dry types 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		
AA	FA	AA 115°	AA 150°	FA 150°
300	400	300	345	460
500	667	500	575	767
750	1000	750	863	1151
1000	1333	1000	1150	1533
1500	2000	1500	1725	2300
2000	2667	2000	2300	3067
2500	3333	2500	2875	3833

80/115°C Rise			80/150°C Rise		
AA 80°	AA 115°	FA 115°	AA 80°	AA 150°	FA 150°
300	354	472	300	405	540
500	590	787	500	675	900
750	885	1180	750	1013	1351
1000	1180	1573	1000	1350	1800
1500	1770	2360	1500	2025	2700
2000	2360	3147	2000	2700	3600
2500	2950	3933	2500	3375	4500

Power Centers, Switchboard Type

Electrical Application Data, *Continued*

Table 5: 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

Power Centers, Switchboard Type

Electrical Application Data, *Continued*

Table 6: Transformer Primary Fuse Application①

System Circuit Volts	Fuse Data Identification			Interrupting Rating		Max. Transf. Kva Ratings②	
	Type	Kv (Max.)	Maximum Amperes	Amperes Symm.	Equiv. 3 Ph. Mva	Self Cooled	Forced Air.
2400	CLE-1	2.8	225X	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	225X	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	1030
	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	2775
	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	2880
	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	3050
	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	3190
	RBA-200	15.5	200E	14,400	330	3415	3985
	RBA-400	15.5	400E	29,400③	670	6830	7970
23,000	RBA-200		200E	10,500	415	5690	6635
	RBA-400	25.8	300E	21,000	830	8535	9950
34,500	RBA-200		200E	6,900	410	8535	9950
	RBA-400	38.0	300E	16,800	1000	12800	14925

		For Self Cooled Transformers	For Forced Air Transformers
Type CLE-1, CLE-2 and CLE-3 Fuses:	Through 7.2 Kv Fuse Rating—	1.4	1.2
	14.4 Kv Fuse Rating—	1.49	1.31
Type RBA Expulsion Type Non-Current Limiting Fuses, all Ratings	—	1.4	1.2
CXN Current Limiting Fuses, All Ratings	—	1.4	1.2

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.

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

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.

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 above. For a 55°C Rise Liquid Filled Transformer, use the Kva Rating for 65°C rise (55°C rating x 1.12). For suggested minimum fuse applications, see Tables, page 38.

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, Switchboard Type

Electrical Application Data, *Continued*

Table 7: Suggested Minimum Current Limiting Fuse Current Ratings For Self-Cooled 2.4-15.5 KV Power Transformer Applications

System Nom. Kv	2.4		4.16		4.8		7.2		12.0		13.2		13.8		14.4	
Fuse Max. Kv	2.75		5.5		5.5		8.3		15.5		15.5		15.5		15.5	
Transformer KVA Rating Self-Cooled	Full Load Current Amps	Fuse① Rating Amps E or C	Full Load Current Amps	Fuse① Rating Amps E or C	Full Load Current Amps	Fuse① Rating Amps E or C	Full Load Current Amps	Fuse① Rating Amps E or C	Full Load Current Amps	Fuse① Rating Amps E or C	Full Load Current Amps	Fuse① Rating Amps E or C	Full Load Current Amps	Fuse① Rating Amps E or C	Full Load Current Amps	Fuse① Rating Amps E or C
Three Phase Transformers																
112.5	27	40	15.6	25	13.6	20	9	15	5.4	8	5.0	8	4.7	8	4.5	8
150	36	50	20.8	30	18	25	12	18	7.2	10	6.6	10	6.2	10	6	10
225	54	75	31.3	45	27.2	40	18	25	10.8	15	9.9	15	9.4	15	9	15
300	72	100	41.6	60	36	50	24	35	14.4	25	13.1	20	12.5	18	12	18
500	120	200	69.4	100	60	100	40	60	24.1	40	21.9	30	21	30	20	30
750	180	250	104	150	90	125	60	100	36.1	60	32.8	45	31	45	30.1	45
1000	241	350X	140	200	120	200	80	125	48.1	75	43.7	65	42	60	40.1	60
1500	360	600	208	300	180	250	120	200	72.2	100	65.6	100	62	100	60.1	100
2000	481	750	278	400X	241	350X	160	250	96.2	150	87.5	150	84	125X	80.2	125X
2500	600	. . .	346	600	301	450X	200	. . .	120	200X	109	175	104	175	100	150

Table 8: Suggested Minimum Expulsion Fuse Current Ratings for Self-Cooled 2.4 to 15.5 Kv Power Transformer Applications

System Nom. KV	2.4		4.16		4.8		7.2		12.0		13.2		13.8		14.4	
Fuse Max. KV	8.3		8.3		8.3		8.3		15.5		15.5		15.5		15.5	
Transformer Kva Rating Self-Cooled	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating
Three Phase Transformers																
112.5	27	40E	15.6	25E	13.6	20E	9	15E	5.4	10E	4.95	7E	4.7	7E	4.51	7E
150	36	50E	20.8	30E	18.0	25E	12	20E	7.2	10E	6.56	10E	6.2	10E	6.01	10E
225	54	80E	31.3	50E	27.2	40E	18	25E	10.8	15E	9.9	15E	9.4	15E	9.02	15E
300	72	100E	41.6	65E	36.0	50E	24	40E	14.4	20E	13.1	20E	12.5	20E	12.0	20E
500	120	200E	69.4	100E	60	100E	40	65E	24.1	40E	21.9	30E	21.0	30E	20.1	30E
750	180	250E	104	150E	90	125E	60	100E	36.1	50E	32.8	50E	31	50E	30.1	50E
1000	241	400E	140	200E	120	200E	80	125E	48.1	80E	43.7	65E	42	65E	40.1	65E
1500	360	540E②	208	300E	180	250E	120	200E	72.0	100E	65.6	100E	62	100E	60.1	65E
2000	481	720E③	278	400E	241	400E	160	250E	96.2	150E	87.5	125E	84	125E	80.2	125E
2500	600	....	346	540E②	301	450E④	200	300E	120.0	200E	109	150E	104	150E	100	150E
3750	....	....	....	....	....	....	....	....	180.0	250E	165	250E	156	250E	150	250E

Table 9: Suggested Minimum Expulsion Fuse Current Ratings for Self-Cooled 25.8 to 38.0 Kv Power Transformer Applications

System Nom. KV	22.9		23.9		24.9		34.5	
Fuse Max. KV	25.8		25.8		25.8		38.0	
Transformer Kva Rating Self-Cooled	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating
Three Phase Transformers								
750	18.9	30 E	18.1	25 E	17.4	25 E	12.6	20 E
1000	25.3	40 E	24.2	40 E	23.1	40 E	16.7	25 E
1500	37.9	65 E	36.2	50 E	34.7	50 E	25.1	40 E
2000	50.5	80 E	48.3	80 E	46.3	65 E	33.5	50 E
2500	63.1	100 E	60.4	100 E	57.9	80 E	41.8	65 E
3750	94.7	150 E	90.6	150 E	86.8	125 E	62.8	100 E

① Fuse ratings are for smallest fuse possible. Choose next largest rating if given rating is not available in selected fuse line. Be sure to check for 1.49:1 ratio for 15.5 kV CLE-1, CLE-2, CLE-3, and CXN.

② Two (2) 300 E Ampere fuse refills used in parallel with 10% derating factor.

③ Two (2) 400 E Ampere fuse refills used in parallel with 10% derating factor.

④ Two (2) 250 E Ampere fuse refills used in parallel with 10% derating factor.

Power Centers, Switchboard Type

Electrical Application Data, *Continued*

Table 10: Secondary Short Circuit Capacity of Typical Power Transformers

Transformer Rating 3 Phase Kva and Impedance Percent	Maximum Short Circuit Kva Available from Primary System	208 Volts, 3 Phase				240 Volts, 3 Phase				480 Volts, 3 Phase				600 Volts, 3 Phase			
		Rated Load Continuous Current, Amps.	Short-Circuit Current RMS Symmetrical Amps. Transformer Alone ②	50% Motor Load ①	Combined	Rated Load Continuous Current, Amps.	Short-Circuit Current RMS Symmetrical Amps. Transformer Alone ②	100% Motor Load ①	Combined	Rated Load Continuous Current, Amps.	Short-Circuit Current RMS Symmetrical Amps. Transformer Alone ②	100% Motor Load ①	Combined	Rated Load Continuous Current, Amps.	Short-Circuit Current RMS Symmetrical Amps. Transformer Alone ②	100% Motor Load ①	Combined
300 5%	50000	834	14900	1700	16600	722	12900	2900	15800	361	6400	1400	7800	289	5200	1200	6400
	100000		15700		17400		13600		16500		6800		8200		5500		6700
	150000		16000		17700		13900		16800		6900		8300		5600		6800
	250000		16300		18000		14100		17000		7000		8400		5600		6800
	500000		16500		18200		14300		17200		7100		8500		5700		6900
	Unlimited		16700		18400		14400		17300		7200		8600		5800		7000
500 5%	50000	1388	21300	2800	25900	1203	20000	4800	24800	601	10000	2400	12400	481	8000	1900	9900
	100000		25200		28000		21900		26700		10900		13300		8700		10600
	150000		26000		28800		22500		27300		11300		13700		9000		10900
	250000		26700		29500		23100		27900		11600		14000		9300		11200
	500000		27200		30000		23600		28400		11800		14200		9400		11300
	Unlimited		27800		30600		24100		28900		12000		14400		9600		11500
750 5.75%	50000	2080	28700	4200	32900	1804	24900	7200	32100	902	12400	3600	16000	722	10000	2900	12900
	100000		32000		36200		27800		35000		13900		17500		11100		14000
	150000		33300		37500		28900		36100		14400		18000		11600		14500
	250000		34400		38600		29800		37000		14900		18500		11900		14800
	500000		35200		39400		30600		37800		15300		18900		12200		15100
	Unlimited		36200		40400		31400		38600		15700		19300		12600		15500
1000 5.75%	50000	2780	35900	5600	41500	2406	31000	9600	40600	1203	15500	4800	20300	962	12400	3900	16300
	100000		41200		46800		35600		45200		17800		22600		14300		18200
	150000		43300		48900		37500		47100		18700		23500		15000		18900
	250000		45200		50800		39100		48700		19600		24400		15600		19500
	500000		46700		52300		40400		50000		20200		25000		16200		20100
	Unlimited		48300		53900		41800		51400		20900		25700		16700		20600
1500 5.75%	50000					3609	41200	14400	55600	1804	20600	7200	27800	1444	16500	5800	22300
	100000						49800		64200		24900		32100		20000		25800
	150000						53500		57900		26700		33900		21400		27200
	250000						56800		71200		28400		35600		22700		28500
	500000						59600		74000		29800		37000		23900		29700
	Unlimited						62800		77200		31400		38600		25100		30900
2000 5.75%	50000									2406	24700	9600	34300	1924	19700	7800	27500
	100000										31000		40600		24800		32600
	150000										34000		43600		27200		35000
	250000										36700		46300		29400		37200
	500000										39100		48700		31300		39100
	Unlimited										41800		51400		33500		41300
2500 5.75%	50000									3008	28000	12000	40000	2405	22400	9600	32000
	100000										36500		48500		29200		38800
	150000										40500		52500		32400		42000
	250000										44600		56600		35600		45200
	500000										48100		60100		38500		48100
	Unlimited										52300		64300		41800		51400

① The motor's short circuit current contributions are computed on the basis of motor characteristics that will give four times normal current. For 208 volts, 50% motor load is assumed while for other voltages 100% motor load is assumed. For other percentages, the motor short circuit current will be in direct proportion.

②Short circuit capacity values shown correspond to KVA and impedances shown in this table. For impedances other than these, short circuit currents are inversely proportional to impedance.

Power Centers, Switchboard Type

Electrical Application Data, *Continued*

Table 11: Type WLI Primary Switch, Standard Ratings

Max. KV	Nom. KV	Impulse Withstand KV	Amperes Continuous	Interrupting	Momentary (Switch closed) Asym. (10 cy.)	Fault closed Asym.
5.0	4.8	60	600	600	40,000	20,000
			600	600	40,000	40,000
			1200	600	80,000	61,000
			1200	1200	80,000	61,000
15.0	13.8	95	600	600	40,000	20,000
			600	600	40,000	40,000
			1200	600	80,000	40,000
			1200	1200	80,000	40,000
			1200	1200	80,000	40,000
			1200	1200	80,000	61,000
25.8	23	125 or 150	600	600	40,000	20,000
			600	600	40,000	40,000
			1200	600	40,000	40,000
			1200	600	60,000	60,000
38.0	34.5	150	600	600	40,000	20,000
			600	600	40,000	30,000
			1200	600	40,000	30,000
			1200	600	60,000	30,000

Table 12: Primary Fuses, Standard Ratings①

Type Fuse	Nom. KV	Max. Aps	Interr. Rating RMS Amsp (Sym)
RBA-200	4.8	200E	19,000
RBA-400		400E	37,500
RBA-800		720E	37,500
CLE-1		225X	50,000
CLE-2		450X	50,000
CLE-750		750E	40,000
CXN		250C	50,000
RBA-200	7.2	200E	16,600
RBA-400		400E	29,400
RBA-800		720E	29,400
CLE-1		125E	50,000
CLE-2		200E	40,000
CXN		250C	50,000
RBA-200	14.4	200E	14,400
RBA-400		400E	29,400
RBA-800		720E	29,400
CLE-1		65E	85,000
CLE-2		125X	85,000
CLE-3		200X	50,000
CXN		100C	50,000
RBA-200	23.0	200E	10,500
RBA-400		300E	21,000
RBA-800		540E	21,000
RBA-200	34.5	200E	6,900
RBA-400		300E	16,800
RBA-800		540E	16,800

Table 13: Molded Case Circuit Breakers, Standard Interrupting Ratings

Breaker Type	Trip Type	Available Ampere Ratings	Interrupting Rating② Amperes, Symmetrical Ac 240 Volts	480 Volts	600 Volts	DC 250V⑧
Conventional Breakers						
EB	NIT	15-100	10000⑥	.....	.....	5000⑤
EHB	NIT	15-100	18000●	14000	.....	10000⑥●
FB	NIT	15-150	18000	14000	14000	10000⑤
JB	NIT	70-250	25000	22000	14000	10000
KB	IT	70-250	25000	22000	14000	10000
CA	NIT	125-225	10000	.....	.....	.....
CAH	NIT	125-225	22000	.....	.....	.....
HCA	NIT	125-225	42000	.....	.....	.....
LBB	NIT	125-400	42000	30000	22000	10000
LB	IT	70-400	42000	30000	22000	10000
DA	NIT	250-400	22000	.....	.....	10000
LC⑩	IT	300-600	42000	30000	22000	.....
MC⑩	IT	400-800	42000	30000	22000	.....
NC⑩	IT	800-1200	42000	30000	22000	.....
PC2000⑩	IT	1000-2000	125000	100000	100000	.....
PC2500⑩	IT	1400-2500	125000	100000	100000	.....
PC3000⑩	IT	1600-3000	125000	100000	100000	.....
PCC2000●⑪	IT	1000-2000	125000	100000	100000	.....
PCC2500⑩⑪	IT	1400-2500	125000	100000	100000	.....
PCC3000⑩⑪	IT	1600-3000	125000	100000	100000	.....
Mark 75® Breakers						
HFB	NIT	15-150	65000④	25000	18000	10000⑧
HKB	IT	70-250	65000	25000	18000	10000
HLB	IT	125-400	65000	35000	25000	10000
HLC⑩	IT	300-600	65000	35000	25000	.....
HMC⑩	IT	400-800	65000	50000	25000	.....
HNC⑩	IT	800-1200	65000	50000	25000	.....
TRI-PAC® Breakers						
FB-P	IT	15-100	200000	200000	200000	.....
LA-P	IT	70-400	200000	200000	200000	.....
NB-P	IT	300-800	200000	200000	200000	.....
PB-P	IT	600-1600	200000	200000	200000	.....
Current Limiting Breakers						
FCL	NIT	15-100	200000	150000	.....	.....
LCL-250	IT	125-250	200000	200000	100000	.....
LCL-400	IT	200-400	200000	200000	100000	.....

Table 14: Mac B and Mac F Magnetic Motor Controllers

Type	NEMA Size	Volts	Prot. Device	Short Circuit Rating of Controller RMS Sym.
Mac B	0, 1, 2, 3	480	MCP Brkr..	22 KA
Mac B	0, 1, 2, 3	480	MCP Brkr. w/Curr. Limit.	100 KA
Mac F	0, 1, 2, 3	480	Class R Fuse Only	100 KA

① See page 37 for additional applications of primary fuses in Type WLI Switches.
② Basis: Underwriters' Laboratories, Inc. Test Procedures.
③ 14,000 amperes, 1-pole, 277 volt Ac.
④ 65,000 amperes, 1-pole, 277 volt Ac, 15-30 amperes; 25,000 amperes, 1 pole, 277 volts Ac, 40-100 amperes.
⑤ Single pole rating at 125 volt Dc and 2-pole at 125/250 volt Dc.
⑥ Dc ratings apply to substantially non-inductive circuits.
⑦ Single pole rating at 125 volt Dc and 2-pole 70, 90, and 100 amperes breakers are rated 125/250 volts Dc.
⑧ Dc ratings not applicable to 3-pole breakers.
● 1 pole rating is at 120 volts Ac.
⑩ SELTRONIC breakers: Solid state trip, no Dc rating.
⑪ Suitable for application at 100% of rating.

Power Centers, Switchboard Type

Electrical Application Data, *Continued*

Interrupting Ratings of Molded Case Circuit Breakers

Table 15: Seltronic Circuit Breaker Rating Plugs①

LC Breaker			MC Breaker			NC Breaker			PC/PCC Breakers		
Fixed Plug	Adj. Plug②		Fixed Plug	Adj. Plug⑦		Fixed Plug	Adj. Plug⑦		Fixed Plug	Adj. Plug⑦	
	Amps.	Adj. Range (%)	Amps.	Amps.	Adj. Range (%)	Amps.	Amps.	Adj. Range (%)	Amps.	Amps.	Adj. Range (%)
300	...	.....	400	...	.....	800	800	75-100	1000	....	.....
350	...	.....	500	500	80-100	900	900	70-100	1200	....	.....
400	400	75-100	600	600	70-100	1000	1000	70-100	1400	....	.....
450	450	70-100	700	700	70-100	1200	1200	70-100	1600	1600	70-100
500	500	70-100	800	800	70-100	....	....	.....	1800	1800	70-100
600	600	70-100	...	...	.....	....	....	.....	2000	2000	70-100

Table 16: Seltronic Breakers — Adjustable Trip Ranges④

Breaker Type	Fixed Instantaneous	Adjustable Short Time		Adjustable Ground Fault	
		Pick-Up Amps	Delay Cycles	Pick-Up Amps	Delay Cycles
LC,HLC	Refer to Curves	3-10 × Rtg.			
MC,HMC	SC 3600-81	2-8 × Rtg.			
NC,HNC	to SC3621-81,	2-8 × Rtg.	Not	N/A	N/A
PC,PCC 2000	AD 29-162, for	2-8 × Rtg.	Adj.		
PC,PCC 2500	Values of Set	2-8 × Rtg.			
PC,PCC 3000	Points Based on Rating Plugs Selected	2-8 × Rtg.			
LCG,HCLG		3-10 × Rtg.		.2-1.0 × Rtg.	
MCG,HMCG		2-8 × Rtg.		.2-1.0 × Rtg.	
NCG,HNCG		2-8 × Rtg.	Not	.2-1.0 × Rtg.	6-30
PCG,PCCG 2000		2-8 × Rtg.	Adj.	200-1200	
PCG,PCCG 2500		2-8 × Rtg.		240-1200	
PCG,PCCG 3000		2-8 × Rtg.		300-1200	
LCA,HLCA		3-10 × Rtg.			
MCA,HMCA		2-8 × Rtg.			
NCA,HNCA		2-8 × Rtg.	4.8 or	N/A	N/A
PCA,PCCA 2000		2-8 × Rtg.	10.8 or		
PCA,PCCA 2500		2-8 × Rtg.	16.8		
PCA,PCCA 3000		2-8 × Rtg.			
LCGA,HLCGA		3-10 × Rtg.		.2-1.0 × Rtg.	
MCGA,HMCGA		2-8 × Rtg.		.2-1.0 × Rtg.	
NCGA,HNCGA		2-8 × Rtg.	4.8 or	.2-1.0 × Rtg.	6-30
PCGA/PCCGA 2000		2-8 × Rtg.	10.8 or	.200-1200	
PCGA,PCCGA 2500		2-8 × Rtg.	16.8	240-1200	
PCGA,PCCGA 3000		2-8 × Rtg.		300-1200	

Table 17: SCB-II Circuit Breakers with Instantaneous Trip, Short Delay Trip and Ground Fault Trip Solid State Devices④⑤

Breaker Type	Trip Range Amperes	Available Current Sensor Ratings	Interrupting Ratings, RMS Amperes Symmetrical, Ac Volts 240	480	600
With Instantaneous Solid State Trip Device					
SPCB-600	125-600	250, 400, 600	65000	35000	25000
SPCB-1200	125-1200	250, 400, 600, 800, 1000, 1200	65000	50000	25000
SPCB-2000	300-2000	600, 800, 1000, 1200, 1600, 2000	125000	100000	100000
SPCB-2500	1250-2500	2500	125000	100000	100000
SPCB-3000	1500-3000	3000	125000	100000	100000
With Short Delay Solid State Trip and Instantaneous Override					
SPCB-600	125-600	250, 400, 600	65000	35000	25000
SPCB-1200	125-1200	250, 400, 600, 800, 1000, 1200	65000	50000	25000
SPCB-2000	300-2000	600, 800, 1000, 1200, 1600, 2000	125000	100000	100000
SPCB-2500	1250-2500	2500	125000	100000	100000
SPCB-3000	1500-3000	3000	125000	100000	100000

Adjustable Solid State Trip Ranges

Current Sensor Amp. Rating	Time/Current Characteristics	Pick-up Range-Times Sensor Rating Min.	Max.	Time Range Seconds Min.	Max.
250, 400, 600, 800	Long Delay	.5	1.2②	2 Sec.⑥	20 Sec.⑥
1000, 1200, 1600	Short Delay	1.0	7.0	2 Hz	10 Hz
2000, 2500, 3000	Instantaneous③	1.0	12.0	....	....
	Ground Fault	.2	1.0	6 Hz	30 Hz

① Breakers with magnetic only rating plugs are not U.L. Listed.
② Do not use long delay pick-up settings which allow continuous current flow in excess of breaker frame rating (i.e., 600A, 1200A, 2000A, 2500A and 3000A).
③ Breakers without adjustable instantaneous trip, but having short time delay for use in selective systems are fitted at the factory with a fixed overriding instantaneous trip device which allows all short time rated breakers to be applied on systems having short circuit current up to the maximum interrupting rating of the breaker frame. This instantaneous override is fixed at 14 times monitor rating for 600, 2500 and 3000 amp units and at 21 times monitor rating for 1200 and 2000 amp units. Fault currents in excess of these values will cause the breaker to trip instantaneously.
④ Adjustable solid state trip devices are set to minimums at factory. Any variation of this policy must be negotiated.
⑤ Suitable for application at 100% of rating in certain switchboard applications. Refer to Westinghouse for current data.
⑥ At six (6) times sensor rating.
⑦ Not available on breakers with integral ground fault feature.

Power Centers, Switchboard Type

Electrical Application Data, *Continued*

Table 18: Type SPB Systems Pow-R Breakers with Pow-R Trip 7 or Digitrip® Solid State Trip Module

Breaker Frame	Trip Range Amps	Rating Plug Amperes	Breaker Type SPB-50 240V	SPB-50 480V	SPB-50 600V	SPB-65 240V	SPB-65 480V	SPB-65 600V	SPB-100 240V	SPB-100 480V	SPB-100 600V
Interrupting Capacity, RMS Sym. Amperes (000 Omitted)											
250	160①-250	200, 225, 250	65	50	42	....	....	....	100	100	50
800	240-800	300, 400, 500, 600, 700, 800	65	50	42	....	....	....	100	100	50
1600	640-1600	1000, 1200, 1600	....	....	....	85	65	50	100	100	85
2000	1280-2000	1600, 2000	....	....	....	....	....	....	100	100	85
2500	1280-2500	1600, 2000, 2500	....	....	....	....	....	....	100	100	85
3000	1280-3000	1600, 2000, 2500, 3000	....	....	....	....	....	....	100	100	85
4000	1600-4000	2000, 2500, 3000, 4000	....	....	....	....	....	....	100	100	85
Short Time Rating, RMS Sym. Amperes (000 Omitted)											
250	160①-250	200, 225, 250	25	25	25	....	....	....	25	25	25
800	240-800	300, 400, 500, 600, 700, 800	25	25	25	....	....	....	25	25	25
1600	640-1600	800, 1000, 1200, 1600	....	....	....	35	35	35	35	35	35
2000	1280-2000	1600, 2000	....	....	....	....	....	....	35	35	35
2500	1280-2500	1600, 2000, 2500	....	....	....	....	....	....	35	35	35
3000	1280-3000	1600, 2000, 2500, 3000	....	....	....	....	....	....	35	35	35
4000	1600-4000	2000, 2500, 3000, 4000	....	....	....	....	....	....	65	65	65

Adjustable Trip Settings — Pow-R Trip 7 Module

Time/Current Characteristic	Pick-Up Points: Times Plug Rating	Times Frame Rating	Amperes	Time Bands, Seconds: Min.	Int.	Max.
Ampere Setting	.8, .9, 1.0	.....	.....	.....	.....	.....
Instantaneous	2, 4, 6, 8, 10	.....	.....	.....	.....	.....
Short Delay	2, 4, 6, 8	.....	.....	.1 Sec.	.2 Sec.	.3 Sec.
Long Delay	(at 6 times)	.....	.....	2 Sec.	10 Sec.	20 Sec.
Ground Fault						
250, 800, 1600 Amp.	.....	.2, .3, .4, .6, .75	600②, 750②, 900	.1 Sec.	.3 Sec.	.5 Sec.
2000, 2500, 3000, 4000	.....	.....	1050, 1200	.1 Sec.	.3 Sec.	.5 Sec.

Adjustable Trip Settings — Digitrip Module

Time/Current Characteristic	Pickup Points — Amperes: Times Plug Rating	Times Frame Rating	Times Sensor Rating	Time Bands
Ampere Setting	.81, .87, .93, 1.0, 1.06, 1.12, 1.18	.....	.....	.....
Instantaneous				
250-3000	2,3,4,5,6,8,10	.....	.....	.....
4000	2,2.5,3,3.5,4,5,6	.....	.....	.....
Short Delay				
250-3000	2,3,4,5,6,7,8	.....	.....	.....
4000	2,2.5,3,3.5,4,4.5,5	.....	.....	.....
Long Delay	At 6 times	.....	.....	2,4,6,10,14,18,22 Sec.
Ground Fault				
250-800	.....	.2,.29,.4,.5,.59,.75,1.0	.....	3,5,10,15,20,25,30,Cy
1600	.....	.2,.29,.4,.5,.59	.....	3,5,10,15,20,25,30,Cy
2000,2500, 3000	.....	.....	.2,.23,.26,.29,.32,.37, .4 × 3000	3,5,10,15,20,25,30,Cy
4000	.....	.....	.2,.21,.23,.25,.26,.28, .29 × 4000	3,5,10,15,20,25,30,Cy

① 160 amp is lowest standard UL Listed rating, except 100 amp is available as special design using 200 amp rating plug with 50% setting. Minimum cable ampacity used with this rating is 200 amps.
② These pickup set points not available on 4000 amp frames.

Power Centers, Switchboard Type

Electrical Application Data, *Continued*

Table 19: Type DS Power Circuit Breakers Interrupting Ratings

Breaker Type	Trip Range Amps.	Current Sensor Rating, Amps	Interrupting Rating-RMS Sym. Amperes					
			Voltage			Voltage		
			240	480	600	240	480	600
			With Instantaneous Trip			With Short Delay Trip		
DS-206	50-800	50, 100, 150, 200, 300, 400, 600, 800	42000	30000	30000	30000	30000	30000
DS-206 S⑥	50-800	50, 100, 150, 200, 300, 400, 600, 800	50000	42000	42000	42000	42000	42000
DS-416	100-1600	100, 150, 200, 300 400, 600, 800, 1200, 1600	65000	50000	42000	50000	50000	42000
DS-416 S⑥	100-1600	100, 150, 200, 300, 400, 600, 800, 1200, 1600	65000	65000	50000	65000	65000	50000
DS-420	2000	2000	65000	65000	50000	65000	65000	50000
DS-632	1200-3200	2400, 3200	85000	65000	65000	65000	65000	65000
DS-840	2000-4000	4000	130000	85000	85000	85000	85000	85000

Adjustable Solid State Trip Ranges④

Current Sensor Ampere Rating	Time/Current Characteristics	Pick-up Range-Times Sensor Rating		Time Range, Seconds	
		Min.	Max.	Min.	Max.
50, 100, 150, 200, 300	Long Delay	.5	1.25③	4 Sec.①	36 Sec.①
400, 600, 800, 1200	Short Delay	4.0	10.0	11 Hz.⑤	30 Hz.⑤
1600, 2000, 4000	Instantaneous	4.0	12.0	.....	.....
3200, 4000	Ground Fault	See Table Below		13 Hz.	30 Hz.

Ground Fault Pick-up Points④

Dial Setting	Sensor 50	100	150	200	300	400	600	800	1200	1600	2000	2400	3200	4000	Sec. Current②
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	....	1.9
D	33	100	120	145	200	270	385	500	730	970	1200	....	....	....	3.0

Table 20: Fusible Devices – Standard Ratings

Device Type	Max. System Voltage	Ampere Rating	Max. Short Circuit Capability of Device and C.L. Fuse Combination at Device Rated Volts-RMS Sym. Amperes
Bolted Pressure Contact Fusible Switch	240 or 480	800, 1200 1600, 2000, 2500, 3000, 4000	200K (W/Class L Fuse)
FDP Quick-Make-Quick Break Fusible Switch	240 or 600	30 thru 200..... 400-600..... 30 thru 600..... 800-1200.....	200K (W/Class R Fuse) 100K (W/Class R Fuse)⑦ 200K (W/Class J Fuse) 200K (W/Class L Fuse)

① At six times sensor rating.
② Amperes necessary to operate ground element as supplied from secondary of external ground sensor. When testing pick-up using these test values, all sensors must be disconnected.
③ Do not use long delay pick-up settings which allow continuous current flow in excess of breaker frame rating (i.e. 800A, 1600A, 2000A, 3200A, 4000A).
④ All adjustable breaker trip devices on these circuit breakers are factory set and shipped at the minimum settings. Any exception to this practice is to be negotiated.
⑤ At 2.5 times short time pick-up.
⑥ Not UL Listed types.
⑦ At 480 volts max.

Power Centers, Switchboard Type

Electrical Application Data, *Continued*

Cable Ranges for Standard Secondary Device Terminals

Wire and cable terminals supplied on switchboard mounted devices for making up incoming or outgoing cable connections are of the mechanical screw clamp pressure type. All standard terminals are suitable for use with either aluminum or copper cable except as noted in the table. Panel mounted devices utilize the terminal provided as standard for and furnished with that device.

Table 21: Standard Switchboard Terminals
Molded Case Breakers②

Device Type	Ampere Rating	Wire Range	
		Individually Mounted	Panel Mounted
EB③	15-100	. . . . .	#14-1/0
EHB, FB, HFB, FB TRI PAC	15-100	#14-1/0	#14-1/0
FB, HFB	125-150	#6-3/0	#4-4/0
CA, CAH③	125-175	. . . . .	#1-4/0
	200-225	. . . . .	2/0-300 MCM
JA, KA, HKA, JB, KB	70-225 (KB-250A)	#6-350 MCM	#4-350 MCM
DA③	250-350	#2-600 MCM	250-500 MCM
	400	#2-600 MCM	(2) #3/0-250 MCM
LB, LBB, HLB	125-225	#6-350 MCM	#4-350 MCM
	250-400	#2-600 MCM	(2) 3/0-250 MCM
LA TRI PAC	250-400	#2-600 MCM	(1) #4-250 MCM, plus (1) 3/0-600 MCM
LA, HLA, LC, HLC	500-600	(2) #2-600 MCM	(2) 250-500 MCM
MC, HMC	125-600	(2) #2-600 MCM	(2) #1-500 MCM
	700-800	(3) #2-600 MCM	(3) 3/0-400 MCM
NC, HNC,	900-1000	(3) #2-600 MCM	(3) 3/0-400 MCM
NB TRI PAC	1100-1200	(4) #2-600 MCM	(4) 4/0-500 MCM
PC, PB TRI PAC	900-1600	(5) #2-600 MCM	. . . . .
	2000	(6) #2-600 MCM	. . . . .
	2500, 3000	As Specified	. . . . .

FDP Switches②

Ampere Rating	Wire Range	
	Individually Mounted	Panel Mounted
240 and 600 Volts Ac		
30	#14-#1/0	#14-1/0
60	#14-#1/0	#14-1/0
100	#14-#1/0	#14-1/0
200	#4-300 MCM	#4-300 MCM
400	#2-600 MCM	#4-600 MCM
600	(2) #2-600 MCM	(2) #4-600 MCM
800	(3) #2-600 MCM	(3) #4-600 MCM, or (2) 500-1000 MCM
200	(4) #2-600 MCM	(4) #4-600 MCM, or (3) 500-1000 MCM

Power Circuit Breakers

Breaker Type	Ampere Rating	Wire Range Individually Mounted
DSL 206, DS 206, DS 206S	600	(2) #2-600
	800	(3) #2-600
DSL 416, DS 416, DS 416S	1200-1600	(5) #2-600
DS 420	2000	(6) #2-600
DS 632, DSL 632	3200	As Specified
DS 840, DSL 840	All	As Specified

Systems Pow-R Breakers

Breaker Type	Ampere Rating	Wire Range, Individually Mounted
SPB- 250	250	(1) #2-600 MCM
SPB- 800	800	(3) #2-600 MCM
SPB-1600	1600	(5) #2-600 MCM
SPB-2000	2000	(6) #2-600 MCM
SPB-2500	2500	As Specified
SPB-3000	3000	As Specified

SCB-II System Circuit Breakers

Breaker Type	Ampere Rating	Wire Range Individually Mounted
SPCB-600	400	#4/0-500 MCM
	600	(2) #2-600 MCM
SPCB-1200	900-1000	(3) #2-600 MCM
	1100-1200	(4) #2-600 MCM
SPCB-2000	1600	(5) #2-600 MCM
	2000	(6) #2-600 MCM
SPCB-2500	2500	As Specified
SPCB-3000	3000	As Specified

Motor Starter Units

Type Unit	NEMA Size	Wire Range
Mac B, F	Size 0	#14-#8①
Mac B, F	Size 1	#14-#8①
Mac B, F	Size 2	#10-#4①
Mac B, F	Size 3	#8-#2/0①
Mac B, F	Size 4④	#6-#4/0

Bolted Pressure Switches

Switch Type	Ampere Rating	Wire Range Individually Mounted
Fusible	800	(3) #2-600
Pressure	1200	(4) #2-600
Switches	1600	(5) #2-600
	2000	(6) #2-600
	Above 2000	As Specified

① Listed with Underwriters' Laboratories, Inc. to accept copper cable only.
② For other terminals available on some ratings of molded case circuit breakers and FDP fusible switches that are suitable for use on copper cable only or on aluminum cable only, refer to Westinghouse.
③ 240 volts only.
④ Not UL Listed.

Power Centers, Switchboard Type

6. Specification Guide

General

This specification covers 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 standards of NEMA, IEEE and ANSI, applicable to it's three major sections.

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 Section
Outgoing Low Voltage Distribution Section.

Incoming Line Section

Air Interrupter Switch—The HV switch shall be manually operated and rated at 600 (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 plexiglass or screen barrier shall exist over the area where energized parts may be readily touched.

Switch shall be cable connected to the transformer terminals to prevent transmission of sound to the switch. The switch case 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 which will consist of a no load selector switch for switching from one feeder to the other on the line side and in series with an air-insulated load interrupter switch. Mechanical interlocking shall be provided such that 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 which will consist of 2 air insulated load interrupter switches connected together on the load side which shall be used 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 _____ E) (three RBA boric acid _____ E) fuses are to be provided on the load side of the HV switch in the HV switch compartment. ____Mva 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. (Optional)

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 (potheads (s)) (clamp terminals) for termination of the (single feed) (loop feed) _____MCM cables, _____per phase.

Liquid Type Transformer Section

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

_____Kva, 3 phase, 60 hertz, OA/FFA, Wemco oil (silicone) (WECOSOL®) insulated, 65°C rise (55°C rise) (Complete with 230V 1∅ 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 Facilities—A flange shall be provided on the end wall of the tank for attaching the Incoming Line Compartment. Flange shall be located on the left (right) when facing the front of the transformer.

Cable Entrance—The cables shall enter the terminal compartment from the top (bottom).

Low Voltage Lead Facilities—A flange shall be provided on the end wall, opposite high voltage flange, for attaching the low-voltage distribution section.

Accessories are to 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.)
Top sampling. (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) (outdoor).

Power Centers, Switchboard Type

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.

Encapsulated Mold Dry Type Transformer Section

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 shall 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 type 1 (outdoor type 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)
H. Voltage: _____ delta (wye)
H.V. BIL: _____ kV
H.V. taps: Full capacity with 2-2.5% above and below rated high voltage.
L. Voltage: _____ wye (delta)
L.V. BIL: _____ kV
Average Temperature Rise: 150°C. (115) (80)

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

Conductor Material
The conductors shall be 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 BIL 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.

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 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 be limited to:
- HV flange
- LV flange
- Provisions for lifting, jacking and rolling
- Vibration damping 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

Outdoor Low Voltage Switchboard Section

Pow-R-Gear Switchboard

General
The Low Voltage Secondary Switching Equipment shall be Westinghouse (Indoor) (Outdoor) metal enclosed Pow-R-Gear™ consisting of a stationary structure assembly and one or more Westinghouse drawout mounted Systems Pow-R-Breakers fitted with disconnecting devices and other necessary equipment. The power assembly is to be suitable for 600 volts maximum Ac service and shall be tested for that voltage class in accordance with applicable NEMA standards. The complete assembly including steel framing and covers, the bus system and the breaker drawout cell details, as a minimum requirement, shall satisfy all applicable provisions of UL 891 and NEMA PB-2 for Low Voltage, Distribution Switchboards and, in addition, shall embody the added safety features as are hereinafter described.

Stationary Structure
Each vertical steel unit forming part of the switchboard line up shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment, and a rear cabling compartment. Each individual circuit breaker compartment, or cell, shall be completely segregated from adjacent compartments or sections by means of barriers at rear, top, bottom and sides. It shall be equipped with drawout rails, levering out mechanism, primary and secondary contacts. Current transformers for feeder instrumentation, where shown on the plans, shall be located within the appropriate breaker cells.

Power Centers, Switchboard Type

Option Number 1
As a safety precaution to prevent accidental contact with live parts during maintenance procedures, the centralized bus subassembly containing the section bus and the through bus, shall be segregated from the rear cabling section by means of removable solid insulating barriers.

A formed steel door with adequate ventilating openings shall be provided for each circuit breaker cell. Each door shall have concealed hinges. Doors over electrically operated breakers shall mount the required devices for local breaker control as well as a circuit ammeter, in a grouped subassembly visible and operable from the front with the door closed.

The top and rear of each vertical unit shall be enclosed with removable steel sheets having the necessary ventilated openings.

The structure shall be so designed that future additions may readily be made. The steel structure shall be thoroughly cleaned prior to the application of phosphatizing coat and a hard dried enamel finish. The finish color shall be ANSI 61 light gray.

Busses and Connections
Each circuit shall include the necessary 3 phase bus connections between the section bus and the breaker line side studs. Load studs shall be equipped with load extension busses terminating in solderless type terminals in the rear cable compartment of each structure. Bus extensions shall be silver plated where outgoing terminals are attached.

All busses and connections shall consist of high conductivity (aluminum) (copper) bars mounted on heavy duty glass polyester supports. (All principal bus joints of aluminum shall be welded.) (Copper bus joints shall be bolted.) Shipping breaks and bus provisions for extending the switchboard line-up shall have silver plated bolted connection points.

The bus shall be (tin plated aluminum) (silver plated copper) of sufficient size to limit the temperature rise to 65°C based on U.L. tests, and rated to withstand mechanical forces exerted during short circuit conditions when directly connected to a power source having the indicated available short circuit current. All connections shall be tightly bolted.

The bus assembly shall be constructed so as to maintain the minimum UL electrical clearances without reliance on the use of insulating material.

Option Number 2
For added safety during maintenance and to inhibit ground faults or phase faults within the bus assembly, all section (vertical) and through (horizontal) bus bars shall be isolated phase from phase and phase from grounded dead metal through the use of insulating material properly applied in a complete insulation/isolation system.①

This system shall be in addition to the minimum UL clearances established in the basic bus design. It shall be totally independent of the bus support system so that it may be removed and replaced for inspection and maintenance without affecting the structural rigidity of the assembly.

Moldarta terminal blocks with integral type barriers between terminals shall be provided for all outgoing secondary control circuits. The terminal blocks shall be accessible by removing the vertical section rear covers.

Disconnecting Devices
The stationary part of the primary disconnecting devices for each circuit breaker shall consist of a set of silver plated copper contacts extending through a glass polyester insulating base. The line busses and load bus extensions shall be directly connected to them. The corresponding moving contacts shall consist of a set of contact finger clusters suitably fitted to the breaker line and load studs. In the "Connected" position, these contact fingers shall engage the stationary contacts forming a current carrying bridge. The assembly shall provide multiple silver-to-silver high pressure point contacts. High uniform pressure on each finger is to be provided by spring action. The entire assembly shall be full floating in order to provide ample flexibility between the stationary and moving elements. Contact engagement shall be maintained only in the "Connected" position.

Stationary primary contacts shall be totally recessed behind an auxiliary rear cell insulating barrier to prevent accidental contact with live parts when the breaker is out of its cell.

The secondary disconnecting devices shall consist of floating contact assemblies mounted on the removable unit and engaging with mating assemblies located at the rear of the compartment. The secondary disconnecting devices shall be silver plated to insure permanence of contact. Secondary contact engagement shall be maintained in the "Connected" and "Test" positions.

Removable Element and Drawout System
The removable element shall consist of an encased System Pow-R-Breaker equipped with the necessary disconnecting contacts, wheels, and interlocks for drawout operation. The removable element shall be of the three position drawout design in which it shall be possible to close the compartment door with the breaker in the "Connected", "Test" and "Disconnected" positions. A positive mechanical interlock shall prevent the breaker from being racked in or out while in the closed position either by tripping it or, if it is already tripped, by blocking its closing. A manual latch shall positively position the removable unit in the "Test" and "Disconnected" positions and provisions for padlocking in all positions shall be made. A limit stop shall be provided in the fully withdrawn position and in this position it shall be possible to rotate the unit 180 degrees for inspection and maintenance.

Breakers shall be (manually) (electrically) operated with stored energy mechanisms. Manually operated breakers shall have a charging handle whose operating force is constant throughout its travel. Any number of partial charging strokes may be used, if desired, in lieu of full strokes to accomplish charging. All breakers shall have solid state trip devices with fully adjustable characteristics necessary to protect and coordinate the system on which they are to be applied.

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

Pow-R-Line Switchboard

General Construction
Furnish and install where indicated a dead front type, completely metal enclosed, self-supporting structure independent of wall supports. It shall consist of the required number of vertical sections bolted together to form one rigid switchboard 90⅜" high incorporating switching and protective devices of the number, ratings and type noted herein or shown on the drawings with all necessary interconnections, instrumentation and control wiring. Switchboard construction shall be of the universal frame type using die-formed members bolted and braced through the exclusive use of self-tapping bolts which will not loosen during shipment. The sides, top and rear shall be covered with removable screw-on plates having formed edges all around. Front plates shall be sectionalized and removable. All front plates shall be fabricated from code gauge steel and shall have formed edges all around. Ventilation openings shall be provided where required.

● When this option is used, Option 1 is not available, and when Option 1 is used, Option 2 is not available.

Power Centers, Switchboard Type

All covers shall be secured by self-tapping screws.

The bus shall be (tin plated aluminum) (silver plated copper) of sufficient size to limit the temperature rise to 65°C based on U.L. tests, and rated to withstand mechanical forces exerted during short circuit conditions when directly connected to a power source having the indicated available short circuit current. All connections shall be tightly bolted.

Small wiring, necessary fuse blocks and terminal blocks within the switchboards shall be furnished when required. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. All hardware used on conductors shall have a high tensile strength and an anti-corrosive zinc plating.

A ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard. A ground lug shall be furnished attached to the ground bus in a convenient location.

Switchboard shall be provided with adequate lifting means and shall be capable of being rolled or moved into installation position and bolted directly to the floor without the use of floor sills.

A-B-C type bus arrangement, left-to-right, top-to-bottom, and front-to-rear, as viewed from the front, shall be used throughout.

Record drawings shall be furnished providing the following information: switchboard voltage/current rating; overall outline dimensions including available conduit space; switching and protective device ampere ratings; and one line diagram.

Adequate conduit space shall be provided to meet NEC requirements.

Each switching and protective device shall be provided with visible means of ON-OFF identification. All terminals shall be of the anti-turn solderless type suitable for Cu or Al cable of sizes indicated.

All exterior and interior steel surfaces of the switchboard shall be properly cleaned and finished with gray hard dried enamel over a rust-inhibiting phosphatized coating. Gray finish color shall be ANSI 61.

Type WRP Switchboard—
Panel Mounted Devices
Switchboard shall be of construction equal to Westinghouse Type WRP with panel mounted distribution devices in which all vertical sections shall have whatever depth is necessary to accommodate and connect the equipment. All vertical sections shall align front and rear.

All internal devices except the main disconnect, shall be removable from the front and shall be panel mounted with the necessary line and load connections front accessible. The main device and its connections shall be rear accessible.

Main horizontal bus bars shall be mounted on glass polyester insulators with all three phases arranged in the same vertical plane. The main bus shall have a maximum ampacity of (1200) (1600) (2000) (2500) (3000) (4000) amperes and shall be rated for short circuits up to (50,000) (75,000) (100,000) (150,000) (200,000) RMS amperes based on the short circuit withstand rating of the installed devices. Main bus splices shall be supplied between adjacent distribution sections.

Switchboards shall be completely factory assembled, wired and tested before delivery and shall bear U.L. labels, where qualified. Designs shall meet NEC and NEMA standards as well as OSHA requirements.

Type WRI Switchboard—
Individually Mounted Devices
Switchboard shall be of construction equal to Westinghouse Type WRI with individually mounted distribution devices in which sections shall have whatever depth is necessary to accommodate and connect the equipment. All vertical sections shall align front and rear.

All internal devices, main and feeders, shall be rear accessible and shall be individually mounted.

Main horizontal bus bars shall be mounted on glass polyester insulators with all three phases arranged in the same vertical plane. The main bus shall have a maximum ampacity of (1200) (1600) (2000) (2500) (3000) (4000) amperes and shall be rated for short circuits up to (50,000) (75,000) (100,000) (150,000) (200,000) RMS amperes based on the short circuit withstand rating of the installed devices. Main bus splices shall be supplied between adjacent distribution sections.

Distribution sections shall be compartmentized so as to include full height vertical barriers of glass polyester material between the front device compartment and the main bus compartment. Between the main bus compartment and the rear cable compartment, a full height glass polyester barrier shall be available as a standard modification.

Each 3 phase vertical section bus shall consist of tin plated aluminum bars, "J" shaped in cross-section, and pre-punched for the attachment of molded case breaker modules. In order to accommodate the maximum number of molded case modules, it shall be possible to incorporate up to a maximum of three sets of section bus in a single steel vertical structure.

Insulated rigid conductors shall extend from load sides of individually mounted breaker modules into the rear compartment where outgoing cable connections may be made without reaching into or near the main bus compartment.

Switchboard shall bear U.L. labels, where qualified. Designs shall meet NEC and NEMA standards, as well as OSHA requirements.

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

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