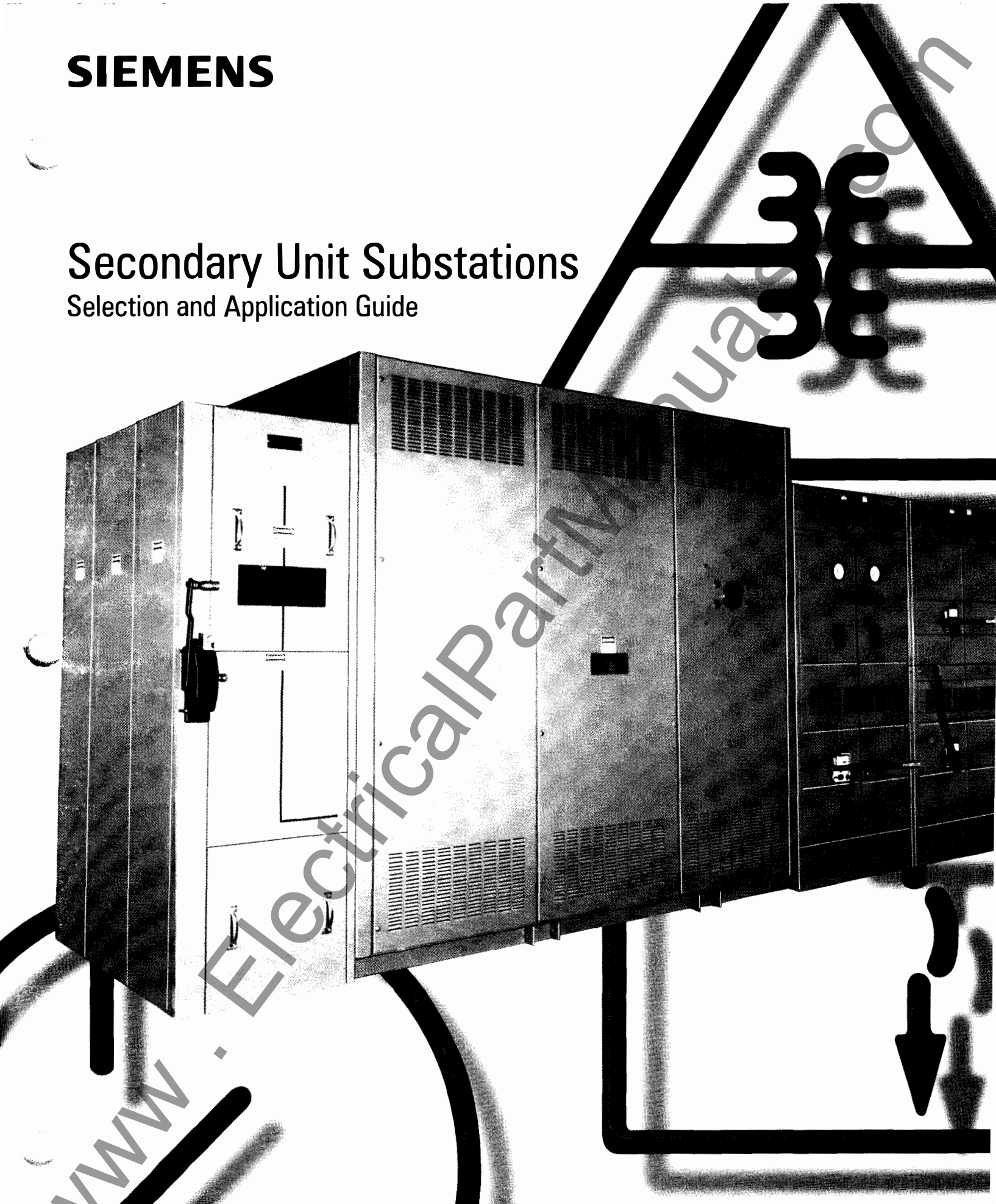
SIEMENS

Secondary Unit Substations

Selection and Application Guide



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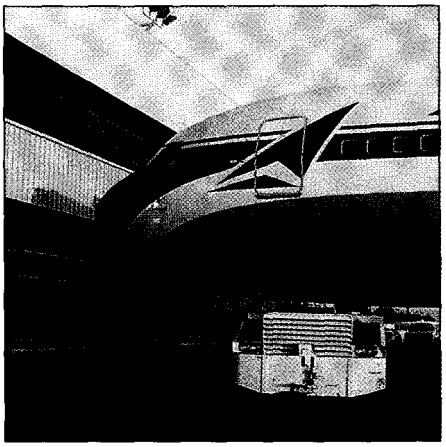

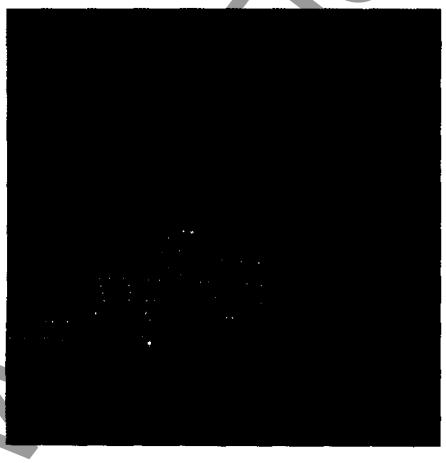

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ACCESS™ Electrical Distribution Communications. Monitor and control electrical distribution for an entire facility from one central location.

Siemens ACCESS™ Electrical Distribution Communication System centrally monitors and controls an entire electrical distribution system. Engineers, accountants, executives, and technicians can access an almost limitless stream of data — for troubleshooting, early warning alarms, power quality studies, preventive maintenance, cost allocation, and facilities planning. ACCESS adds a new dimension to managing energy-intensive facilities, allowing identification and correction of potential problems before they cause damage, waste, injury, or downtime.

System Overview

ACCESS enables users to connect new or retrofitted Siemens intelligent metering and protective devices in switchboards, switchgear, and motor control centers via a twisted pair of wires, in order to "access" critical electrical operating information.

ACCESS provides a graphical user interface for viewing and reporting real-time, historical, min / max, etc. information on a desktop computer or field-installed industrial computer. The field device network uses an industry standard RS-485 twisted pair, which has galvanic isolation of up to 500 volts. Siemens "SEABus" communications protocol is utilized on the RS-485 high speed LAN. SEABus is an open protocol with complete documentation allowing users to integrate Siemens devices directly into other customized communications systems.

Siemens ACCESS Electrical Distribution Communications System meets ANSI / IEEE C37.90.1, C37.90.2, and RFI / EMI 6241 specifications.

Primary Functions

- Reducing costly downtime by identifying system problems well in advance of tripping.
- Providing data for more efficient allocation of power usage cost, and providing accurate verification of utility billing.
- Identifying and controlling peak power demand. Allowing actions such as load shedding, changes in billing structure from the utility, or other remedial steps to minimize power cost.
- Providing data to plan substation expansion need, such as the ability to know steady-state and momentary percentage of capacity for all breakers and transformers.

ACCESS™ Software Capabilities

	Software Package		
Software Feature	**SIEServe**	**WinPM**	**WinHost**
Operating System	MS Windows	MS Windows	MS Windows
Maximum No. of Devices	128/Port	Unlimited	Unlimited
Password Protection	—	√	√
Real-time Data Display	√	√	√
Min / Max Data Retrieval	—	√	√
Discrete Input Status	√	√	√
Waveform Capture	—	√	√
Event Logging	—	√	√
Device Configuration	—	√	√
Clearing Device Data	—	√	√
Pick-up Information	√	√	√
Manual Control	—	√	√
Alarm Configuring	—	√	√
Alarm Logging	—	√	√
Printing Data / Reports	—	√	√
Trending Capability	—	√	√
One-line Diagrams	—	√	√
Custom Diagrams	—	√	√
Dynamic Data Exchange	√	√	√
Networking Capability	—	—	√
PLC Integration	—	—	√
Third Party Devices	—	—	√
Interface to Other System	—	—	

ACCESS Connectivity

The Siemens ACCESS System is designed to meet the flexible monitoring and control needs of industrial, construction, and OEM customers. The strong foundation of the system consists of intelligent field devices with the primary responsibilities of metering, control, overcurrent protection, and motor protection. As an added value, all of the Siemens microprocessor based field devices have RS485 communications capability to transfer powerful information to a remote location. The field devices communicate information such as metered values, long time pick-ups, motor overloads, breaker status, tripping data, wave form data, and much more.

Where central monitoring and control are desired, Siemens offers three software options that can be used either independently or networked:

- SIEServe™ software is a Microsoft® Windows™ application that provides real-time information from devices to other applications via Windows Dynamic Data Exchange (DDE).
- WinPM™ software provides the operator a custom graphic user interface in the Windows environment with access to all device data. Customizable diagrams, alarms, snapshots to disk, event logging, control, configuration, waveform capture, harmonic data, trending, and reporting are all part of the WinPM package.
- Where more customized systems are required, Siemens WinHost software features detailed customer graphics, communications with outside vendor devices, PLC integration, and networking with customer systems.

Secondary Unit Substations

A *unit substation* is defined as a substation consisting of one or more transformers mechanically and electrically connected to and coordinated in design with one or more switchgear or switchboard assemblies. A *secondary unit substation* is defined as a unit substation whose outgoing section is rated below 1000 volts.

A typical secondary unit substation consists of three sections:

1. An incoming section that accepts incoming high voltage (2400 to 13,800 volts) line. ①
2. A transformer section that transforms incoming voltage down to utilization voltage (208/120 to 600 volts).
3. An outgoing section that distributes power to outgoing feeders and provides protection for these feeders (600 volts and less).

The primary reason for using a secondary unit substation is to bring power as close as possible to the center of the loads. Another reason is that it provides a system design concept incorporating a wide variety of components that permits tailoring equipment to the needs of the application.

A secondary unit substation provides

- Reduced power losses
- Better voltage regulation
- Improved service continuity
- Increased functional flexibility
- Lower installation cost
- Efficient space utilization

In addition to the above benefits that are common to all secondary unit substations, the design provides the following:

Proven Performance. We have been designing, building and applying secondary unit substations for many years. This experience and know-how assures you of unsurpassed quality and performance.

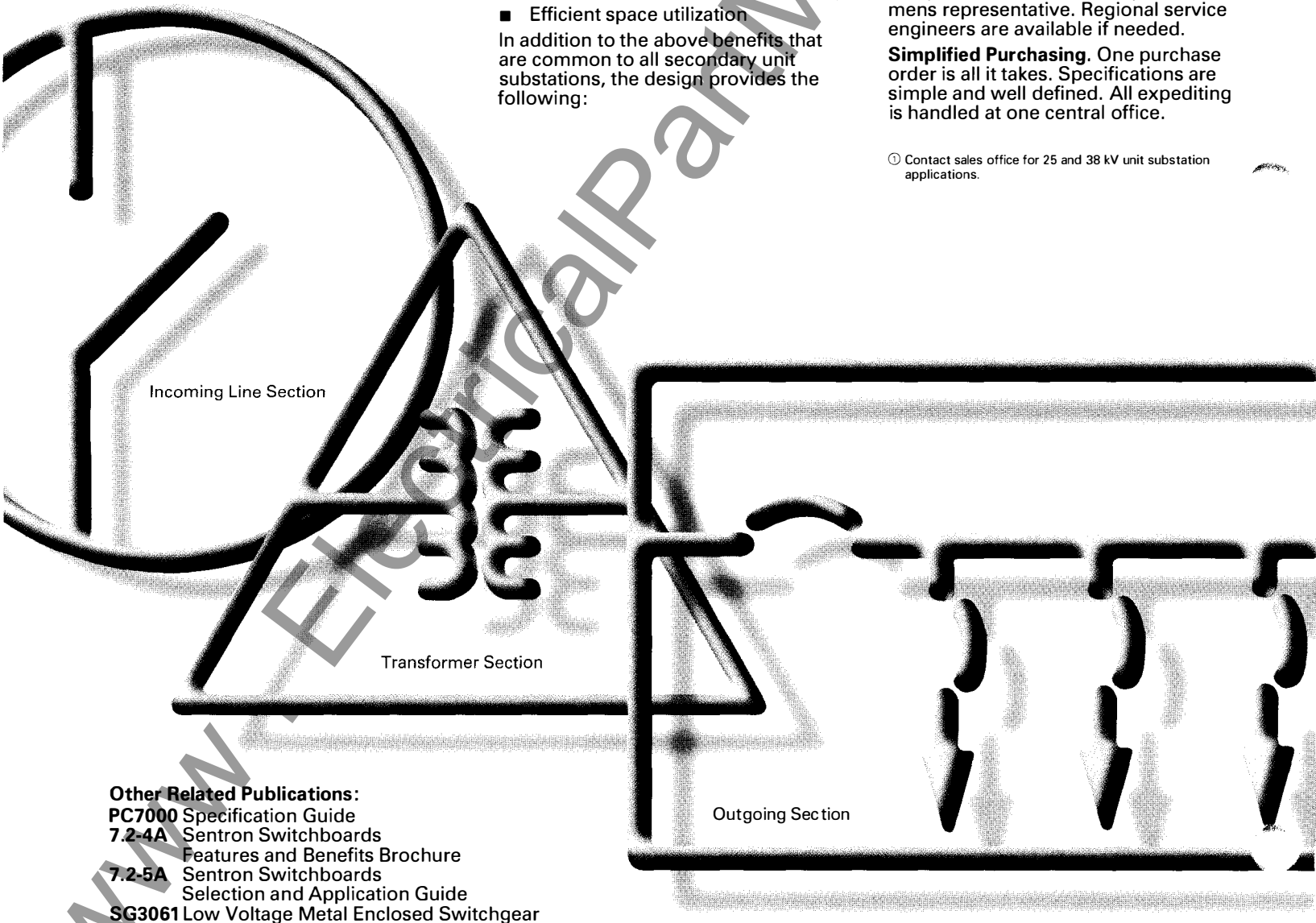
Total Testing. All Siemens secondary unit substations are designed and production tested to meet the applicable ANSI, NEMA, IEEE and UL standards where established.

Coordinated Engineering. Every component and assembly of our secondary unit substations are designed and engineered as an integral part of a complete system.

Single Source Responsibility. Should a problem ever develop, you have but one phone call to make: to your Siemens representative. Regional service engineers are available if needed.

Simplified Purchasing. One purchase order is all it takes. Specifications are simple and well defined. All expediting is handled at one central office.

① Contact sales office for 25 and 38 kV unit substation applications.

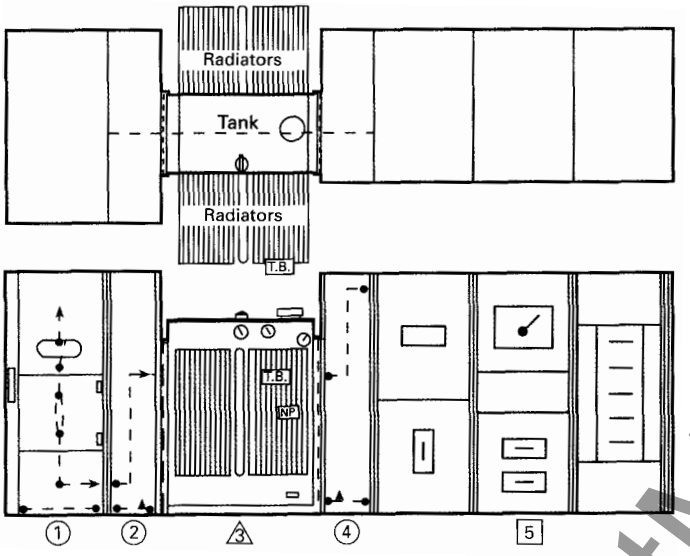


Other Related Publications:
PC7000 Specification Guide
7.2-4A Sentron Switchboards
Features and Benefits Brochure
7.2-5A Sentron Switchboards
Selection and Application Guide
SG3061 Low Voltage Metal Enclosed Switchgear

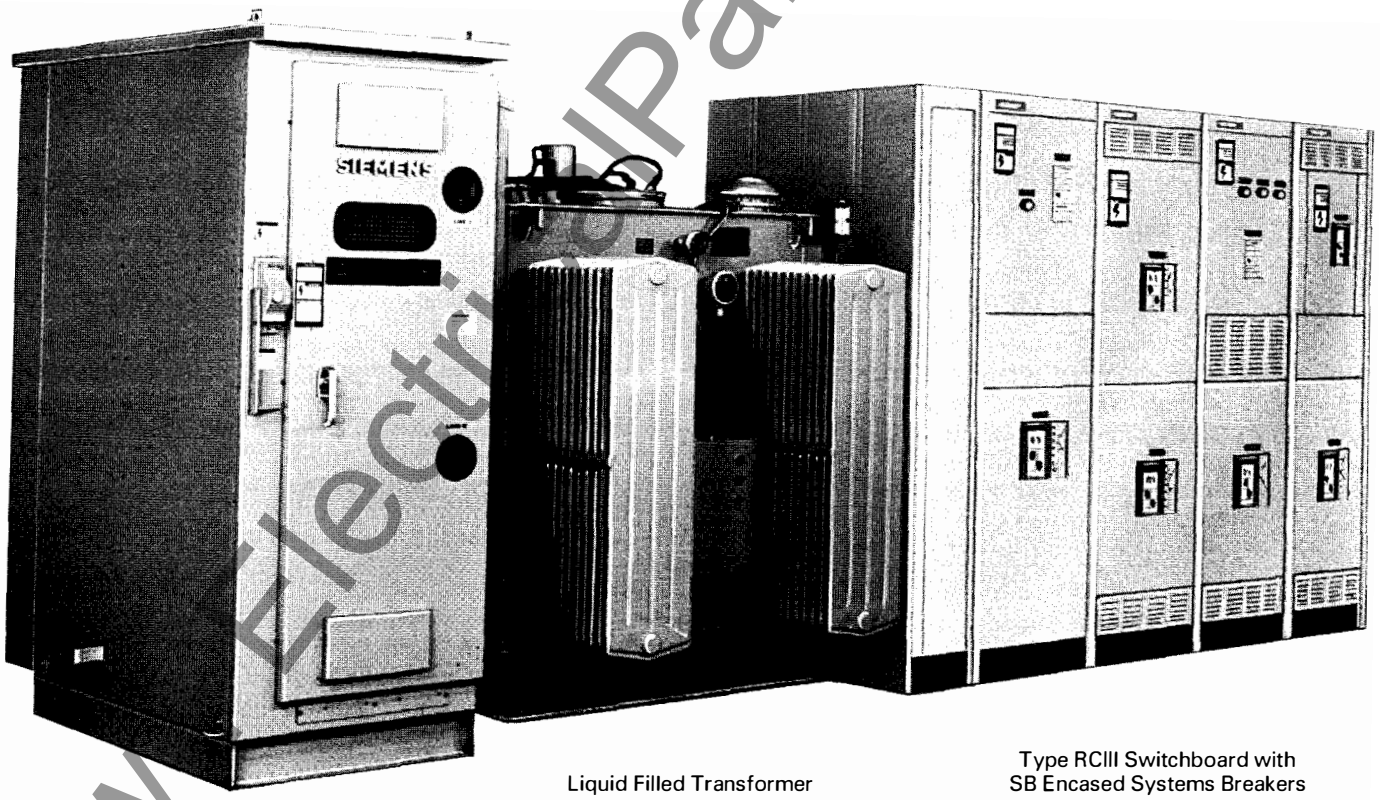
Reference

Top View

Front View



① HV Switch
② HV Transition
③ Liquid Transformer
④ LV Transition
⑤ LV Switchboard

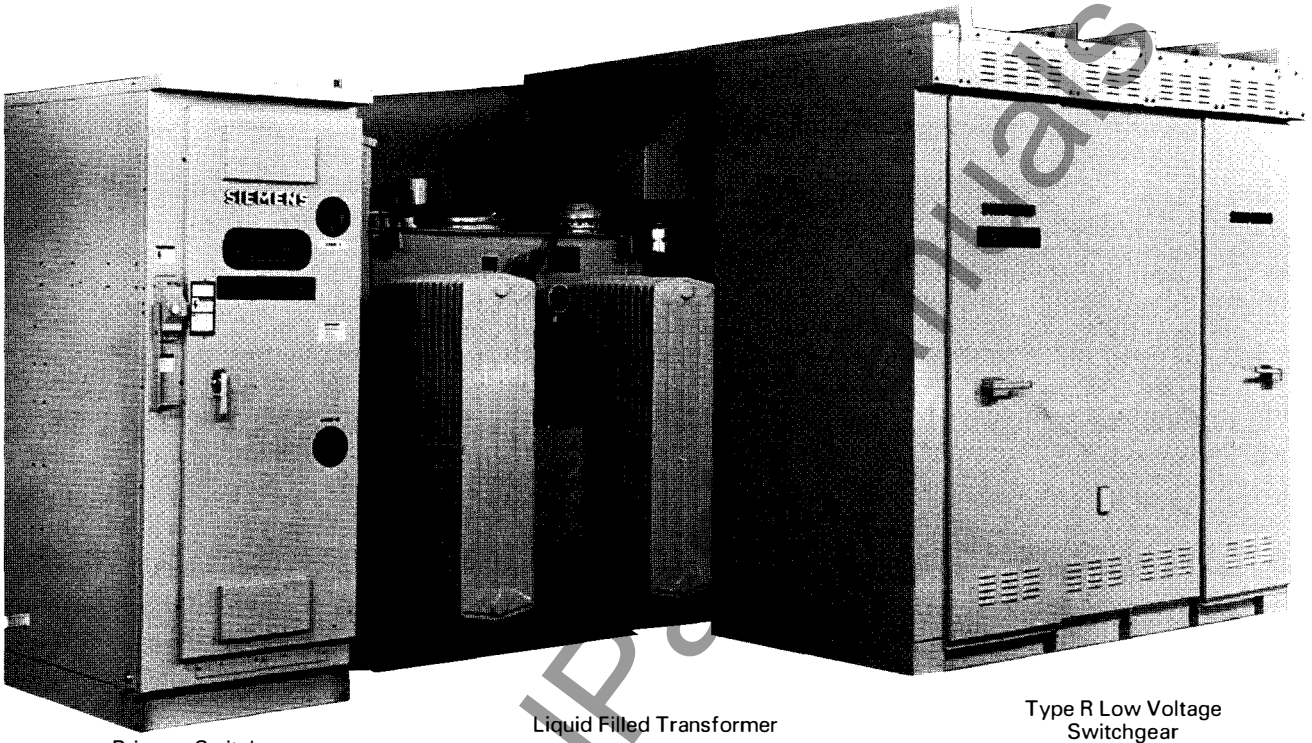


Primary Switch

Liquid Filled Transformer

Type RCIII Switchboard with SB Encased Systems Breakers

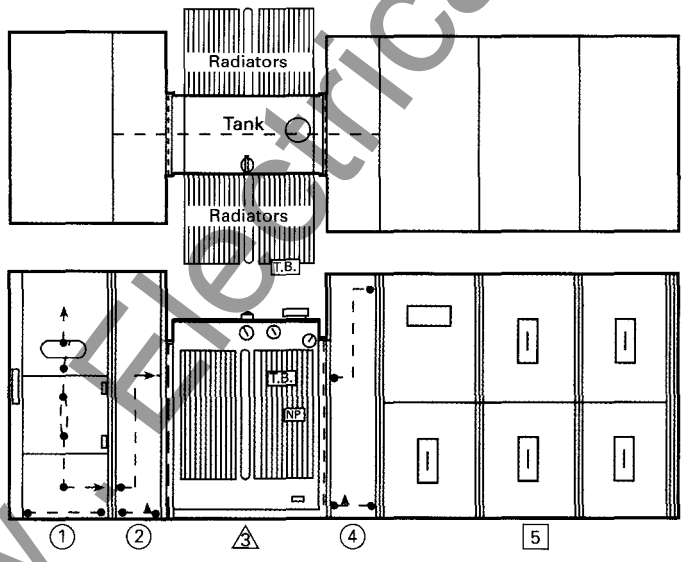
Reference



Primary Switch

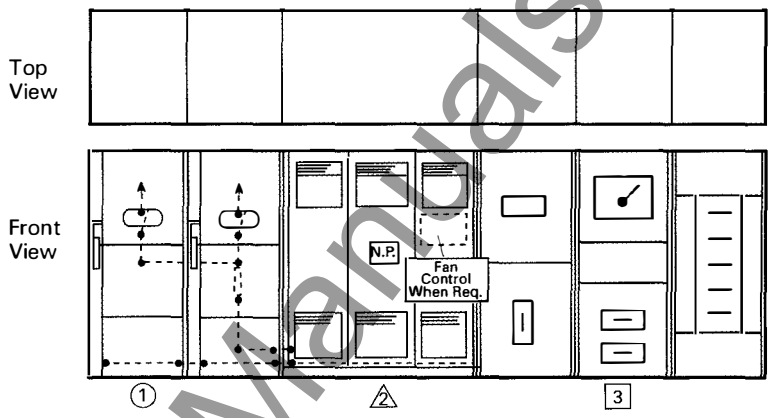
Liquid Filled Transformer

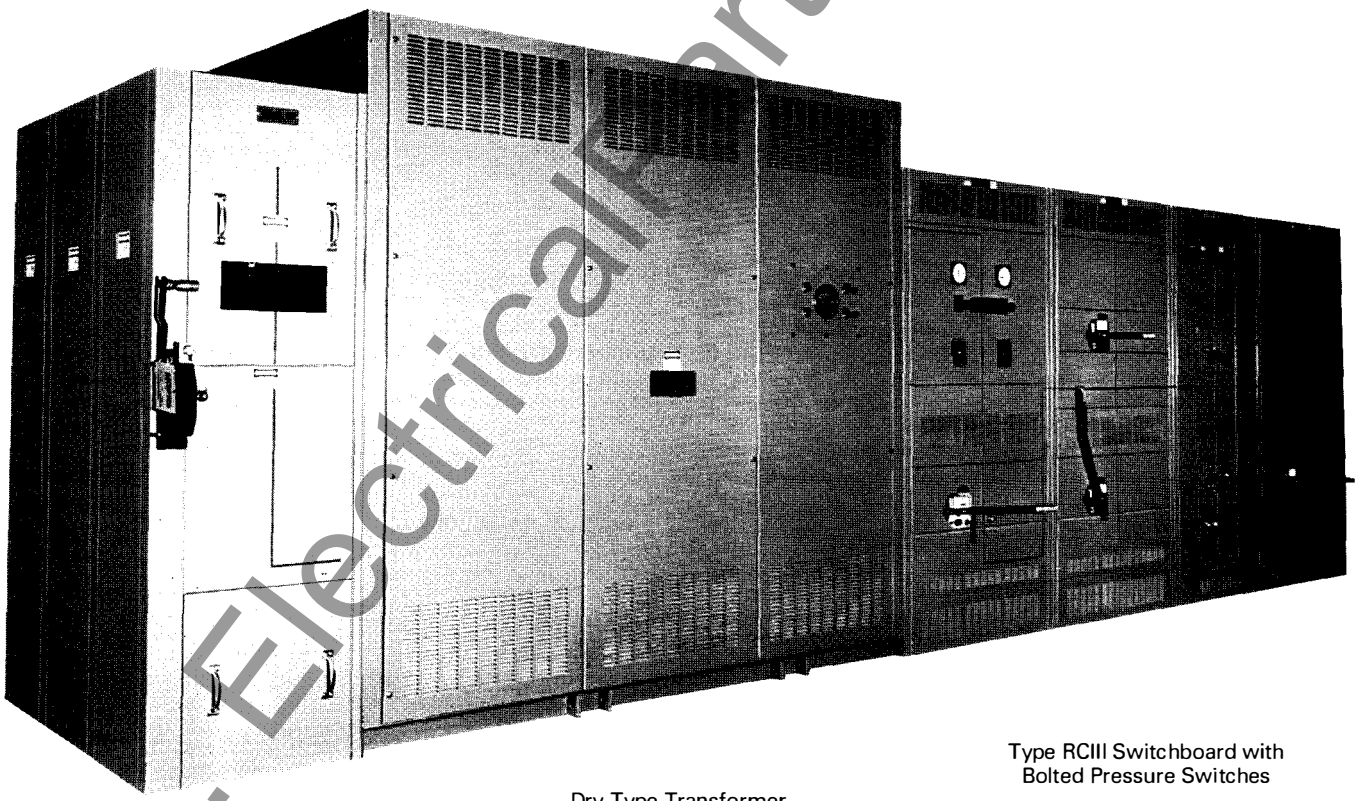
Type R Low Voltage Switchgear



① HV Switch
② HV Transition
△ Liquid Transformer
④ LV Transition
5 LV Switchgear

① HV Switch
⚠ Dry Type or Cast Coil Transformer
3 LV Switchboard

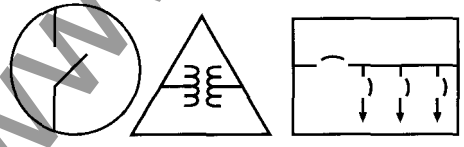




Primary Switch

Dry Type Transformer

Type RCIII Switchboard with
Bolted Pressure Switches



Incoming Line Section

The incoming line section of a Siemens secondary unit substation can be ordered in any one of four basic configurations. The most commonly used is the air interrupter switch providing a primary disconnect. When primary circuit protection and/or disconnection means is located near the substation, an air terminal chamber is the usual choice. A liquid interrupter switch and an oil cutout switch are two alternatives. A primary metering unit can also be incorporated in the incoming line section.

Air Interrupter Switch
The Siemens air interrupter switch is a stationary mounted, three pole, two position (open-close) device which uses a quick-make, quick-break arcing blade with an arc chute for safe closing and normal current interruptions. The switch position is visible through a safety front window and is indicated on the operating handle mechanism.

The switch is available with or without fuses, which can be either current limiting or expulsion type. Each fused switch has a hinged compartment door that covers the fuses and is mechanically interlocked with the switch so the door can be opened only when the switch is open.

The switch is available with cable lugs or potheads and can be arranged for top or bottom entrance of cables.

Surge arresters can be furnished, if required.

A duplex switch is also available, consisting of two Kirk key interlocked switches located side by side. This arrangement permits the selection of one of the two incoming sources of power to the transformer.

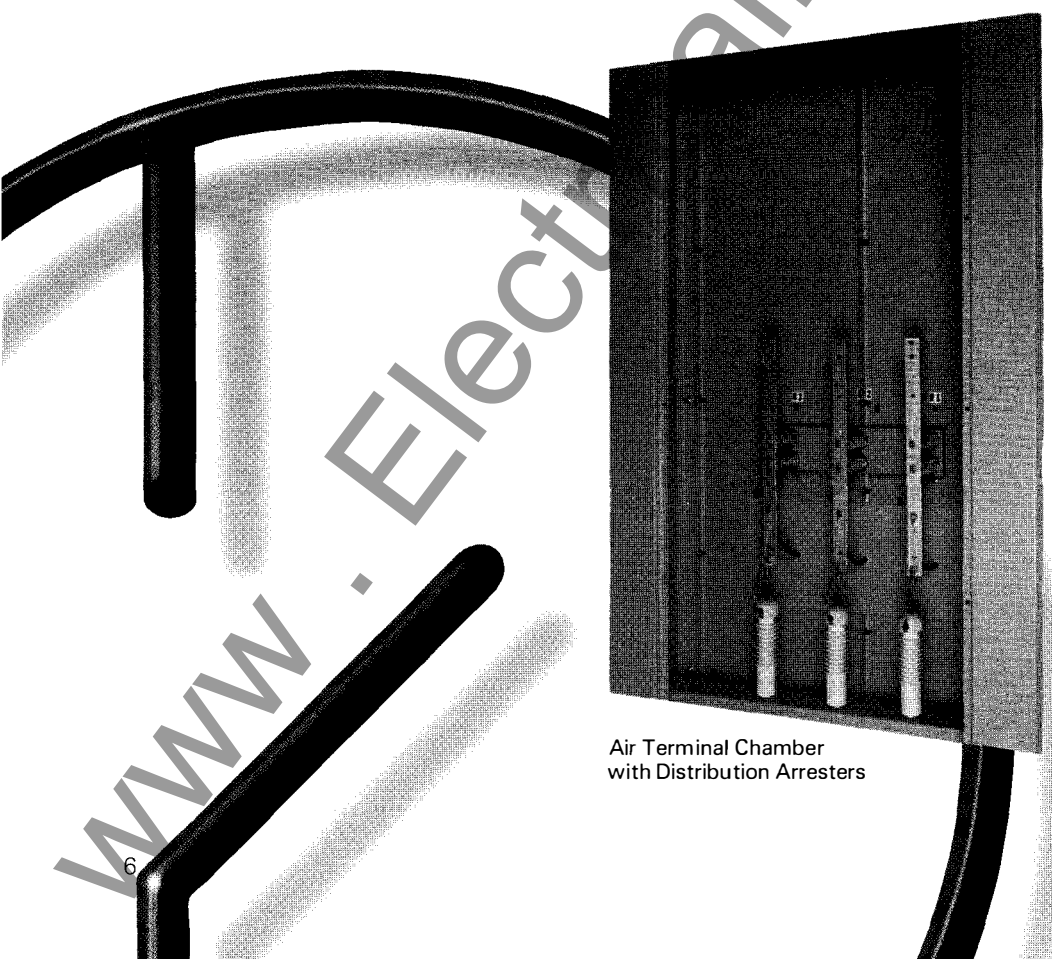
The air interrupter selector switch consists of a stationary rear-mounted, three pole, two position (Line 1-Line 2) switch in series with a three pole, two position (ON-OFF) interrupter switch. Mechanical interlocking is provided so that the load interrupter switch must be open before the selector switch can be changed from one feeder to another feeder. See page 8 for available switch ratings.

Air Terminal Chamber
The air terminal chamber is floor mounted and can be equipped with cable lugs or potheads (optional). It is directly connected to the high voltage side of the transformer. Both indoor and outdoor construction is available, and the unit can be arranged for top or bottom entrance. Space can be provided for loop feeding of cables, if needed.

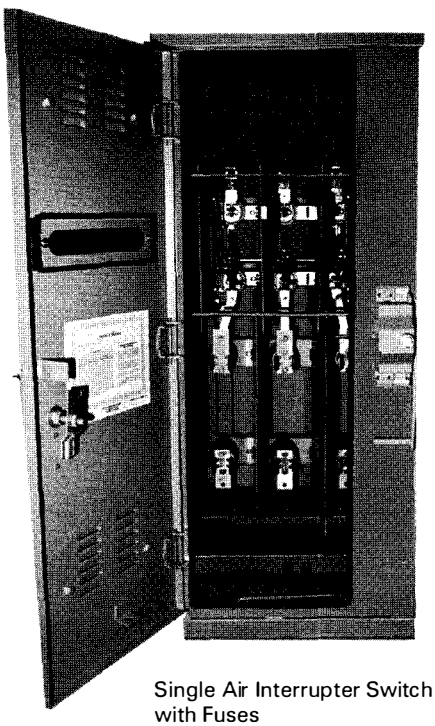
Since air terminal chambers provide no means either to disconnect or to protect the transformer, such a means should be provided upstream from the transformer.

Liquid Interrupter Switch
This is a three pole, two or three position non-fused assembly with the switch immersed in oil. It can interrupt **load currents up to 400 amperes. The liquid interrupter switch is available only on substations incorporating a liquid filled transformer.**

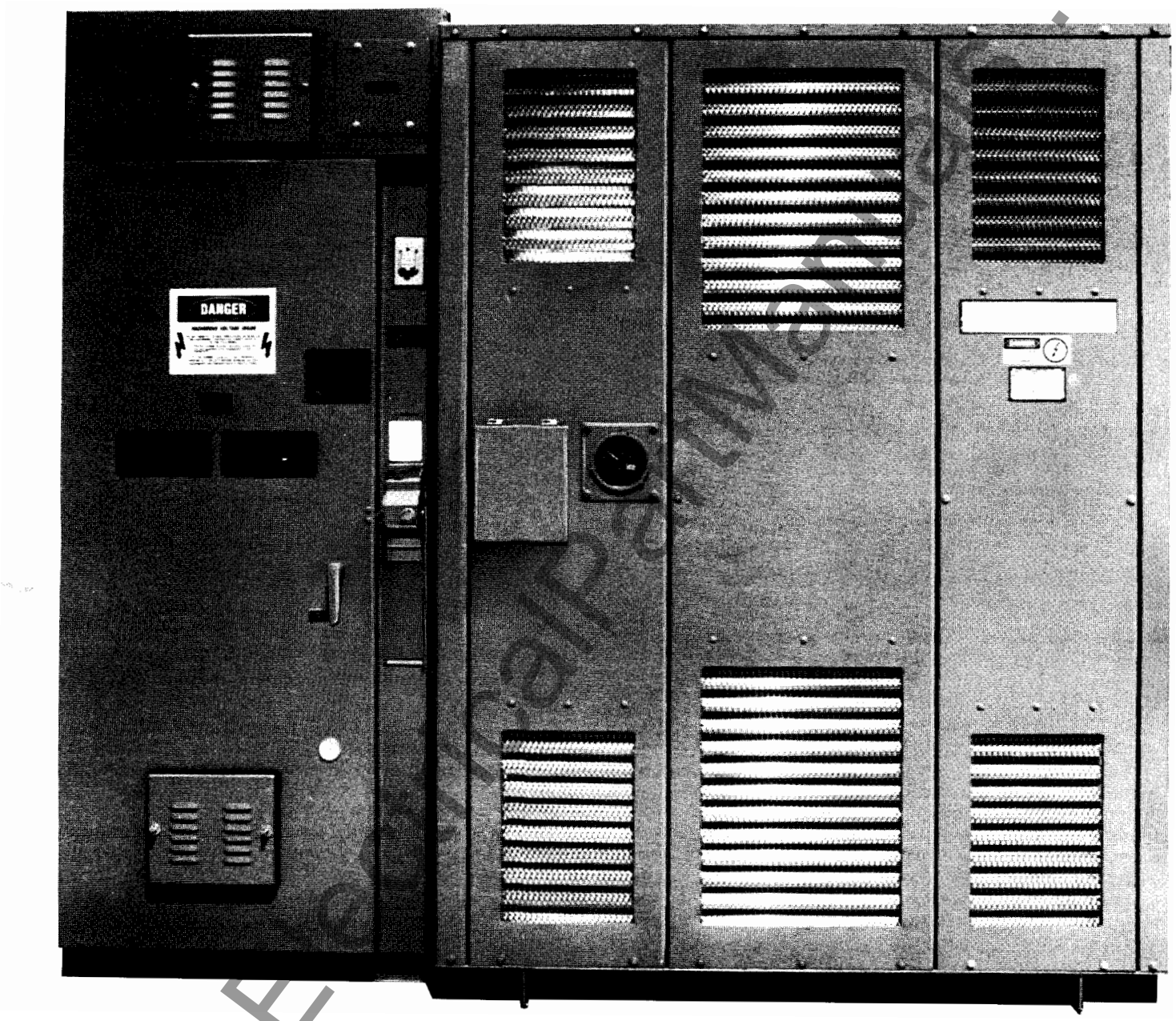
Primary Metering Unit
This is a separate unit available to match an adjacent air interrupter switch unit. It can be equipped with current transformers, potential transformers and devices for user metering or with complete provisions for power company metering. Special designs can be provided to meet local power company requirements.



Air Terminal Chamber
with Distribution Arresters



Single Air Interrupter Switch
with Fuses



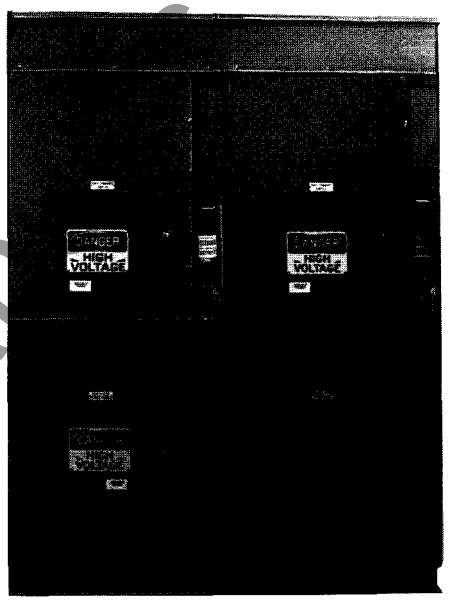
Single Air Interrupter Switch / Outdoor Dry Type Transformer

Incoming Line Section

Indoor Air Interrupter Switch Ratings①

Voltage Ratings ② ③				Current Ratings ② ③				
						Short-Time Ratings		
Nominal kV, RMS	Maximum Design kV, RMS	1 Min. Power Frequency Withstand kV, RMS	1.2 × 50 Impulse Withstand kV, BIL	Continuous Ampere, RMS	Load Interrupt Amperes RMS	Momentary Assym. kA, RMS	2-Sec kA, RMS	Fault-Close kA, RMS Assym.
4.16	4.76	19	60	600	600	40	25	40
				1200	1200	61	38	61
7.2	8.25	26	75	600	600	40	25	40
				1200	1200	61	38	61
13.8	15.00	36	95	600	600	40	25	40
				1200	1200	61	38	61

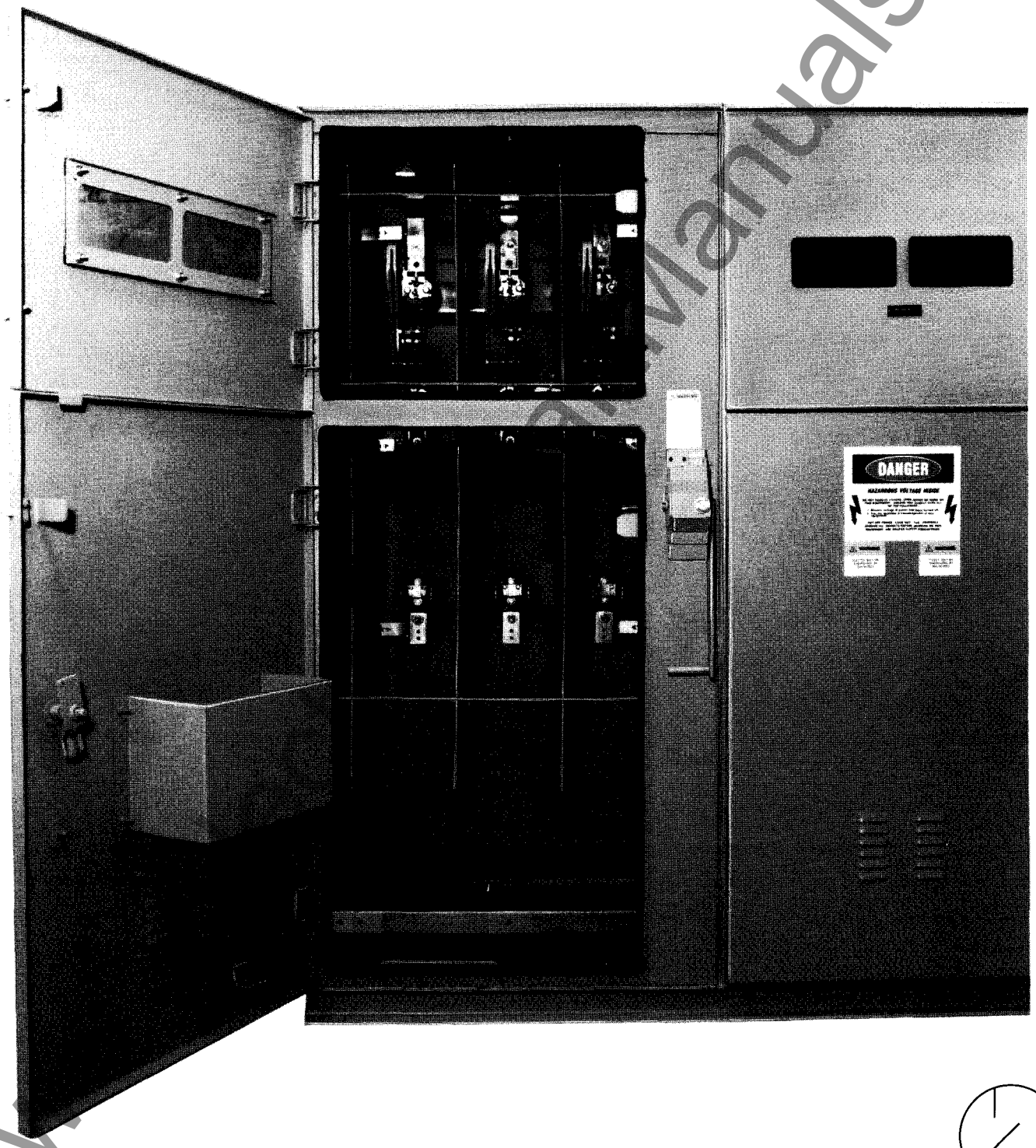
① Contact sales office for 25 and 38 kV ratings.
② Ratings apply to Stored Energy Operated Switches.
③ Special ratings available - consult Siemens.
UL and MET listings for specific application - consult Siemens.



Power Fuses

Max Design KV	System KV	Interrupting Ratings		Maximum Continuous Current		
		RMS Symmetrical Amperes	Nom. Equiv. 3Ø-MVA ①	Single Barrel	Double Barrel	Triple Barrel
Current Limiting Fuse						
5.5	2.4	50,000	208	200E	400E	—
	4.16	50,000	360	200E	400E	—
	4.8	50,000	416	200E	400E	—
15.5	6.9	40,000	480	125E	250E	—
	7.2	40,000	500	125E	250E	—
	11.5	40,000	800	125E	250E	—
	12.0	40,000	830	125E	250E	—
	12.47	40,000	860	125E	250E	—
	13.2	40,000	910	125E	250E	—
	13.8	40,000	955	125E	250E	—
	14.4	40,000	1000	125E	250E	—
5.5	2.4	60,000	250	10E Through 150E	175E Through 450E	—
	4.16	60,000	430			—
	4.8	60,000	500			—
	4.8	60,000	500	—		—
	4.8	50,000	500	—	—	600E
	4.8	50,000	500	—	—	750E
15.5	6.9	50,000	596	10E Through 100E	—	—
	7.2	50,000	620		—	—
	11.5	40,000	800		125E Through 200	—
	12.0	40,000	830			—
	12.47	40,000	860			—
	13.2	40,000	910			—
	13.8	40,000	955			—
	14.4	40,000	1000			—
Expulsion Fuse — S and C Type SM or Westinghouse Type RBA						
5.5	4.8	17,200	125	200E	—	—
	4.8	37,500	270	400E	720E②	—
17	14.4	14,000	335	200E	—	—
	14.4	12,500	300	200E	—	—
	14.4	25,000	600	400E	—	—
15.5	13.8	34,000	815	400E	—	—

① The 3ph MVA = 1.73 × (kV) × (fuse interrupting kA)
② Double Barrel Fuse. Consult Siemens for dimensions.



Incoming Line Section

Current-Limiting Fuse Selection ①

Transformer Rating		2.4 System kV, Line-to-Line				4.16 System kV, Line-to-Line				4.8 System kV, Line-to-Line			
			Fuse Size				Fuse Size				Fuse Size		
kVA②	Impd. ③ (%)	FLA	Min	133%	Max	FLA	Min	133%	Max	FLA	Min	133%	Max
150	2.0-4.5	36	40E	50E	80E	21	25E	30E	40E	18	25E	25E	40E
225	3.5-4.5	54	65E	80E	100E	31	40E	40E	65E	27	30E	40E	50E
300	4.0-5.0	72	80E	100E	125E	42	50E	65E	80E	36	40E	50E	80WE
500	5.0	120	150E	200E	200E	69	80E	100E	125E	60	65E	80E	100E
750	5.75	180	200E	250E	300E	104	125E	150E	150E	90	100E	125E	150E
1000	8.0	241	300E	—	300E	139	200E	200E	200E	120	150E	—	150E
1000	5.75	241	300E	400E	400E	139	200E	200E	250E	120	150E	200E	200E
1500	5.75	361	400E	500E	—	208	250E	300E	400E	180	200E	250E	300E
2000	5.75	482	600E	—	—	278	400E	400E	400E	241	300E	400E	400E
2500	5.75	602	—	—	—	348	400E	—	—	300	400E	400E	400E
3000	5.75	722	—	—	—	416	450E	600E	—	362	400E	—	—

Transformer Rating		7.2 System kV, Line-to-Line				12.0 System kV, Line-to-Line				12.47 System kV, Line-to-Line			
			Fuse Size				Fuse Size				Fuse Size		
kVA②	Impd. ③ (%)	FLA	Min	133%	Max	FLA	Min	133%	Max	FLA	Min	133%	Max
150	2.0-4.5	12	15E	20E	25E	7	10E	10E	15E	7	10E	10E	15E
225	3.5-4.5	18	20E	25E	40E	10.8	15E	15E	20E	10.4	15E	15E	20E
300	4.0-5.0	24	30E	40E	50E	14.4	20E	20E	30E	14	15E	20E	30E
500	5.0	40	50E	65E	80E	24	30E	40E	50E	23	25E	30E	50E
750	5.75	60	80E	80E	100E	36	40E	50E	80E	35	40E	50E	65E
1000	8.0	80	100E	—	100E	48	65E	65E	80E	46	50E	65E	65E
1000	5.75	80	100E	125E	150E	48	65E	65E	100E	46	50E	65E	80E
1500	5.75	120	150E	200E	200E	72	80E	100E	125E	70	80E	100E	125E
2000	5.75	160	200E	200E	200E	96	125E	150E	150E	92	100E	125E	150E
2500	5.75	201	—	—	—	120	150E	200E	200E	116	150E	200E	200E
3000	5.75	241	—	—	—	144	200E	200E	200E	139	150E	200E	200E

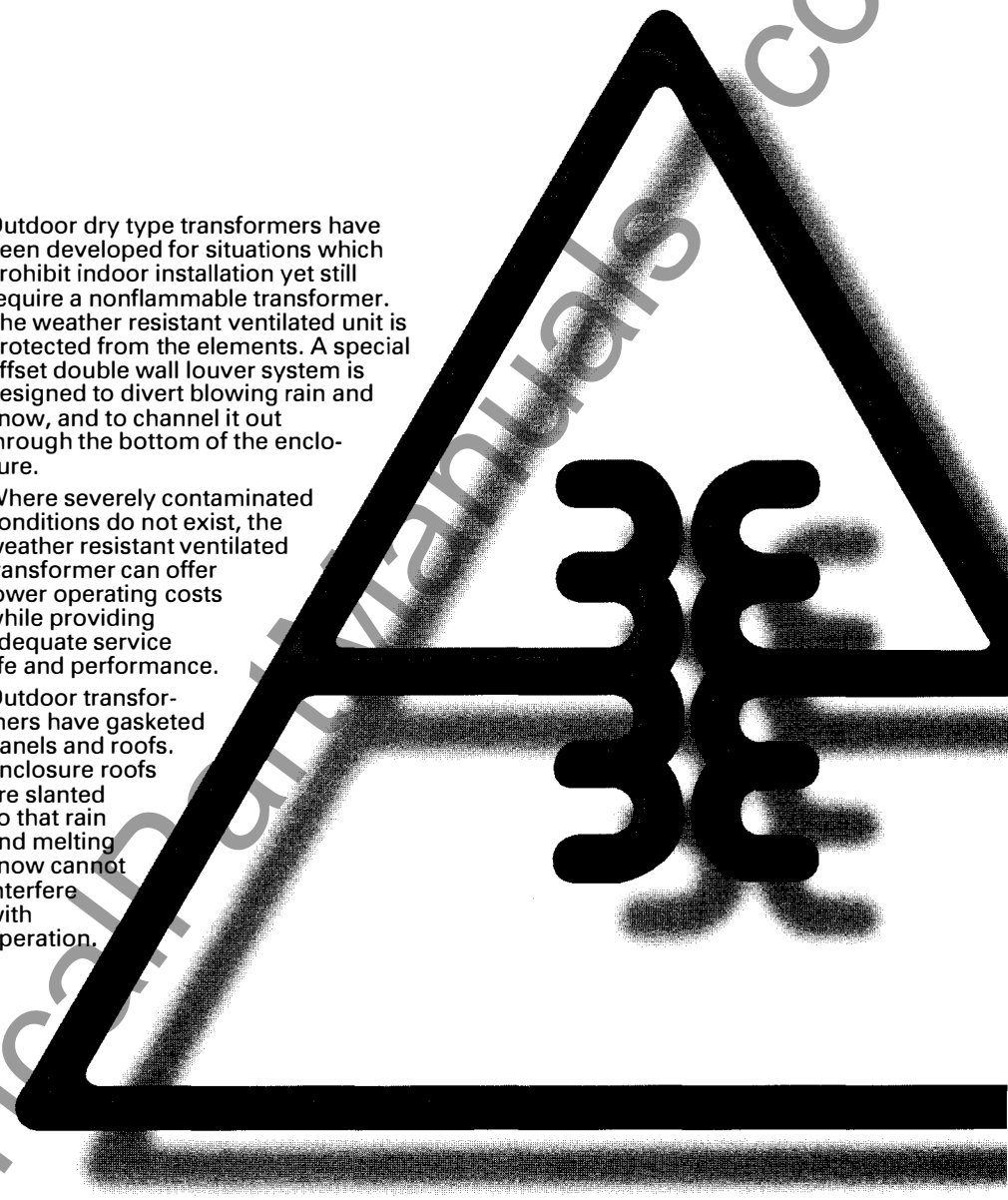
Transformer Rating		13.2 System kV, Line-to-Line				13.8 System kV, Line-to-Line				14.4 System kV, Line-to-Line			
			Fuse Size				Fuse Size				Fuse Size		
kVA②	Impd. ③ (%)	FLA	Min	133%	Max	FLA	Min	133%	Max	FLA	Min	133%	Max
150	2.0-4.5	6.6	10E	10E	15E	6.2	10E	10E	15E	6	10E	10E	10E
225	3.5-4.5	9.8	15E	15E	20E	9.4	15E	15E	20E	9	15E	15E	20E
300	4.0-5.0	13	15E	20E	30E	12.6	15E	20E	25E	12	15E	20E	25E
500	5.0	22	25E	30E	50E	21	25E	30E	40E	20	25E	30E	40E
750	5.75	33	40E	50E	65E	32	40E	50E	65E	30	40E	40E	65E
1000	8.0	44	50E	65E	65E	42	50E	65E	65E	40	50E	65E	65E
1000	5.75	44	50E	65E	80E	42	50E	65E	80E	40	50E	65E	80E
1500	5.75	66	80E	100E	100E	63	80E	100E	100E	60	65E	80E	100E
2000	5.75	88	100E	125E	150E	84	100E	125E	150E	80	100E	125E	150E
2500	5.75	109	125E	150E	150E	105	125E	150E	150E	100	125E	150E	150E
3000	5.75	131	150E	200E	200E	125	150E	200E	200E	120	150E	200E	200E

① Minimum fuse size shown will clear transformer magnetizing inrush current. 133% fuse size permits overload operation of transformer up to 133% rating. Maximum fuse size provides transformer fault protection for phase-phase, 3-phase and phase-ground faults on secondary windings of standard 3-phase transformers. Suffix E denotes NEMA standard fuse rated 30°C rise above 40°C average ambient.

② The self-cooled kVA rating of the transformer as listed here should be used in selection of fuse size on forced-air cooled transformer applications. Also, on such applications, the 133% fuse size must be chosen for proper coordination.

③ Typical percent impedance on self-cooled kVA base, subject to ±7½% tolerance.

Transformer Section



Siemens secondary unit substations are available with a choice of liquid filled or dry type transformers. Liquid filled units are available with either oil, R-Temp, or silicone as the insulating fluid. Dry type units can be conventional or cast coil. Page 12 lists the standard transformer ratings for each type.

Non-standard units are also available with such characteristics as special temperature rises, insulation levels, low losses, low noise levels, special impedances, and voltages to meet specific application requirements. Weights, dimensions, and performance characteristics of non-standard units can be obtained from Siemens.

Many factors are involved in the choice of a transformer for a particular application. These range from initial cost to environmental factors to personal preference.

Liquid filled transformers have their core and coil immersed in either mineral oil, R-Temp, or silicone fluid. The oil-filled transformer is generally applied outdoors but may also be applied indoors when designed to avoid any possible fire hazard. Oil-filled units are the lowest cost of all the available types of transformers and feature compact size and high BIL levels.

R-Temp and silicone filled transformers are similar to the oil-filled type in construction and features with the exception of the insulating fluid. These units are designed primarily for indoor application but can also be used outdoors near building walls or on roofs. R-Temp fluid has a fire-point of 311°C. Silicone offers a fire-point of 371°C.

A **ventilated dry type transformer** is one in which the windings are cooled by the natural circulation of ambient air through the transformer. This type transformer utilizes vacuum pressure impregnation (VPI), a superior moisture-resistant insulation system designed to operate at an average temperature rise of 150°C. VPI/epoxy dry types are applied in areas where heavy or conducting contaminants exist in the air. Ventilated dry type transformers are lightweight and are fire and toxic resistant.

Outdoor dry type transformers have been developed for situations which prohibit indoor installation yet still require a nonflammable transformer. The weather resistant ventilated unit is protected from the elements. A special offset double wall louver system is designed to divert blowing rain and snow, and to channel it out through the bottom of the enclosure.

Where severely contaminated conditions do not exist, the weather resistant ventilated transformer can offer lower operating costs while providing adequate service life and performance.

Outdoor transformers have gasketed panels and roofs. Enclosure roofs are slanted so that rain and melting snow cannot interfere with operation.

An overhang on all four sides provides extra weather protection.

The **cast coil transformer** has its high voltage coils vacuum cast in epoxy resin providing a non-hygroscopic, sealed coil, highly resistant to moisture and industrial and chemical contaminations. It has excellent dynamic short circuit strength. The cast coil insulation provides small size, low sound levels, and high efficiency. It is virtually non flammable and self extinguishing. It has unlimited storage duration and will be ready for immediate use.

Siemens unit substation transformers — liquid filled, dry type, and cast coil — can be custom designed to meet customer specifications including loss evaluations, harmonic load conditions, or other special applications.

Transformer Section

Standard Transformer Ratings①

Transformer Type	Primary Voltages	kVA 3-Phase Self-Cooled	kVA 3-Phase Fan-Cooled	Secondary Voltage 208Y/120V 240 Delta	Secondary Voltage 480Y/277V 480 Delta	Std. Impedance ② (% IZ)	NEMA Sound Level (dB) Self-Cooled	NEMA Sound Level (dB) Forced-Air Cooled
Liquid Filled 65°C Rise ③	2400 4160 4800	150	—	√	√	2.0-4.5 ④	55	—
		225	—	√	√	3.5-4.5 ④	55	67
		300	—	√	√	4.0-5.0 ④	55	67
		500	—	√	√	4.0-5.0 ④	56	67
	6900 7200	750	862	√	√	5.75	57	67
		1000	1150	√	√	5.75	58	67
	12000 12470 13200 13800	1000	1150	√	√	8.0	58	67
		1500	1725	—	√	5.75	60	67
		2000	2300	—	√	5.75	61	67
		2500	3125	—	√	5.75	62	67
		3000	3750	—	√	5.75	63	67
VPI Ventilated Dry Type 150°C Rise ③ VPI/Epoxy Dry Type 115°C Rise	2400 4160 4800	150	—	√	√	5.0	55	—
		225	—	√	√	5.0	58	—
		300	400	√	√	5.0	58	—
		500	667	√	√	5.75	60	—
	6900 7200	750	1000	√	√	5.75	64	67
		1000	1333	√	√	5.75	64	67
	12000 12470 13200 13800	1000	1333	√	√	8.0 (opt.)	64	67
		1500	2000	—	√	5.75	65	68
		2000	2666	—	√	5.75	66	69
		2500	3333	—	√	5.75	68	71
		3000	4000	—	√	5.75	70	71
Cast Coil Dry Type 80 or 115°C Rise ③	2400 4160 4800	150	—	√	√	3.0	55	—
		225	—	√	√	4.0	58	—
		300	400	√	√	5.0	58	—
		500	667	√	√	5.75	60	67
	6900 7200	750	1000	√	√	5.75	64	67
		1000	1333	√	√	5.75	64	67
	12000 12470 13200 13800	1000	1333	√	√	8.0 (opt.)	64	67
		1500	2000	—	√	5.75	65	68
		2000	2666	—	√	5.75	66	69
		2500	3333	—	√	5.75	68	71
		3000	4000	—	√	5.75	70	71

① Contact sales office for 25 and 38 kV ratings.
② Standard impedance tolerance is ±7-1/2%. Impedance values apply to units with standard BIL ratings. Higher BIL ratings are typically 1% to 1.5% higher impedance.
③ For applications where the average ambient temperature is 30°C.
④ Transformers with impedances of 4.0% or less are designed to withstand 25 times normal current for two seconds.

Liquid Filled

Core Construction
Wound cores of Siemens liquid filled transformers are rectangularly shaped, single turn laminations of high quality, grain oriented magnetic core steel. Fully annealed after cutting and forming, the core loops can be opened for assembly through coil windows without deterioration in performance characteristics. Lamination joints are staggered and precisely cut for close fit. Each loop rests on the joint end, and is in direct contact with the bottom core clamp for positive grounding. Cores are compact and designed for low excitation currents, low losses and quiet performance.

The upper and lower core clamps are rigidly constructed. Core clamps are chemically cleaned to remove any dirt or impurities from the forming and welding operations. This assures that only clean metal will be in contact with the cooling medium. Core clamps and all structural parts are insulated from live parts to prevent development of voltage potential in any part.

Coil Construction
The coil is of rectangular construction with sheet-wound aluminum secondary windings and insulated wire-wound aluminum primary windings (copper windings available as an option).

Coils are equipped with cooling ducts in order to dissipate the heat being generated. Sufficient ducts are located throughout the coils to avoid hot spots in the windings and to assure overload capability.

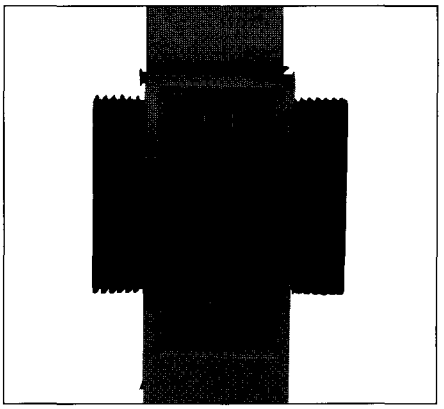
Stresses
Axial short circuit stresses are virtually eliminated by the use of sheet-wound secondary and wire-wound primary windings with no interleaved components. Coils are wound with the secondary coil nearest the core and supported by a strong insulating form. The primary is wound directly over the secondary coil with a suitable insulating full-length barrier between the primary and secondary windings. The coil wire is wound tightly and uniformly through a tension device, and conductors are bonded to a diamond patterned epoxy paper to insure maximum short circuit strength.

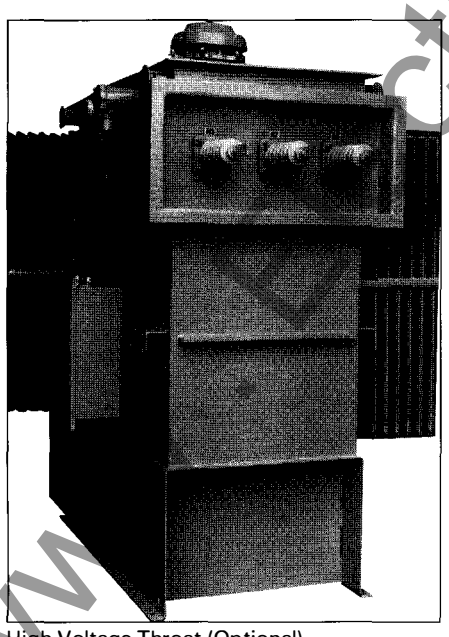
Insulating Material
All insulating materials have been thoroughly tested and proven with respect to their electrical and mechanical characteristics and are stable at nameplate operating temperatures.

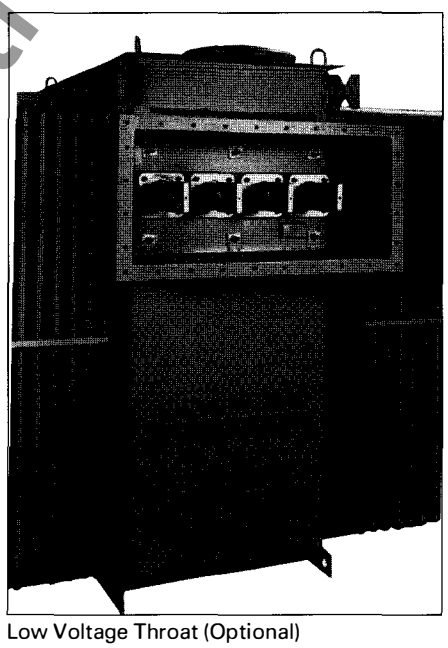
In liquid filled transformers, the insulation system is thermally upgraded and chemically modified to resist the effects of high temperature. This enables the transformer to maintain full load-carrying ability at rated operating temperature without affecting life expectancy.

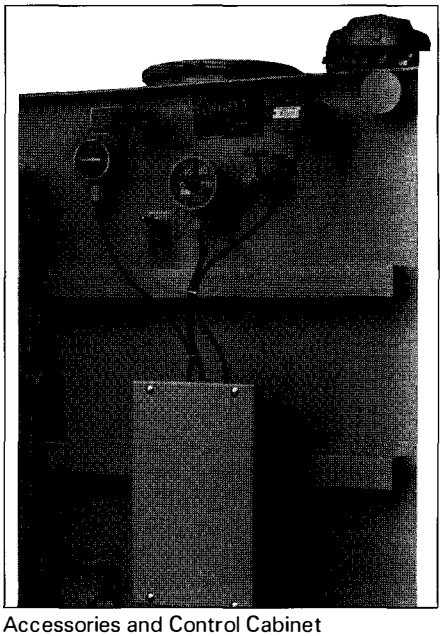
Thermally-upgraded corrugate or stick duct insulation is used for longitudinal and radial coil spacers. It is also used between layers, and between high-and low-voltage coils. The porosity of the insulating materials permits the insulating liquid to penetrate the insulating material, giving it a high dielectric strength.

Tap Changer
The externally operated tap changer allows for line voltage changes, when de-energized. The stacked multi-phase assembly features one-piece stationary contacts rigidly locked in place. All three phases are switched simultaneously on the stacked multi-phase rotary switch. Switching of the contacts is made through a bridging roller.


Low Voltage Throat with full length air terminal chamber (Optional)

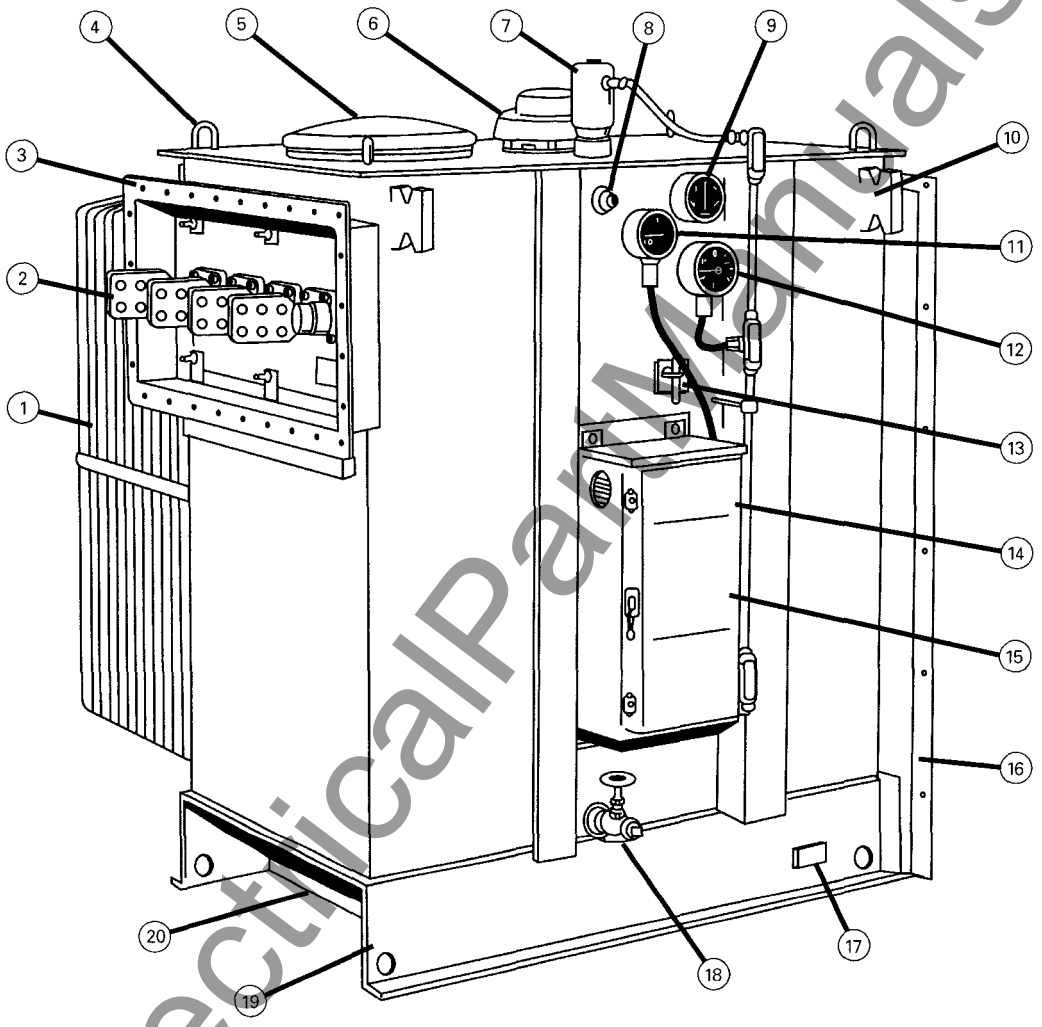

High Voltage Throat (Optional)


Low Voltage Throat (Optional)


Accessories and Control Cabinet

Transformer Section

Liquid Filled



- ● Radiators
  Provided as required to meet rating specifications. Detachable radiators optional.
- ② Low Voltage Bushing Terminals
- ③ Throat
  (optional)
- ④ Cover Lifting Eye (optional)
- ⑤ Inspection Port Handhole
  Bolted, sealed cover allows interior inspection.
- ⑥ Pressure Relief Device
  Automatic resealing device (optional).
  Available with optional alarm contacts.
- ● Sudden Pressure Relay
  (optional)
- ⑨ Top Filter Press Connection
- ⑨ Pressure / Vacuum Gauge
  Available with optional alarm contacts.
- ⑩ Tank Lifting Lugs
  Lift hooks welded to tank at each corner.
- ⑪ Liquid Level Gauge
  Shown with optional alarm contacts.
- ● Temperature Gauge
  Provided with magnetic resettable pointer. Shown with optional alarm contacts. Indicates top fluid temperature.
- ● Tap Changer
  De-energized, externally operable, handle equipped for locking.
- ⑭ Control Cabinet (optional)
- ⑮ Nameplate
- ⑮ Full Height Flange (optional)
- ● Grounding Pad
  Front and rear.
- ⑱ Fluid Drain Sampling Valve
  One-inch drain valve with sampler.
- ⑲ Base
  Suitable for skidding or rolling.
- ◐ Jacking Pads

Tank Construction

The transformer tank is fabricated of precision cut, heavy gauge, cold rolled steel plates with a minimum number of plates used to reduce the number of welded seams.

Formed structural members are welded to the side wall so the complete tank is sufficiently reinforced to withstand a test pressure 25% greater than normal operating pressure. The top of the tank is fully strengthened with welded plate steel. Lifting devices are provided at the corners of the tank to permit crane handling of the transformer.

Cooling radiators assure that the temperature rise of the liquid will not exceed the specified limit when the transformer is continuously operated at full load.

The entire tank is shot blasted and then steam cleaned before painting to remove any impurities from the forming and welding operation. Each tank is painted with alkyd enamel paint in accordance with ANSI standards.

A flange is provided on the primary and secondary sides of the transformer for bolting to the incoming and outgoing sections, providing an uninterrupted line-up of equipment.

Special Fluids

R-Temp and Silicone fluids are fire resistant liquid dielectric coolants formulated for use in transformers installed indoors, on roofs, in close proximity to buildings and structures, and significant public access areas. Their unique electrical, thermal, and safety properties are advantageous to these applications where transformer rupture, explosion, or fire would be most undesirable.

R-Temp fluid is a high molecular weight, paraffinic hydrocarbon-based material with a fire-point of 312°C.

Silicone fluid has a fire point rating of 371°C.

Forced-Air Cooling

OA/FA Ratings — Standard Siemens secondary unit substation transformers are OA (self-cooled) rated. Installation of optional forced-air cooling equipment (available on 750 kVA and above equipment) changes the rating to OA/FA (self-cooled / forced air) and increases kVA capacity by 15% (750–2000 kVA) and 25% (2500 kVA and above).

Cooling Equipment — Controls are temperature activated from contacts on liquid temperature gauge. Manual override is provided. Fan motors are 120 or 240 volts, single phase. Operating voltage and wiring to control cabinet must be supplied by customer. Fan blades utilize low noise design that is maintenance free, and fan guard design meets OSHA requirements.

Optional 55°C/65°C rise rating provide a 12% increase in kVA capacity when operated at 65°C rise over ambient.

Standard Accessories

- De-energized tap changer, externally operated
- Combination drain and filtering valve / sampling device
- Pressure test connection
- One inch upper filling and filter press connection
- Thermometer (dial type)
- Provision for lifting and jacking
- Ground pads, front and rear
- Nameplate with diagram and rating
- Pressure vacuum gauge
- Pressure relief valve
- Liquid level gauge

Optional Accessories

- Pressure relief device
- Rapid rise relay
- Winding temperature indication and relay (indicate hot spot or other)
- Lightning arresters (distribution, intermediate or station class)
- Throats (high and / or low voltage)
- Air terminal cabinets (high and / or low voltage)
- Detachable bolt-on radiators with valves
- Pressure / vacuum bleeder valve
- Alarm contacts

Typical Fluid Information ①

Typical Fluid Properties ②		Mineral Oil	R-Temp	Silicone (561 Fluid)
Chemical	Name	Paraffinic Hydrocarbon	Refined Paraffinic Hydrocarbon	Polydimethyl-siloxane
	Structure	C_xH_y	C_nH_m	$[(CH_2)_2SiO]_y(CH_3)_2$
Dielectric	Dielectric Strength (ASTM D 877) 25°C KV	30	25	35
	Dielectric Constant (ASTM D 924) 25°C	2.2	2.2	2.7
	Dissipation Factor (ASTM D 924) 25°C (ASTM D 924) 100°C	0.0004 0.009	0.0001 0.004	0.0001 0.0015
	Volume Resistivity (ASTM D 1169) ohm cm 25°C	1.0×10^{12}	1.1×10^{13}	1×10^{14}
Thermal	Pour Point (ASTM D 97) °C	–40	–15	–50
	Thermal Conductivity (ASTM D 2717) Cal/(Sec cm² °C)/cm	0.00029	0.00030	0.00036
	Specific Heat (ASTM D 2766) Cal/gm/°C 25°C	0.393	0.450	0.360
	Coefficient of Expansion (ASTM D 1903) (OC/OC/°C)	0.00076	0.00080	0.00104
Physical	Specific Gravity (ASTM D 1298) 25°C	0.875–0.910	0.869–0.910	0.957–0.964
	Interfacial Tension (ASTM 0971) (dyne/cm) 25°C	40	40	20.8
	Viscosity (ASTM D 445, D 2161) 25°C 40°C	14–16 12.0	350–379 120–140	47.5–52.5 35–39
	Flash Point (ASTM D 92) °C	150	238	268
	Fire Point (ASTM D 92) °C	160	311	371
	Rate of Heat Release at 60 Kw/m² Convective, Kw/m² Radiative, Kw/m²	 906 661	 546 361	 53 25
	Main Gases Evolved During Combustion	H_2, CO,H_2O,CO_2, CH_n	H_2,CO,H_2O, CO_2,CH_n	H_2,H_2O, CO,CO_2,CH_n

① From Dow Corning bulletin 561 *Transformer Fluid*, Bulletin 10-278D-93, 1993.

② For test methods, see *Standard Specifications for Silicone Fluid Used for Electrical Insulation*, ASTM D 4652-87, March 1987. 545-546.

Transformer Section

Dry Type

Core Construction

The core construction of each Siemens ventilated dry type transformer is made of non-aging, high permeability, grain oriented, cold rolled, silicon steel specifically processed for low losses.

The thin-gauge laminations are precision cut with special high quality shear blades in such a manner that the flux path is aligned with the axis of highest permeability in the steel. Each lamination is flat and free from burrs and is inorganically insulated on both surfaces to minimize eddy-current losses.

Laminations are stacked to computer specifications on a specially designed table to ensure flatness and prevent the introduction of bending stresses while the finished core is being set in an upright position.

Careful positioning of each lamination produces close fitting joints to minimize core loss and noise. As an optional feature, custom miter cut joints can be supplied for premium quality, low core loss design, or where required by customer specification.

Cores are designed to accommodate the coils with the optimum combination of high space factor and air flow, assuring a maximum utilization factor and compact design. The completed core assembly is rigidly clamped using formed steel members ensuring positive support and high strength, and preventing displacement under stress.

Coil Construction

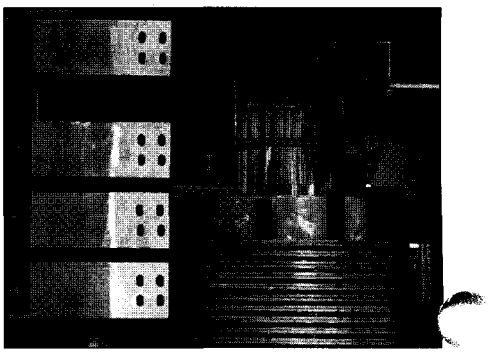
Coils are precision wound with high quality electrical grade aluminum, or with optional copper conductor. Primary coil construction may be random, layer, or disc, depending on the voltage class and basic impulse level required. Standard construction used is sheet-wound aluminum secondary windings and insulated, wire-wound primary windings. All coils are braced for full short circuit withstand capability in accordance with ANSI standards.

Where sheet windings are employed, axial short-circuit stresses are virtually eliminated. The primary is wound directly on the low-voltage winding with a suitable insulating barrier between the coils consisting of cooling duct spacers and sheet installation built up to the proper thickness.

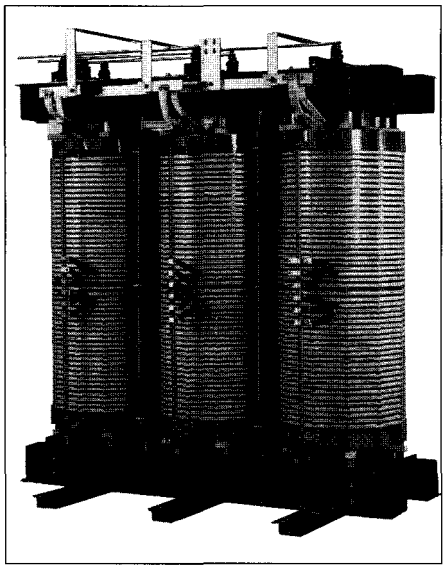
Where the coils are wire-wound, adequate bracing is supplied at the end of the coils to assure full short-circuit capability. Primary coils may also be of the disc or random-type construction with suitable spacers to provide coil-to-coil cooling and insulation.

Cooling is achieved by ducts in both the primary and secondary coils. When forced-air cooling is required, the air is directed through the cooling ducts to achieve the forced-air rating.

LV Bus Bar — Top Mounted

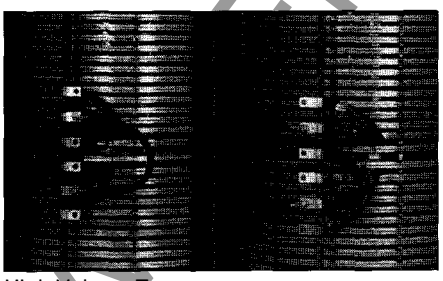


LV Bus Bar — End Mounted

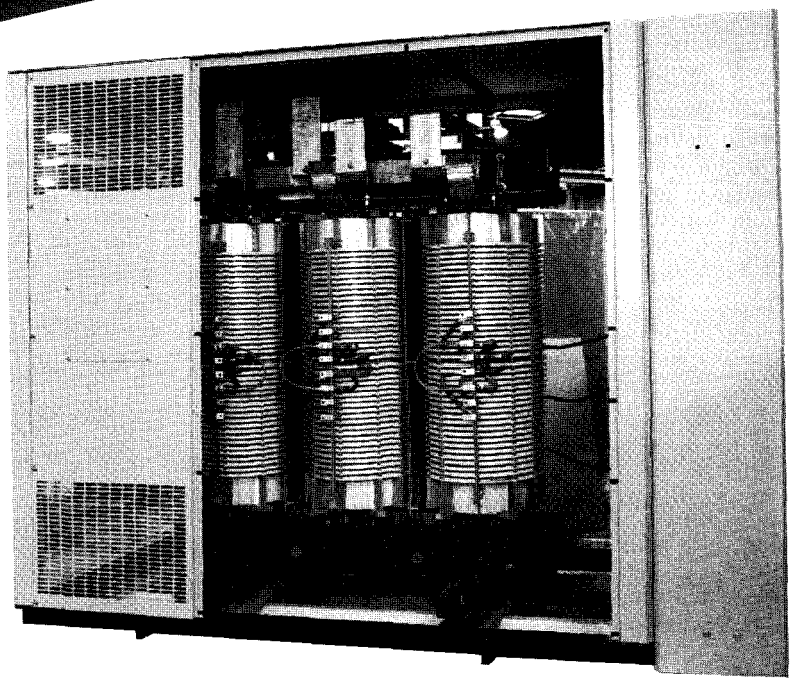


Core and Coil of Ventilated Dry Type Transformer

Ventilated Dry Type Transformer Assembly



High Voltage Taps



Dry Type

Insulating Material
All insulating materials have been thoroughly tested and proven with respect to their electrical or mechanical characteristics, are stable at operating temperatures, and are compatible with the cooling medium. All insulating material in the core and coil is chosen for the temperature system of the transformer and capability for that point of application.

Vacuum Pressure Impregnation
Siemens offers vacuum pressure impregnation (VPI) as a standard feature for dry type transformer construction. The VPI transformer provides high dielectric strength, superior mechanical stamina, and maximum design flexibility.

The VPI transformer utilizes high-performance, precatalized, polyester insulating varnish. The varnish creates a clear, yet high-bond strength product. This process completely seals and binds the windings into a high strength, environmentally protected assembly. The VPI process begins with pre-baking coils to remove any moisture. The assembly is then placed in a vacuum chamber, and the polyester varnish is introduced into the chamber. After the varnish penetrates the assembly, a high pressure blanket of dry nitrogen is placed on top of the varnish forcing the liquid material into every conceivable space and gap. The pressure is broken and the varnish is evacuated. The assembly is then baked to cure and set the insulated materials.

VPI/Epoxy Coating (Optional)
For environments polluted with chlorides, acids, alkalies, salt water, or high humidity, Siemens offers the epoxy-coated transformer. In addition to the VPI process, two mils of modified epoxy resin is added resulting in a premium transformer that will handle aggresive environments.

UL Listed Designs
Siemens offers UL listed / UL labeled ventilated dry type transformers. UL listed ratings include 500 through 3000kVA, 5KV and 15KV class primary, 600 volt class secondary, with temperatures rise options of 150°C, 115°C, or 80°C.

Dry type transformers utilize a UL recognized, 220°C insulation system that incorporates inorganic materials and polyester resins. Principle components of this system include Dupont Nomex® paper, resin-glass laminates, silicon rubber, and polyester varnish.

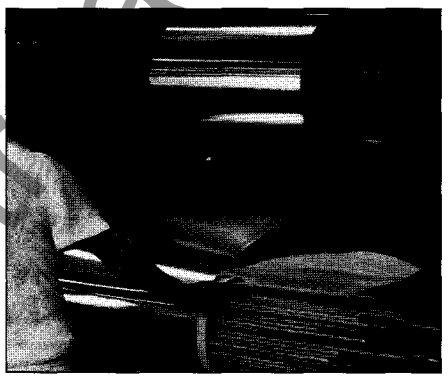
K-Factor Ratings (Optional)
Siemens dry type unit substation transformers are available with K-Factor rated designs as an optional feature for applications having non-linear or non-sinusoidal load conditions. The transformer K-Factor rating is based on the amount of harmonic distortion indicated in IEEE C57.110.

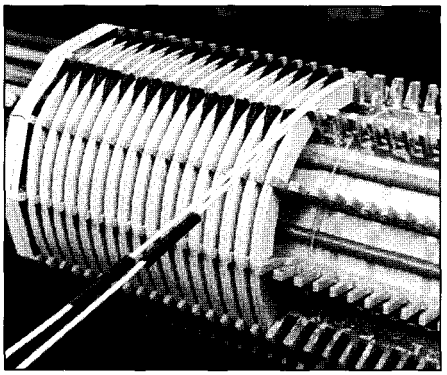
Ratings include:
- K4 for 50% non-linear load
- K13 for 100% non-linear load
- K20 for 150% non-linear load
- K30 for 200% non-linear load
- Other K-Factor rating or harmonic load profile specified.

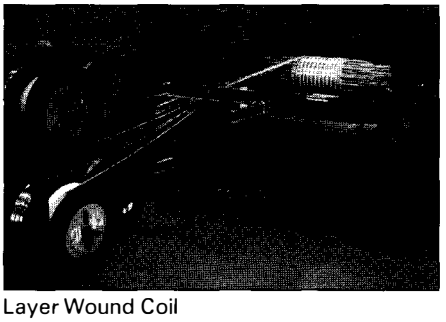
Taps
All Siemens ventilated dry type transformers include primary windings equipped with voltage adjustment tap leads to compensate for variations in incoming line voltages. Taps are two 2.5% taps full capacity above nominal (FCAN) and two taps full capacity below nominal (FCBN). Tap connections are located on the surface of each coil and are accessible behind removable enclosure panels. Taps are applied while the transformer is de-energized by changing terminal board links or flexible cables to provide for system voltage adjustment.

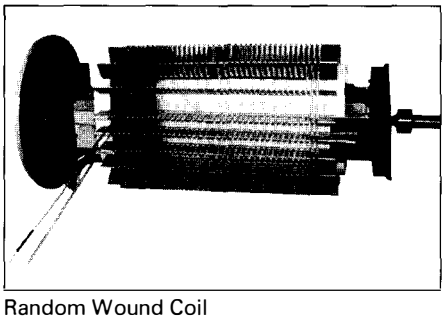
Forced Air Cooling
Ventilated, dry type transformers 500 kVA and above are equipped with provisions for future installation of forced air cooling fans. This includes space and mounting provisions for installation of fans and controls.

Optional: Complete forced air cooling is available to increase base kVA rating to an additional 33.3% over the self-cooled kVA rating. Complete forced air cooling incorporates the following features:
- Fan motors (120V AC, 1 phase) and blades with personnel protective guards.
- Solid state digital temperature indicator that monitors the winding temperature from single phase sensing. Three phase temperature


Sheet Wound Coil


Disc Wound Coil


Layer Wound Coil


Random Wound Coil

sensing can be specified as an option.

- Control panel with protective fuses and all necessary controls for operation of fan system.
- Auxiliary remote alarm and remote trip contacts.
- All hardware and wiring.
- Self test and memory.

Enclosures

Indoor ventilated, dry type transformers are provided with 12 gauge steel enclosures finished with light gray (ANSI #61) paint. Enclosures are sized to assure proper air flow for adequate cooling. Removable front and rear covers provide access for maintenance, inspection, and de-energized tap access. The enclosure base includes provisions for jacking, lifting, skidding, or rolling the transformer.

Weather Resistant Ventilated Dry Type Transformers

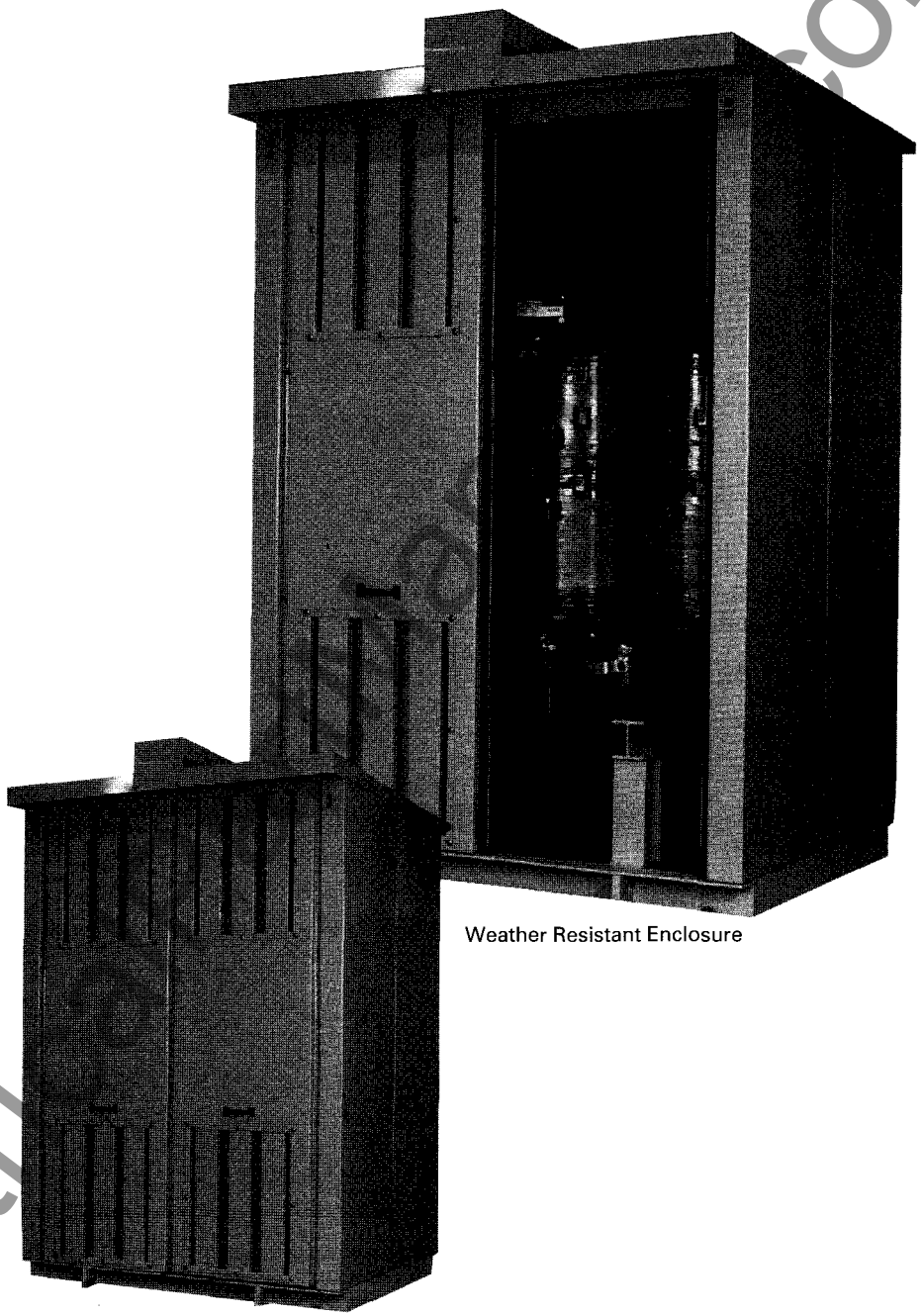
The outdoor dry type transformer has been developed for situations which prohibit indoor installation but still require a non-flammable transformer. Optional enclosures for outdoor locations incorporate weather resistant (NEMA 3R) construction with the same ratings, features, and flexibility of indoor units. The weather resistant feature includes special air louvers, gasketed covers, and space heaters.

Although the enclosure is similar to the standard ventilated dry unit, it can be built with tamper resistant construction as an optional feature allowing access only with proper tools.

Loss Evaluated Transformers (Optional)

Siemens offers transformers with guaranteed losses for customer loss evaluations. A "low loss" design is offered when users are looking for a transformer that, over a period of time, will actually cost less in total owner cost than a standard transformer with higher losses.

The cost of electric power has increased over the years. In the past when electricity was less expensive, the first cost, or original purchase price, was the primary consideration. With low loss energy-conserving transformers, the initial purchase price may be higher because material content is more expensive. However, the payback and continued savings may justify that cost in operating expenses when an optimized design is furnished.



Weather Resistant Enclosure

Siemens can provide an optimized design when the user specifies a dollar evaluation for no load (core) and load (conductor) losses. The evaluation formula should be stated as $_____ per kilowatt core and $_____ per kilowatt conductor (load).

Computer generated designs will optimize for lowest total owner cost, based upon evaluated cost of electrical losses and the initial purchase price of the transformer. Design considerations include the use of low loss core steel, copper or aluminum conductor, and design temperature rise.

Sample Loss Evaluation (using typical data)

Standard "High Loss" Transformer	Costs
Initial Purchase Price =	$15,000.00 (A)
Core Loss 3200 Watts × 3.50/watt =	$11,200.00
Conductor Loss 17200 Watts × 1.75/watt =	$30,100.00
Operating Cost =	$41,300.00 (B)
Total Owner Cost (A+B) =	**$56,300.00**
Optional "Low Loss" Transformer	**Costs**
Initial Purchase Price =	$18,000.00 (A)
Core Loss 2900 Watts × 3.50/watt =	$10,150.00
Conductor Loss 15400 Watts × 1.75/watt =	$26,950.00
Operating Cost =	$37,100.00 (B)
Total Owner Cost (A+B) =	**$55,100.00**

Transformer Section

Cast Coil

Coil Construction

High voltage coils are wound with insulated aluminum or copper conductor. The fully insulated coil is solidly cast in epoxy compound under vacuum to assure complete penetration to all spaces and surfaces for a complete, void free encapsulation. Coil ends and taps are brought to special terminals with internal threads which become imbedded in the casting. These terminals have a knurled outer surface to hold them against turning when leads and jumpers are bolted in place.

High voltage coils utilize winding techniques which produce a continuously wound coil whereby electrical stress is reduced, giving better voltage distribution throughout the coil, and assuring complete penetration of the cast epoxy.

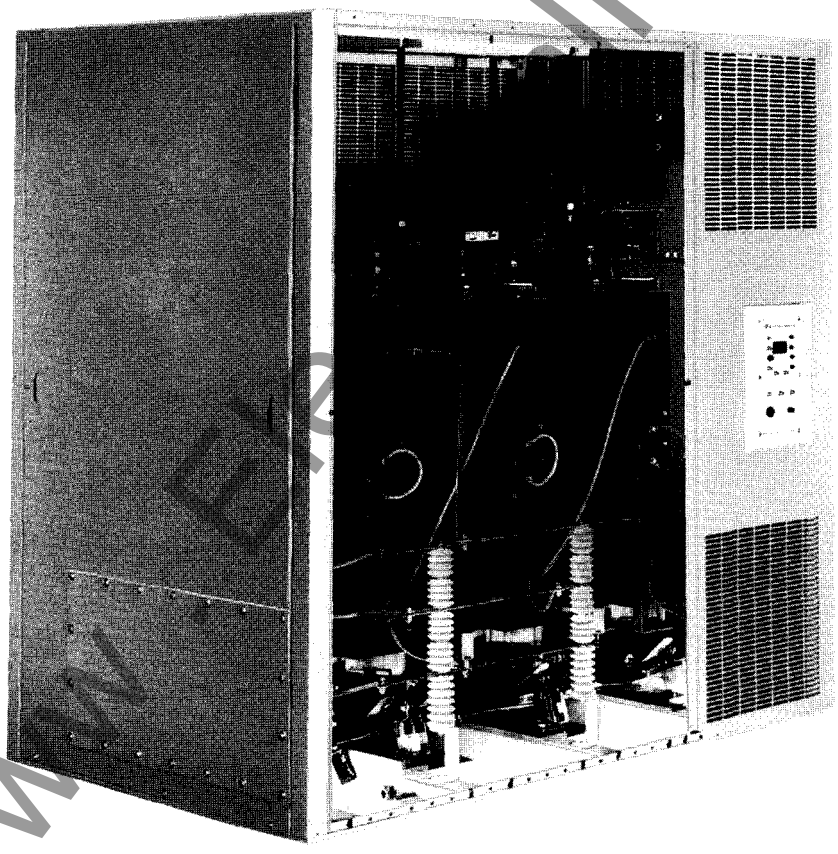
Depending on design parameters, secondary coils are aluminum or copper conductor using the same vacuum casting method described for the epoxy cast high voltage coils, or would consist of sheet wound conductor which is insulated between layers with epoxy impregnated insulation and wrapped with polyester-glass sheets. When baked, the epoxy fuses with the insulated conductor and forms into a solid block. Epoxy is added to the layer margins to complete the casting.

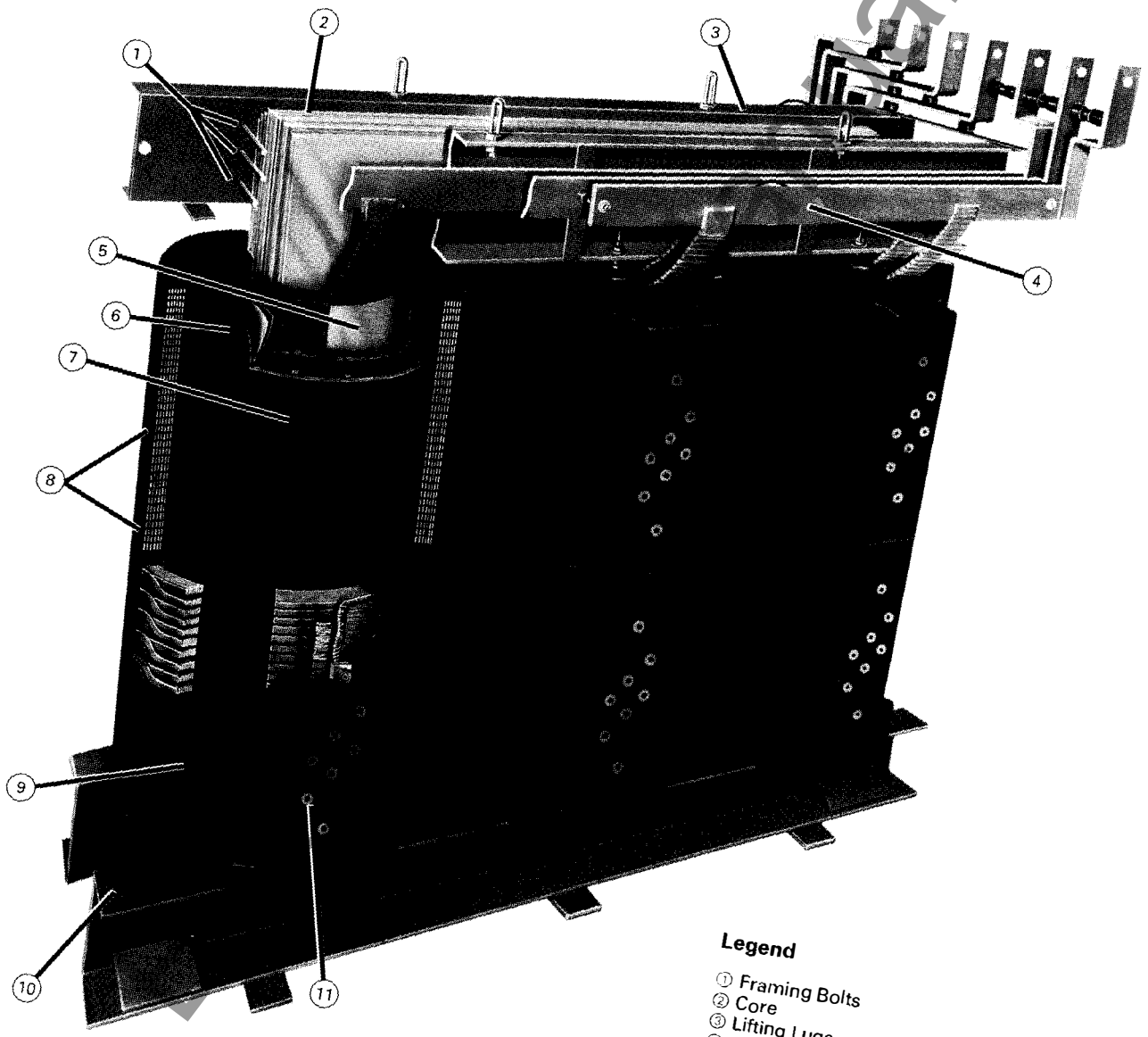
Insulation

Cast coil transformers utilize insulating materials recognized for 185°C operation. A proprietary formula consisting of high-grade epoxy, thermally conductive mineral fillers, or glass fiber cloth is used to cast the completed insulated coil. Other high temperature materials such as polyester varnish, glass cloth, laminates, and porcelains assure long life.

General Features

- Cast Epoxy Resin Is Non-Hygroscopic; Highly Resistant To Moisture And Industrial And Chemical Contamination
- Excellent Dynamic Short Circuit Strength, Low Sound Levels, High Efficiency
- Cast Coil Insulation Is Virtually Non-Flammable And Self Extinguishing
- No Oil, No Catch Basins, No Leakage, No Valves Nor Gauges — Minimum Checking And Maintenance
- No Environmental Problems
- No Vaults And No Special Protection; Can Be Installed At Any Convenient Location
- Unlimited Storage Duration And Still Ready For Immediate Application And Use
- Vacuum Casting Eliminates Critical Voids Providing Operation Free Of Partial Discharge





Legend

1. Framing Bolts
2. Core
3. Lifting Lugs
4. Low Voltage Bus
5. Conductor Material
6. Air Ducts
7. Low Voltage Coil
8. Winding Section
9. High Voltage Coil
10. Support Blocks With Resilient Pads
11. High Voltage Taps

Testing and Accessories

Transformer Testing

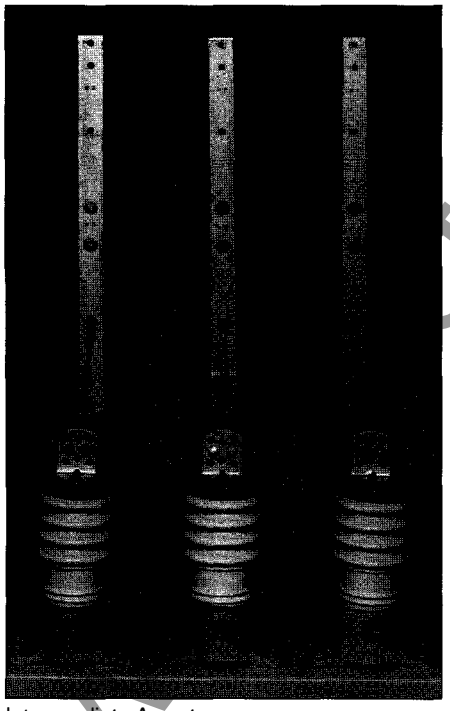
Throughout the manufacturing process and prior to shipment, all Siemens transformers are thoroughly inspected and tested according to current ANSI Standard Test Codes for transformers. Each transformer must pass the following tests:

1. Resistance measurements on all windings at the rated voltage connections of each unit and at the tap extremes of one unit only at a given rating on an order.
2. Ratio tests at the rated voltage connection and at all tap connections.
3. Polarity and phase-relation tests at the rated voltage connection.
4. No-load losses at the rated voltage connection.
5. Exciting current at rated voltage on the rated voltage connection.
6. Impedance and load loss at rated current on the rated voltage connection.
7. Impulse tests and temperature rise tests will be made on one unit of a given rating of an order only when a record of the temperature test made (in accorance with ANSI standards) on a duplicate or essentially duplicate unit is not available.
8. Applied potential tests.
9. Induced potential tests.
10. Partial discharge test for dry type and cast coil transformers.

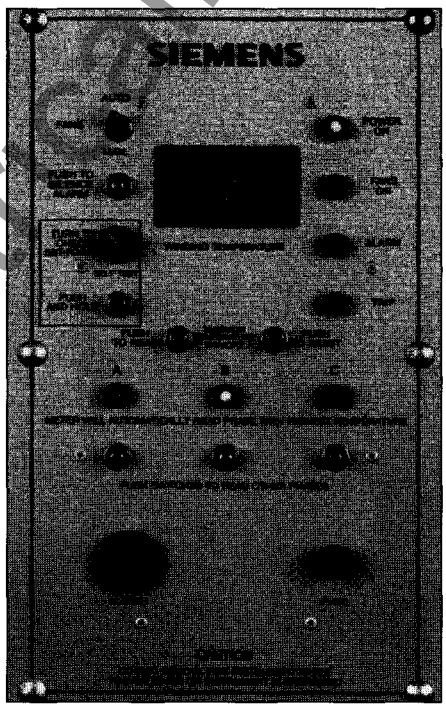
Standard Accessories for Transformers.

Description	Liquid Filled	Ventilated Dry Type	Weather Resistant Ventilated Dry Type	Cast Coil
No-Load Taps ①	✓	✓	✓	✓
Provisions for Lifting	✓	✓	✓	✓
Provisions for Jacking	✓	✓	✓	✓
Ground Pads	✓	✓	✓	✓
Instruction Nameplate	✓	✓	✓	✓
Drip-Proof Roof, Special Ventilation Louvers	—	—	✓	—②
Space Heaters	—	—	✓	—②

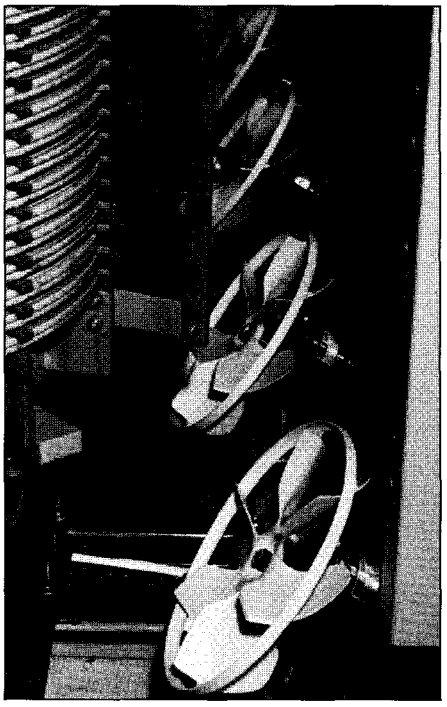
① Taps can be changed only when transformer is de-energized.
② Available as an optional feature.



Intermediate Arresters



Temperature Monitor and Fan Control Module



Fan Cooling

Normal Load and Fault Currents (Secondary) of Three Phase Transformers

Transformer Rating 3 Phase kVA and Impedance %①	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			Rated Load Continuous Current, Amps.	Short-Circuit Current RMS Symmetrical Amps			Rated Load Continuous Current, Amps.	Short-Circuit Current RMS Symmetrical Amps			Rated Load Continuous Current, Amps.	Short-Circuit Curent RMS Symmetrical Amps		
			Transformer Alone	50% Motor Load ②	Combined		Transformer Alone	100% Motor Load ②	Combined		Transformer Alone	100% Motor Load ②	Combined		Transformer Alone	100% Motor Load ②	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		13000
	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
1000 8.0%	50000	—	—	—	—	—	—	—	—	1203	12030	4800	16830	—	—	—	—
	100000										13350		18150				
	150000										13980		18750				
	250000										14315		19115				
	500000										14555		19355				
	Unlimited										15040		19840				
1500 5.75%	50000	4164	47600	8300	55900	3609	41200	14400	55600	1804	20600	7200	27800	1444	16500	5800	22300
	100000		57500		65800		49800		64200		24900		32100		20000		25800
	150000		61800		70100		53500		57900		26700		33900		21400		27200
	250000		65600		73900		56800		71200		28400		35600		22700		28500
	500000		68800		77100		59600		74000		29800		37000		23900		29700
	Unlimited		72500		80800		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										48100		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
3000 5.75%	50000	—	—	—	—	—	—	—	—	3608	33600	14400	48000	2887	26880	11520	38400
	100000										43800		58200		35040		46560
	150000										48600		63000		38880		50400
	250000										53520		67920		42720		64240
	500000										57720		72120		46200		57720
	Unlimited										62755		77160		50160		61680

① Short circuit currents are calculated with impedances and kVA shown in this table. Impedances are typical values.

② Short circuit current contributions are calculated on the basis of motor characteristics that will produce four times normal circuit. 50% motor load contribution is assumed for 208V and 100% motor load contribution is assumed for 240V, 480V and 600V.

Transformer Section

Standard Transformer Insulation Levels (kV BIL)

Transformer High Voltage Rating	Liquid Filled Transformer		Ventilated Dry Type Transformer		Cast Coil Dry Type Transformer	
	HV	LV (600 Max)	HV	LV (600 Max)	HV	LV (600 Max)
2,400	45	30	30	10	45	10
4,160	60	30	30	10	60	10
4,800	60	30	30	10	60	10
6,900	75	30	45	10	75	10
7,200	75	30	45	10	75	10
12,000	95	30	60	10	95	10
12,470	95	30	60	10	95	10
13,200	95	30	60	10	95	10
13,800	95	30	60	10	95	10

Temperature Rise/Insulation System

	Liquid Filled		Dry Type		
Winding Temp. Rise	**65°C**	**55°C**	**150°C**	**115°C**	**80°C**
Hot Spot Rise	15°C	10°C	30°C	30°C	30°C
Hot Spot Temp.	80°C	65°C	180°C	145°C	110°C
Max Ambient①	40°C	40°C	40°C	40°C	40°C
Total Temp.	120°C	105°C	220°C	185°C	150°C
Rating of Insulation System	120°C	120°C	220°C	220°C	220°C
% Reserve/Increase	0%	12%	0%	15%	30%

① Average ambient is 30°C for 24 hour period.

Three-Phase kVA Ratings

Liquid Filled Type						Dry Type	
65°C Rise		55°C/65°C Rise				150°C Rise	
OA ①	FA ②	OA ① 55°C	FA ② 55°C	OA ① 65°C	FA ② 65°C	AA ③	FA ④
300	—	300	—	336	—	—	—
500	—	500	—	560	—	500	667
750	862	750	862	840	966	750	1000
1000	1150	1000	1150	1120	1288	1000	1333
1500	1725	1500	1725	1680	1932	1500	2000
2000	2300	2000	2300	2240	2576	2000	2667
2500	3125	2500	3125	2800	3500	2500	3333
3000	3750	3000	3750	3360	4200	3000	4000

Liquid Filled Transformer
① OA—Self-cooled
② FA—Forced-air cooled

Dry Type Transformer
③ AA—Self-cooled
④ FA—Forced-air cooled

Standard Transformer High Voltage Taps

Rated Transformer Voltage	High Voltage Taps			
	+5%	+2-1/2%	−2-1/2%	−5%
2,400	2,500	2,460	2,340	2,280
4,160	4,360	4,260	4,055	3,950
4,800	5,040	4,920	4,680	4,560
6,900	7,245	7,070	6,730	6,555
7,200	7,560	7,380	7,020	6,840
12,000	12,600	12,300	11,700	11,400
12,470	13,095	12,780	12,160	11,845
13,200	13,860	13,530	12,870	12,540
13,800	14,490	14,145	13,455	13,110

Standard Sound Levels — Decibels

Max. Base kVA (Self Cooled)	Liquid Filled Transformer		Vent. Dry and Cast Coil Transformer	
	OA	FA	AA	FA
300	56	—	58	67
500	56	—	60	67
750	58	67	64	67
1000	58	67	64	68
1500	60	67	65	67
2000	61	67	66	69
2500	62	67	68	71

Impedances (±7-1/2% Tolerance)

kVA	Vent-Dry and Cast Coil Transformer	Liquid Filled Transformer
300	5.0%	5.0%
500	5.0%	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%

Three-Phase Secondary Ampere Ratings

Base kVA	Sec. Volts	Liquid Filled						Ventilated Dry		Cast Coil	
		65°C Rise		55°C/65°C Rise				150°C Rise		80°C Rise	
		OA	FA	OA 55°C	FA 55°C	OA 65°C	FA65°C	AA	FA	AA	FA
300	208	—	834	—	933	—	834	834	—	834	—
	240	—	722	—	808	—	722	722	—	722	—
	480	—	361	—	404	—	361	361	—	361	—
	600	—	289	—	323	—	289	289	—	289	—
500	208	—	1388	—	1556	—	1388	1388	—	1388	—
	240	—	1203	—	1347	—	1203	1203	—	1203	—
	480	—	601	—	674	—	601	601	—	601	—
	600	—	481	—	539	—	481	481	—	481	—
750	208	2396	2080	2396	2333	2683	2080	2080	2778	2080	2778
	240	2075	1804	2075	2021	2324	1804	1804	2406	1804	2406
	480	1038	902	1038	1011	1162	902	902	1203	902	1203
	600	830	722	830	808	929	722	722	962	722	962
1000	208	3194	2780	3194	3111	3578	2780	2780	3704	2780	3704
	240	2767	2406	2767	2695	3099	2406	2406	3208	2406	3208
	480	1383	1203	1383	1347	1549	1203	1203	1604	1203	1604
	600	1106	962	1106	1077	1239	962	962	1283	962	1283
1500	480	2075	1804	2075	2021	2324	1804	1804	2406	1804	2406
	600	1659	1444	1659	1616	1859	1444	1444	1924	1444	1924
2000	480	2767	2406	2767	2696	3099	2406	2406	3208	2406	3208
	600	2213	1924	2213	2155	2478	1924	1924	2565	1924	2565
2500	480	3759	3010	3759	3368	4211	3010	3010	4010	3010	4010
	600	3008	2406	3008	2694	3367	2406	2406	3208	2406	3208
3000	480	4510	3608	4510	4041	5052	3608	3608	4811	3608	4811
	600	3608	2887	3608	3233	4041	2887	2887	3849	2887	3849

Transformer Dielectric Tests ①

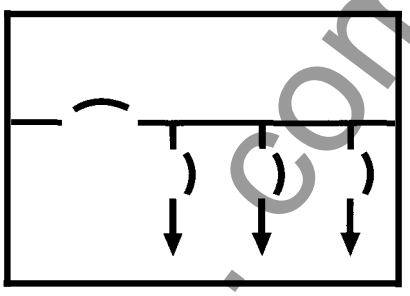
Transformer Type	Voltage Class (kV)	Applied Test 60 Hertz All kVA Ratings (kV)	Basic Impulse Levels 1.2 x 50 ms (kV)	Induced Test 7200 Cycle All kVA Ratings
Liquid Filled	1.2	10	30	Twice Normal Voltage
	2.5	15	45	
	5.0	19	60	
	8.6	26	75	
	15.0	34	95	
Ventilated Dry Type	1.2	4	10	Twice Normal Voltage
	2.5	10	20	
	5.0	12	30	
	8.6	19	45	
	15.0	31	60	
Cast Coil	1.2	4	10	Twice Normal Voltage
	2.5	31	60	
	5.0	31	75	
	8.6	34	95	
	15.0	34	95	

① For Standard BIL Ratings

Surge Arrester Characteristics

System Voltage (kV)	Arrester Rating (kV Class)	
	Effectively Grounded System	Ungrounded System
2.4	3	6
4.16	6	6
4.8	6	6, 9
6.9, 7.2	6	9, 12
8.3	6	9, 12
12.0	9, 10	15, 18
12.47	10, 12	15, 18
13.2	10, 12	15, 18, 21
13.8	10, 12	15, 18, 21

Outgoing Section



Types SB3 and RCIII Switchboards

Whether the design is for a 240V AC, 400 ampere system; a 600V AC, 4000 ampere system; or something in between, Siemens Switchboards should be considered. Every aspect of design has been aimed at improving layout convenience, reducing installation costs, and minimizing the impact and cost of system changes. These switchboards provide the rugged construction and service flexibility necessary in systems for industrial plants, hi-rise complexes, hospitals, and commercial buildings, and are built to UL-891 and NEMA PB-2 standards.

Type SB3 Front Connected Switchboard

The SB3 switchboard is available with main bus up to 6000 amperes. All sections are front and rear aligned. Options include, but are not limited to, incoming and outgoing busway, Siemens ACCESS™ System communications, ① and cold sequence utility C.T. Compartments.

Type RCIII Rear Connected Switchboards

The RCIII switchboard differs from the SB3 switchboard primarily in the mounting of the devices in the distribution section. The branch and feeder devices are individually mounted and compartmentalized. Because of this method of mounting, access to outgoing cable terminations must be from the rear of the switchboard. Bus bar extensions from the feeder devices are run back to the rear of the unit for easy access.

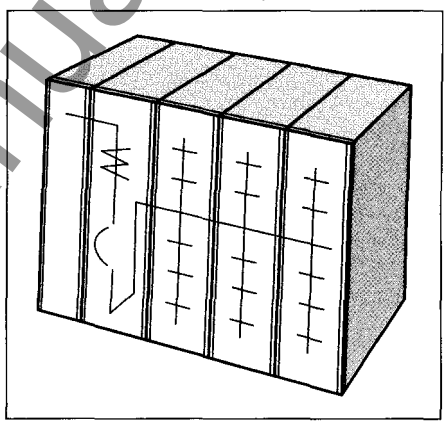
The front and rear of all sections align, designed for mounting away from the wall. RCIII switchboards will accommodate systems up to 6000 amperes, 600 volts maximum in any three-phase three-wire or three-phase four-wire configuration. The main bus can be specified for 600 to 6000 ampere rating. Main devices and bus ties are available up to 5000 amperes, branch devices up to 2000 amperes.

As with Type SB3, the RCIII switchboard can be of indoor or outdoor NEMA 3R construction.

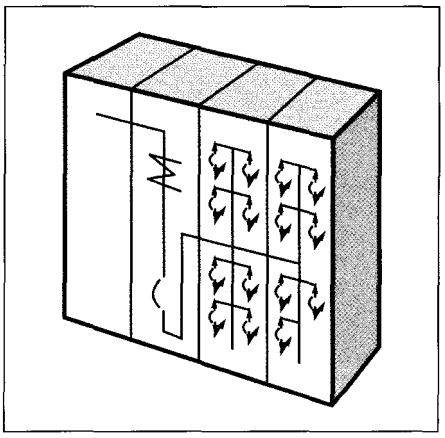
Switchboard Distribution Sections

All standard distribution sections are 90 in. high and 38 in. wide. Optional height of 70 in. and optional width of 32 in. and 46 in. are also available.

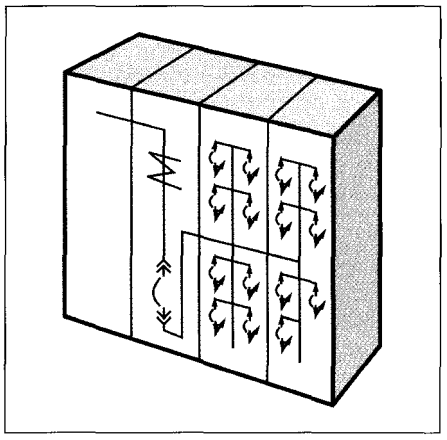
Distribution sections can also be specified in depth of 20 in., 28 in. and 38 in. Rear access is required to make use of the additional depth of the switch boards, and to provide access to bus connections, where required.



Type SB3 Switchboard



RCIII Switchboard—Fixed Mounted Devices



RCIII Switchboard—Drawout Mounted Devices

Main Devices

Switchboard Type	Mounting		Molded Case Circuit Breaker Fixed	Vacu-Break Fusible Switch Fixed	Bolted Pressure Fusible Switch Fixed	Insulated Case Breaker	LV Power Circuit Breaker
	Individual	Panel					
SB3	Yes		400-3000A	400-1200A	800-4000A	800-4000A Fixed	—
		Yes	400-1200A	400-600A	—		
RCIII	Yes	No	400-2000A	400-1200A	800-4000A	800-4000A Fixed/ Drawout	800-1600A Fixed 800-4000A Drawout

Branch Devices

Switchboard Type	Mounting		Molded Case Circuit Breaker Fixed	Vacu-Break Fusible Switch Fixed	HCP Fusible Switch Fixed	Bolted Pressure Fusible Switch Fixed	Insulated Case Breaker	LV Power Circuit Breaker
	Individual	Panel						
SB3	Yes		400-3000A	800-1200A	800-1200A	800-2000A	800-2000A	800-2000A
		Yes	15-1200A	30-600A	800-1200A	—	—	—
RCIII	Yes-Rear	Yes	100-2000A	100-1200A	—	800-2000A	800-4000A Fixed/ Drawout	800-1600A Drawout

Distribution Sections

Switchboard Type	Access	Dimensions in inches				
		Height		Width		Depth ①
		Std.	Opt.	Std.	Opt.	
SB3	Rear	90	70	38	32 or 46	48 or 58
RCIII	Rear	90	70	25, 32, 38 ●	32 or 46	48 or 58

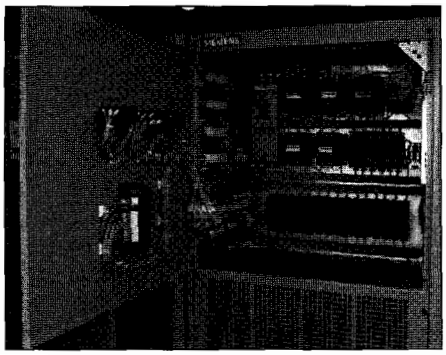
① Match transformer depth.

Outgoing Section

Switchboards

Service Sections

Typical switchboards consist of a service section, and one or more distribution sections. Service sections can be fed directly from the transformer.

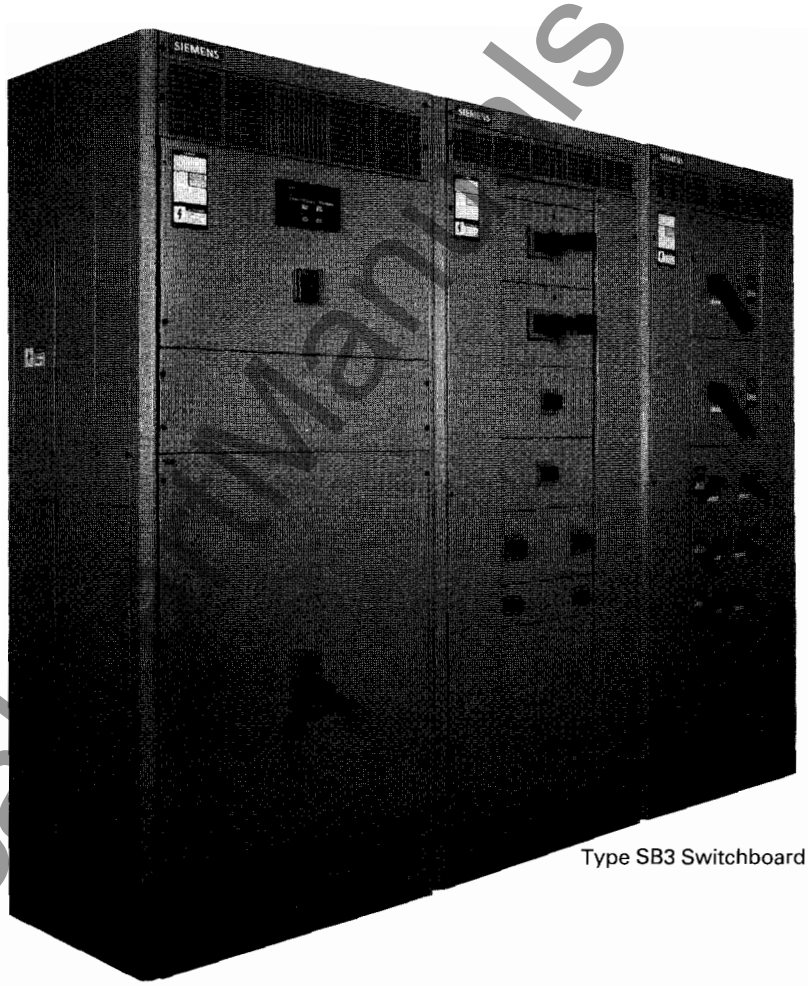


Customer Metering Compartment

Service Section Options
Utility Metering
In addition to the main disconnect, the service section usually contains utility metering provisions. "Hot" metering (CT's on the line side of the main disconnect) is normal, but "cold" metering provisions (CT's on the load side of main disconnect) can also be furnished.

Whether hot or cold metering is required, the C.T's provided by the utility company will be mounted in a completely separate compartment. The compartment will be built to utility company standards, with hinged doors and provisions for metering equipment provided by the utility.

Customer Metering
The service section often provides space for many user instrument requirements. Ammeters, voltmeters, and their associated selector switches can be mounted in the service section along with the main disconnect. A separate section would be needed only if a large instrument or an unusual number of instruments were required.



Type SB3 Switchboard

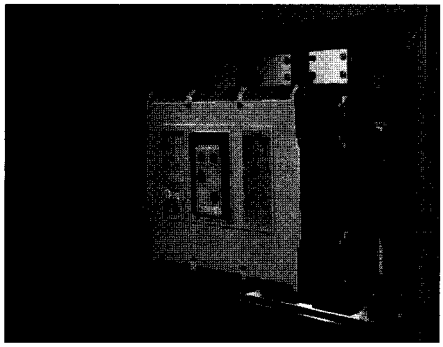
Main Disconnect Options

Main protective devices can be mounted individually for quick access in an emergency. Switchboards will accommodate a variety of main protective devices. Selection depends on the characteristics of each electrical system.

Type RL Power Circuit Breakers
Power circuit breakers, 800–4000 amperes, 600 volts AC, with solid-state overcurrent trip devices offer stored-energy tripping plus optional ground fault protection, selective tripping, and a broad range of accessories.

Type RL LV Power Circuit Breaker

Type SB Encased Systems Breakers
Insulated case circuit breakers, 800–4000 amperes, 600 volts AC, with solid-state trip devices, offer stored-energy tripping plus optional ground fault protection, selective tripping, and a broad range of accessories.



Type SB Encased Systems Breaker

Molded Case Circuit Breakers
Heavy Duty: Standard interrupting capacity, thermal-magnetic breakers, 400–1200 amperes, 600 volts AC, provide protection that allows "immediate restoration of power" for normal system requirements. A wide range of accessory options is available, including shunt trip, motor operator, auxiliary switches, alarm switches, and others.

Extra Heavy Duty: High-interrupting-capacity thermal-magnetic breakers, 400–2000 amperes, 600 volts AC, provide increased protections where high available fault currents exist, with the same convenience and accessory feature offered in standard interrupting capacity breakers.

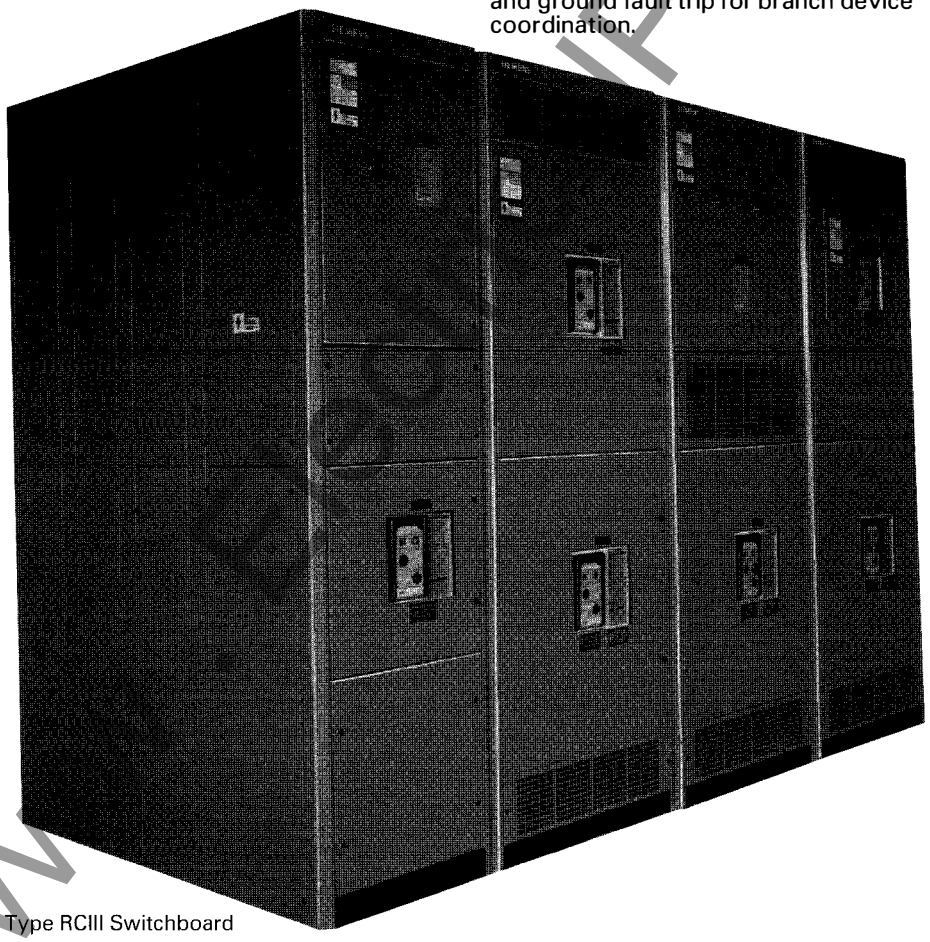
Solid-State Sensitrip®: Full function breakers 400–1600 amperes, 600 volts AC, have solid-state circuitry which assures minimal damage through the quick interruption control of fault currents, and includes short-time delay and ground fault trip for branch device coordination.

Fuseless Current Limiting: Molded case breakers, 400–2000 amperes, 600 volts AC, with thermal-magnetic protection provide coordinated protection for branch devices and circuits where extremely high fault currents are available. Solid state current limiting molded case breakers also available in ratings of 400–1600A.

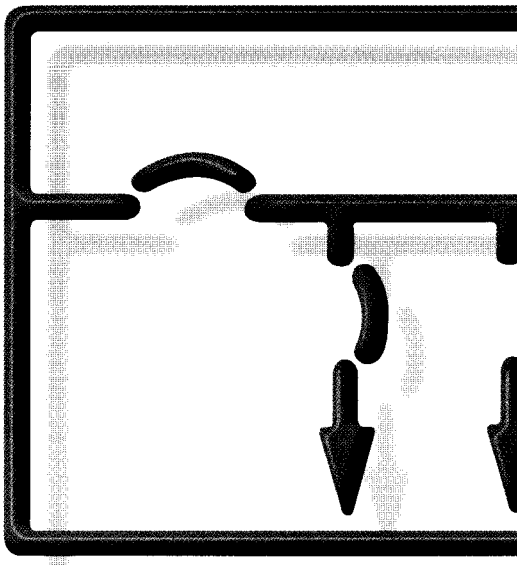
Fusible Switches
Vacu-Break® Fusible Switches, 400–1200 amperes, 600 volts AC, provide protection, coordination with branch protective fusible switches, and application flexibility in systems where high available fault currents are encountered.

Bolted Pressure Switches
Bolted pressure switches, 800–4000 amperes, 480 volts AC, combine economy with extremely high interrupting capacity in conjunction with Class L fuses. Options include short trip, ground fault relaying, and a wide range of other accessories.

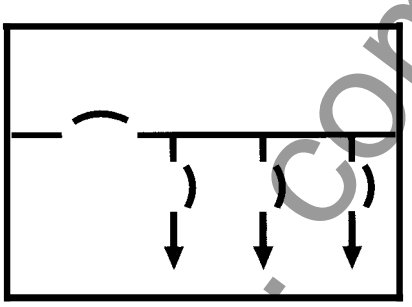
Ground Fault Relays
All main protective devices, except Vacu-Break fusible switches, can be equipped with ground fault relays to comply with the National Electrical Code (Section 230–95) ground fault protection requirements.



Type RCIII Switchboard



Outgoing Section



Switchboards

Bus Bars Design
Siemens switchboard bus bars are available in standard tin-finished aluminum or optional silver-finished copper. Standard bus is sized on the basis of heat rise criteria, in accordance with UL 891. All bus bars are sized to limit heat rise to 65°C above an ambient temperature of 40°C maximum.

As an option, conductor material can be sized according to density limits, based on bus material. The applicable limits are:
Copper—1000 amperes/sq. in.
Aluminum—750 amperes/sq. in.

Tapered capacity through-bus is standard in all switchboards in accordance with NEMA and UL 891 standards. In compliance with those standards, at each distribution section, the through-bus capacity is reduced as load is taken off. The through-bus is tapered to a minimum of one-third the ampacity of the incoming service mains.

If required by special system characteristics, switchboards can be supplied with optional full-capacity bus; i.e., the ampacity of the through-bus remains at the full ampacity of the main throughout the switchboard.

Splice Plates
All splice plates can be accessed, bolted, and unbolted from the rear of the switchboard to make connection of adjacent sections easy. Each splice plate is attached by grade 5 bolts to assure solid joints between sections, and to maintain full bus ampacity through the splice joint.

To make installation and servicing of the splice plates easier, all phase and neutral through-busses are stacked one above the other, eliminating the need to stuff bolts in between bus bars that are stacked one behind the other in the same horizontal plane.

Disconnect Links in Service Entrance Equipment
In switchboard service sections to be used as service entrance equipment on 1Ø3W and 3Ø4W systems, provisions must be included to isolate the neutral bus from the grounded service neutral. This removable link gives you the ability to check branch neutral continuity on the load side of the main disconnect.

To maintain a service ground to the switchboard frame while the link is removed, a bonding strap is connected from the switchboard frame to the neutral bus on the line side of the removable link.

UL and "SUSE" (suitable for use as service entrance) labels will be furnished on service sections specified for service entrance.

Cable Terminals
Screw mechanical connectors (lugs) are provided as standard equipment on all devices. However, compression connectors are available as an option on all main lugs, main bolted pressure switches, main power circuit breakers, and main insulated case circuit breakers.

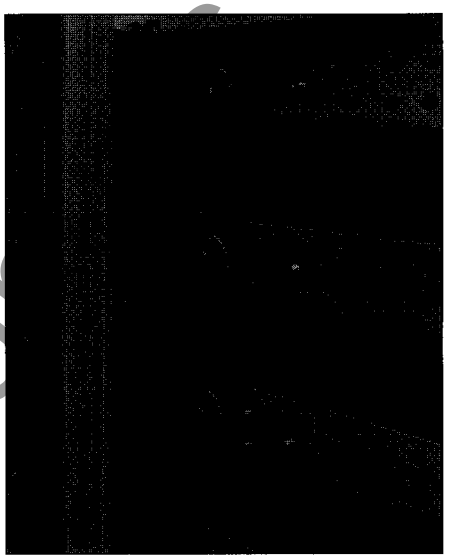
Distribution Sections
Siemens switchboard distribution sections are engineered for accessibility and expanded use. For expanded wiring room and exceptional accessibility, generous top and bottom gutters have been created by locating through-bus in the rear center of the distribution section. In cable entrance section no obstructions are less than 8 in. above the floor, and no live bus bars are located less than 10 in. off the floor. So there is plenty of room to run cables into the distribution section for connections.

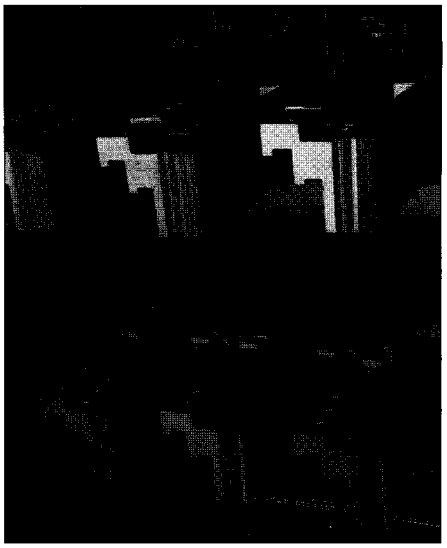
Standard bolted gutter covers give complete access to load conductors. Hinged doors can be furnished where quick access to load connectors is desired.

Heavy channels form a rigid ring at the base and top of each section, and heavy gauge structural members are used for the vertical corner posts eliminating encroachment of additional bracing into the top and bottom gutter areas.

To provide additional room for load cable routing where needed, pull box extensions are available in heights of 10, 15, 20, 25, and 30 in. to mount on any standard distribution section. Top plates on all sections are easily removed in the field for drilling, punching, and cutting conduit entry holes.

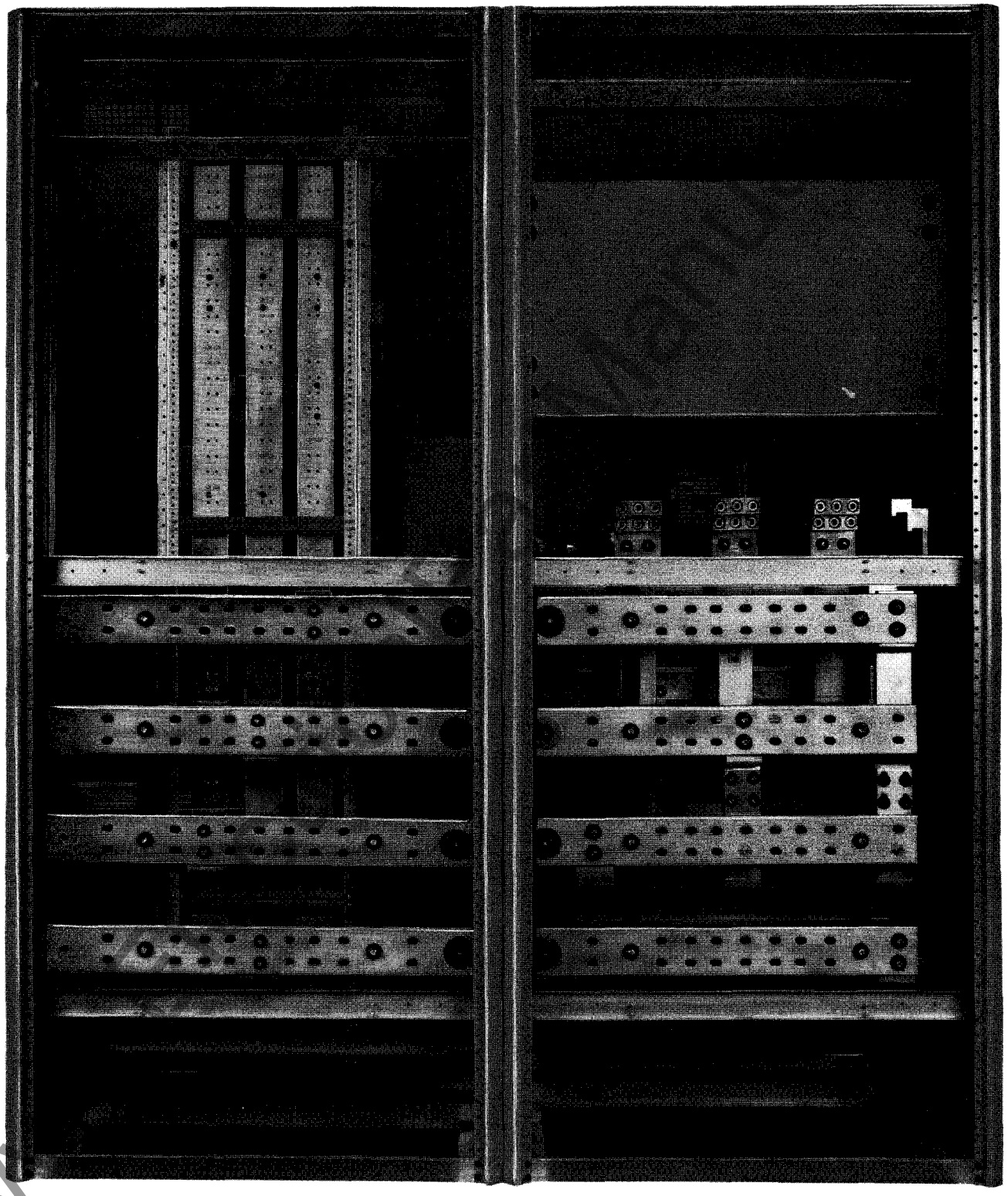
Because all distribution sections can accommodate any combination of





panel-mounted branch devices, including molded case circuit breakers, Vacu-Break fusible switches, and motor starters, future system modifications are easier to handle without adding switchboard sections.

To make additional distribution sections easier to install when they are necessary, the through-bus in each distribution section is extended, and the end is pre-drilled to accept splice plate bolts. To add a section to an existing switchboard, set the new section flush against the side of the existing distribution section, and bolt together the bus bar splice plates.



Bus Bars and Lug Construction

Outgoing Section

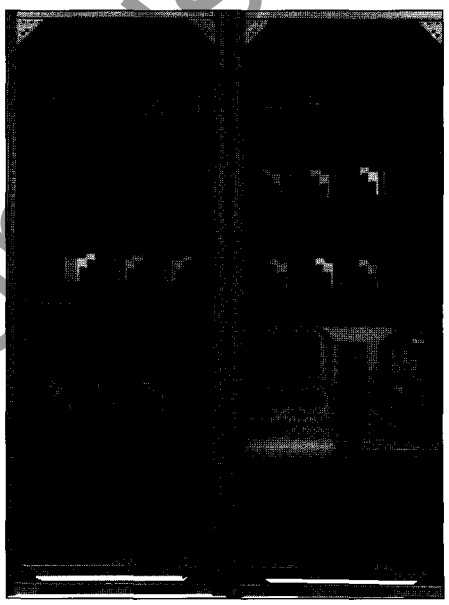
Switchboards

Distribution Sections, (cont'd)
Distribution sections of SB3 switchboards can accept any combination of molded case circuit breakers and fusible switches. If the system calls for a mixture of these devices, there is the option of grouping the devices in logical patterns within a single section. A separate section is not needed for each type of device. And because all types of devices can be put in a single section, the total number of sections required in the system can be reduced.

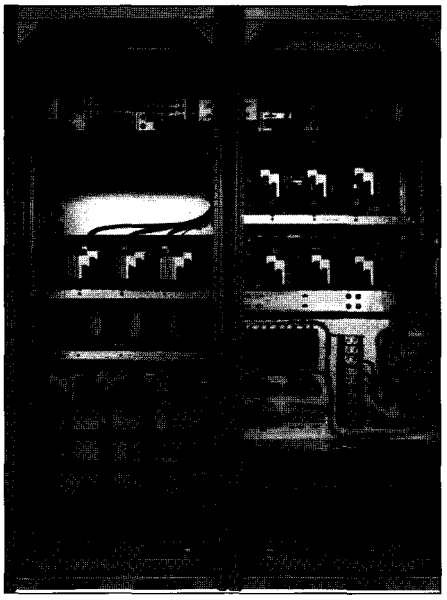
For future modifications devices can be added or replaced as the system grows and changes. If a motor starter has to be added after the installation, an entire switchboard section need not be provided to house it. It can be installed in any distribution section with available unit space.

Operating Temperatures
All distribution sections contain louvers both at the top and bottom to assure cool operation in accordance with UL Standard 891.

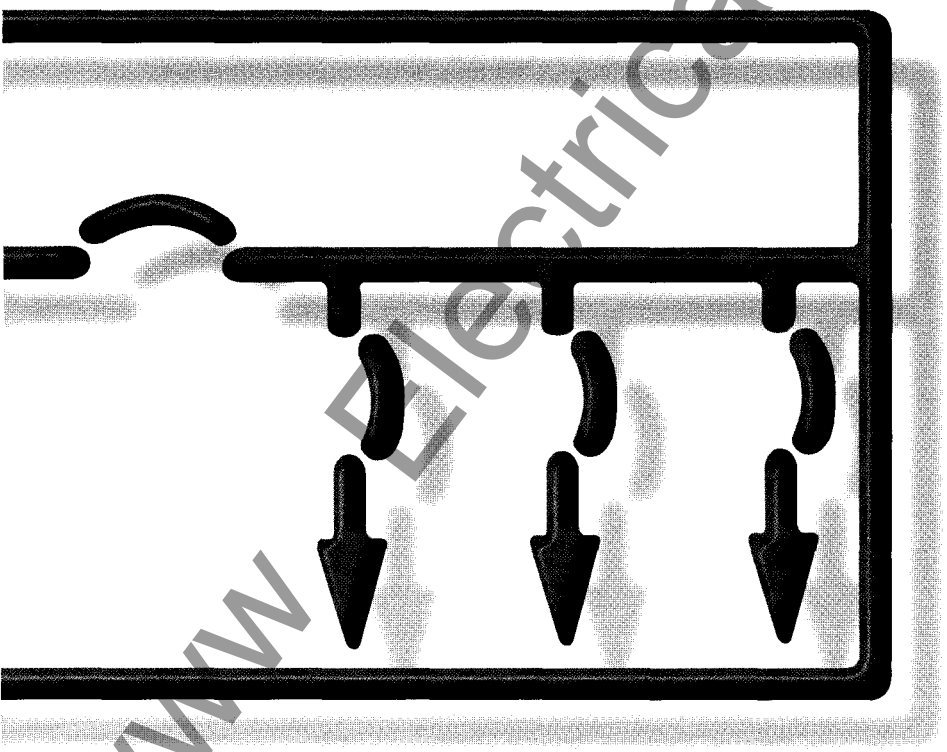
Bus Location
All through-bus to adjoining sections is located in the rear center of the distribution section. This design provides large, unobstructed wiring gutters at the top and bottom of each section. Wiring takes less time and costs less to install.



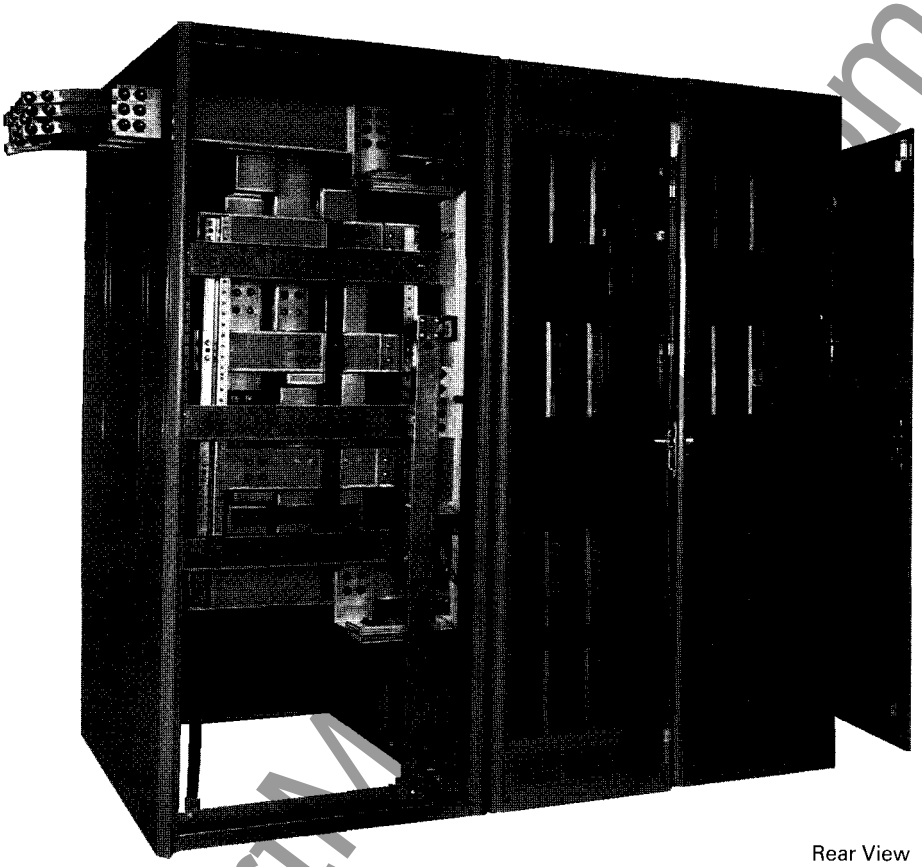
Rear View of Bus and Cable Compartment of Distribution Feeder Section — Barriers Installed



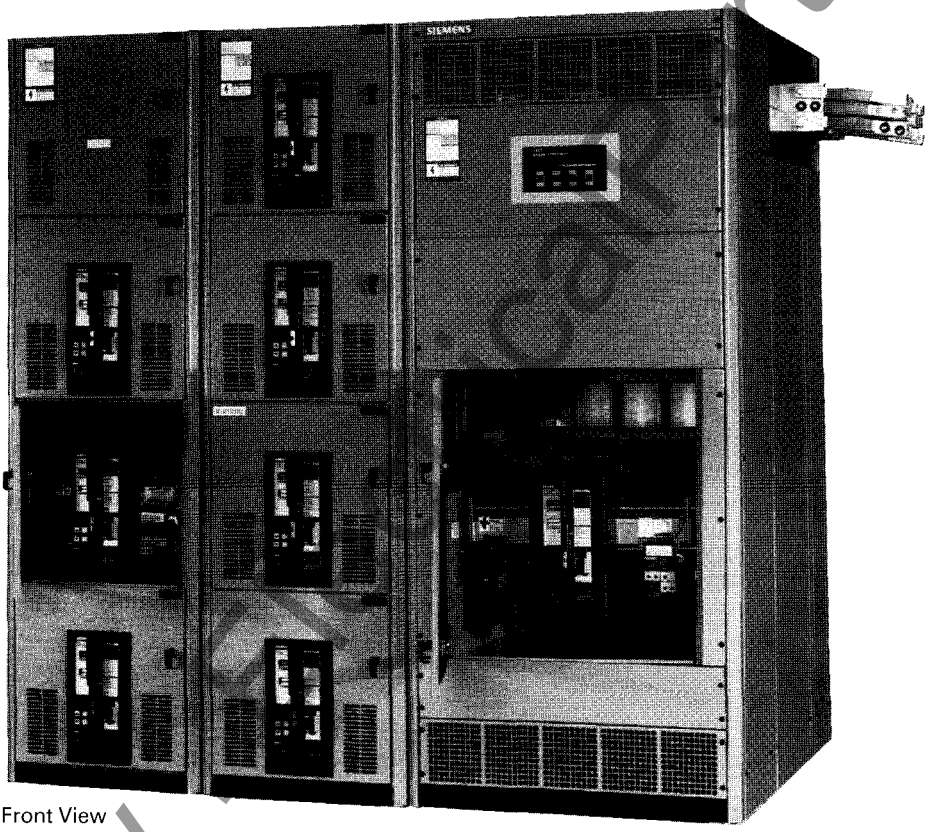
Rear View of Bus and Cable Compartment of Feeder Section — Barriers Removed



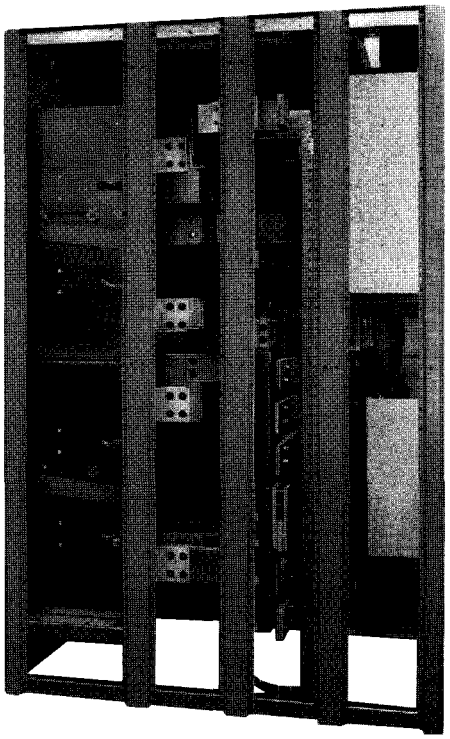
Incoming Service and Distribution Feeder Section
for Type RL Drawout LV Power Circuit Breakers



Rear View



Front View



Type RCIII Cutaway Side View

Outgoing Section

Type RCIII Switchboards

Distribution Feeder Section

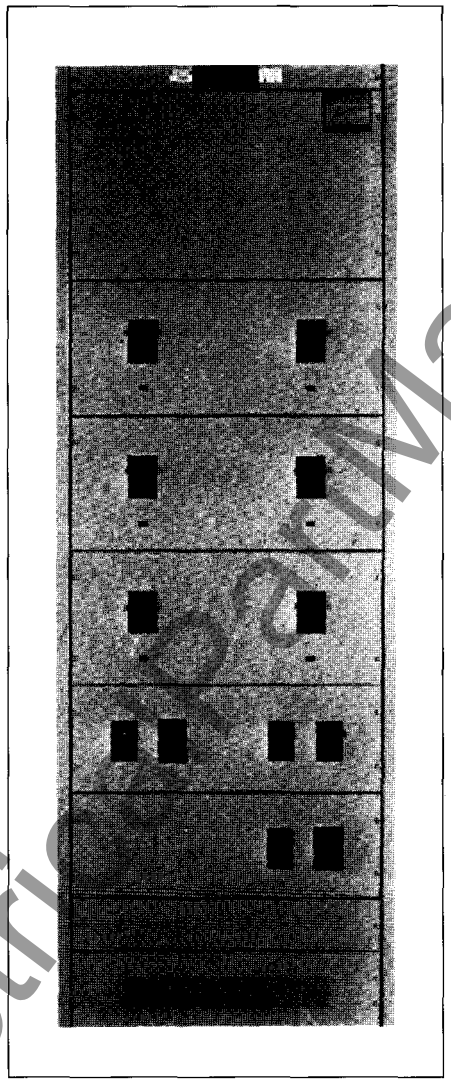
Siemens Type RCIII switchboard differs from front connected switchboards primarily in the distribution section. The branch and feeder devices are individually mounted. Because of this method of mounting, access to outgoing cable terminations must be from the rear. Bus bar extensions from the feeder devices are run back to the rear of the unit for easy access.

Molded Case Circuit Breakers

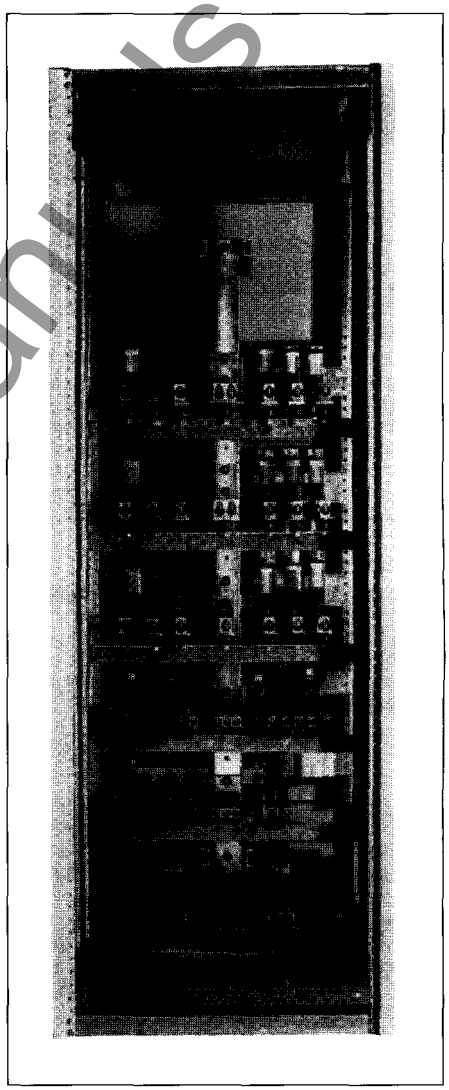
Fixed or Plug-in Individually Mounted Devices

This design consists of a front section where the distribution devices are mounted, a bus section in the center and a cable termination area in the rear. The front metal cover represents a grounded protection for the operator at the front of the switchboard. The main through-bus runs near the bottom of the switchboard. Section bus risers from the main bus are located in the center of the distribution section with taps to branch breakers.

The load side terminals of each front mounted device are extended through the bus compartment into the rear cable compartment. These bus extensions are insulated where necessary as they pass between the main bus bars. Additional protection can be provided with optional barriers between devices and bus compartment, between individual devices, between bus and cable compartment, and between vertical sections.

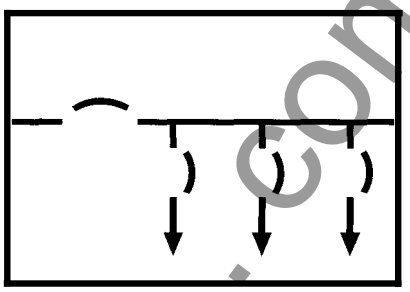


Front View



Rear View

Type RCIII Switchboard with Individually Mounted Molded Case Circuit Breakers



Type SB Encased Systems Breakers

Drawout or Fixed Mounted Devices
Insulated case circuit breakers are individually mounted in their own compartments as standard. Metal barriers are provided at the sides of each compartment and an insulation horizontal barrier is located between breakers in the same vertical section. Access is provided through a hinged metal door on each breaker compartment.

The insulated case circuit breaker drawout assembly is a self-contained, integral unit that permits quick circuit breaker replacement or inspection and maintenance of breakers without de-energizing the entire switchboard. The easily accessible and maintainable spring loaded primary disconnect fingers are mounted on the breaker. The drawout assembly consists of a stationary frame and a movable carriage to support the breaker. The secondary disconnects for accessory control circuits are mounted on the movable carriage. A matching set is mounted on the stationary frame.

The drawout design of insulated case circuit breakers makes it possible to place the breaker in the fully withdrawn, disengaged test, or engaged position. The load side of each breaker has bus bars extending from the rear of the primary disconnect through the bus compartment into the rear cable compartment. Additional protection can be provided with optional barriers between the bus and cable compartment and between vertical sections.

Outgoing Section

Distribution Feeder Section
Drawout low-voltage power circuit breakers are also individually mounted in their own compartments as standard. Metal barriers are provided at the sides and rear of each compartment and a horizontal metal barrier is located between breakers in the same vertical sections. Access is provided through a hinged metal door on each breaker compartment.

Safe Closed-Door Drawout Mechanism
The low voltage power circuit breaker can be moved from "connect" through "test" to "disconnect" position without opening the door. In the "connect" position, both the primary and secondary disconnects are engaged. In the "test" position, the primary disconnect terminals are disengaged; however, the secondary disconnects are maintained to permit operation of the circuit breaker. In the "disconnect" position, the primary and secondary disconnects are disengaged and separated a safe distance from the corresponding stationary terminals. In the "fully withdrawn" position, both primary and secondary contacts are disconnected and the circuit breaker may be inspected or removed for more complete accessibility.

The load side of each breaker has bus bars extending from the rear of the primary disconnect through the bus compartment into the rear cable compartment. Additional optional barriers can be provided between bus and cable compartments and between vertical sections.

Testing
Testing conducted by Siemens includes both production testing of switchboard sections for compliance with UL requirements, and developmental, design verification, and quality control testing.

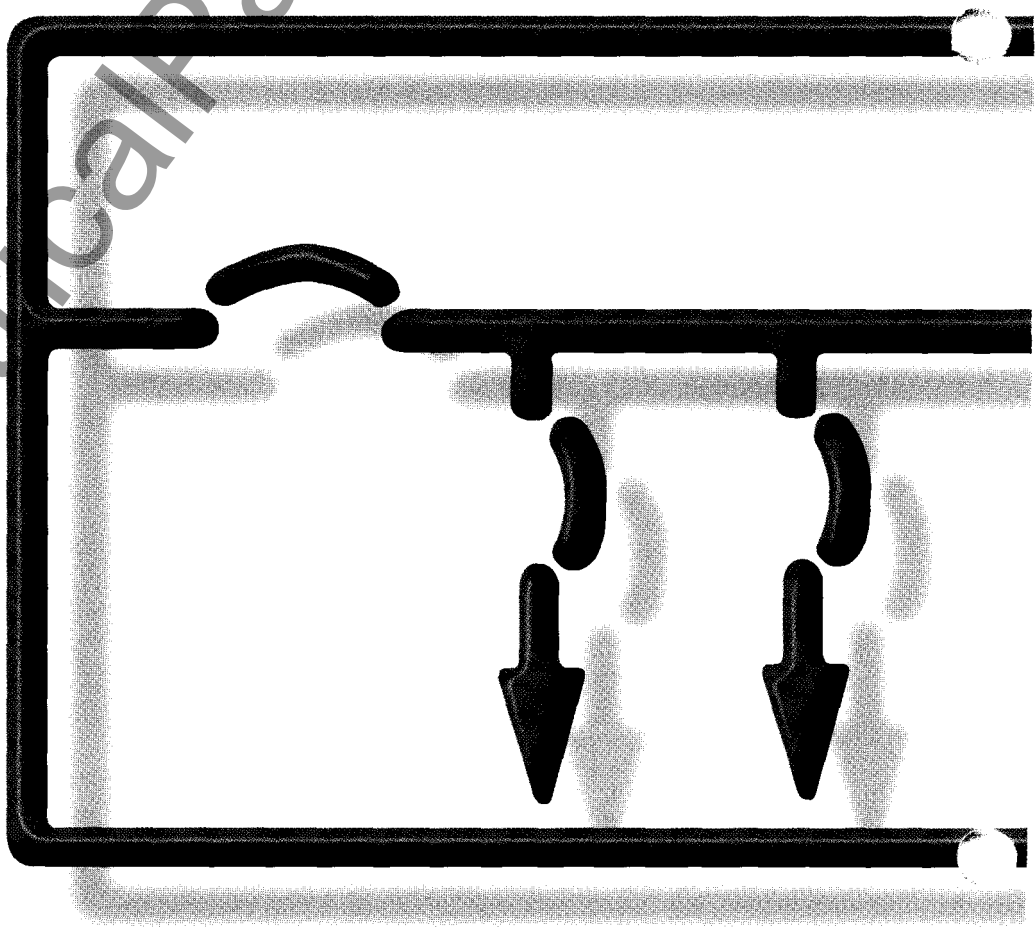
Production tests check structural integrity and are performed on all switchboard sections in accordance with UL procedures. A test voltage equal to twice the rated voltage plus 1000 volts (Vt = 2Vr + 1000) is applied for one minute to each switchboard section to check the integrity of the conductor and insulator materials, and the switchboard assembly. These tests are performed routinely to verify proper equipment fabrication and assembly.

For more sophisticated design verification and developmental testing a separate laboratory is used. This test lab is fully instrumented for advanced, multi-phase electrical test work over a wide range of system conditions.

Among the tasks performed is the determination of heat rise at busway connections, and at protective device terminations on both line and load sides.

All heat rise tests are conducted in strict accordance with applicable UL standards. Heat rise data from the tests are carefully compared to UL allowable levels.

Another important laboratory program is the systematic verification of short circuit withstand capabilities for all switchboard conductor materials. Switchboard bus has been thoroughly tested and is UL short circuit withstand rated (UL File #E-22578). Switchboard sections with designs conforming to test specifications will carry a label noting the short circuit current withstand rating applicable to that section.



Modifications and Accessories

Metering

Utility Metering
Requirements for power company metering and instrument transformer requirements vary with serving utility. Typically, utility company current transformers require a 30 in. high compartment. Service sections meet most utility metering standards.

Customer Metering
A full compartment of switchboard instruments with appropriate current transformers, potential transformers and selector switches are available in all Siemens switchboards.

The meters and instrument switches are mounted on hinged panels with potential transformers and fuses behind the door. Current transformers are mounted on the main bus or, in the case of branch feeder metering, at the load terminals of the branch protective device and normally do not require additional unit space.

4300 and 4700 Power Meters
The 4300 Power Meter is provided as a standard metering option for SB3 and RCIII switchboards. Alternate metering options for SB3 and RCIII include the higher accuracy 4700 Power Meter or analog metering equipment if specified. The 4300 and 4700 Power Meters are microprocessor-based, three-phase meters that provide advanced features at an affordable price. These meters are designed as an alternative to full-featured digital instrumentation packages, providing high accuracy, high reliability, high transient surge and hipot-withstand capabilities. Voltage and amperage measurements are true RMS, including harmonics.

The 4300 and 4700 Power Meters can be configured to operate in Wye (Star), Delta, or Single-phase voltage modes. The meter is equipped to monitor the measurements shown in Table 7.5. The display module has a high visibility, liquid crystal display (LCD). Functions buttons display measured data, including volts, amperage, power function, all three voltage and amperage phases.

Replacing analog meters and selector switches, the two-module design simplifies wiring and reduces installation time. This makes the Power Meter ideally suited for economical metering on three-phase industrial and commercial switchboards. A communications port allows the power meter to be used as a stand-alone power monitoring station or as one element in a large energy-management network.

When used as part of a Siemens ACCESS™ installation, the 4300 and 4700 Power Meters can communicate with up to 128 ACCESS-compatible devices. Using a direct PC connection or a dial-up modem, the module interfaces with Siemens SIEServe™ on-line software that monitors any ACCESS component on the electrical distribution system.

Ammeters and Voltmeters (Analog)
Ammeters are switchboard type with ±1% accuracy, 0 to 6000 amperes maximum. The included instrument switch will provide positions to read each phase and will include an OFF position. Panel type ammeters with ±3% accuracy, 800 ampere maximum, can be furnished for branch feeder metering to conserve panel space.

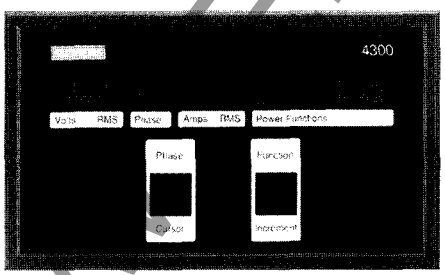
Metering Features	Power Meter Accuracy 4700	4300
Phase currents	±.2%	±.5%
Avg. phase current	±.2%	±.5%
Ampere demand	±.2%	N/A
Phase voltages	±.2%	±.5%
Avg. phase voltage	±.2%	±.5%
Line voltages	±.2%	±.5%
Avg. line voltage	±.2%	±.5%
kW	±.4%	±1.0%
kVA	±.4%	N/A
kVAR	±.4	N/A
kW demand	±.4%	±1.0%
kW hours	±.4%	±1.0%
kVAR hours	±.4%	N/A
Power factor	±1.0%	±2.0%
Frequency	±.4%	N/A

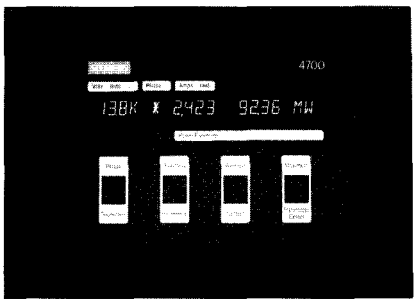
Available CT Ratios — Ampere Rating

100:5	500:5	1500:5
150:5	600:5	2000:5
200:5	800:5	2500:5
300:5	1000:5	3000:5
400:5	1200:5	4000:5

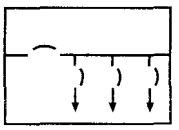
Voltmeters are switchboard type with ±1% accuracy, 0 to 600 volts AC. The included instrument switch provides positions to read each phase-to-phase voltage and each phase-to-neutral voltage, and has an OFF position.

Current Transformers/Potential Transformers
Potential transformers are recommended wherever the system voltage exceeds 150 volts AC phase-to-neutral to lower voltage levels for instrument switches and meters mounted on the switchboard front panel.





Siemens 4300 and 4700 Power Meters

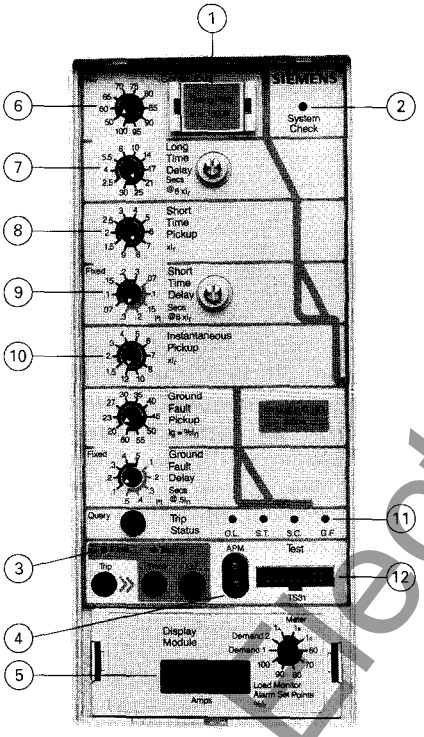


Outgoing Section

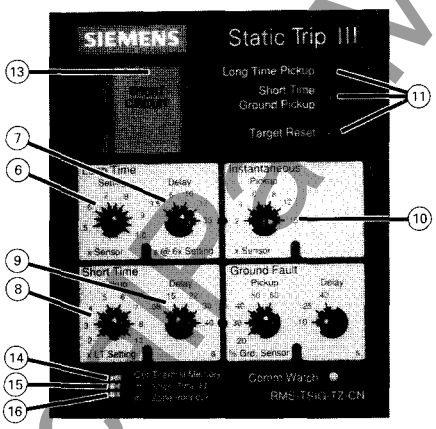
Modifications and Accessories

SB Encased Systems Breakers

- Shunt Trip
- Auxiliary Switches, up to 6 NO / NC
- Undervoltage Release
- Electronic "Bell Alarm" Module
- Electric Charging Motor Operator with Electronic Controller
- Integral Local Electric Close Option
- Integral Kirk-Key Interlock on SB
- Close Blocking Device
- Trip Padlock Device
- Position Padlock Device (Drawout Moveable Element)
- Cell Switches, 4 N.O. / N.C. (Mounted on Drawout Stationary Element)
- Automatic Safety Shutters
- Kirk-Key Provision (Mounted on Drawout Stationary Element)
- Mechanical Interlock
- Capacitor Trip Device
- Remote Indication/Relay Panel
- Auxiliary Power Module (for bench-testing trip unit)
- TS 31 Universal Test Set



Type SB Encased Systems Breaker Trip Unit



Static Trip III Trip Unit

Type RL Low Voltage Power Circuit Breakers

Static Trip® III Microprocessor-Based Tripping

The Static Trip III trip unit comes in four models for maximum flexibility.

All communicating Static Trip III trip units include a local communication port that supports the breaker mounted display unit or BDU. The BDU features a high-visibility alphanumeric display. Real-time metered values, min/max values, event log data and setpoint data can be read on the BDU in straightforward engineering units. Alarm and relay setpoint can be configured using the BDU keypad.

Type RL LV Power Circuit Breaker

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① Replaceable Rating Plugs Adjustable From 50-100% Of Frame Rating.
② Continuous Self-Diagnostic "Watchdog"
● Integral Test Functions For Phase And Ground Fault (Trip And No-Trip Tests)
④ External Power Source Allows Bench Testing Of Stand-Alone Trip Unit
⑤ Plug-In Display Modules For Current And Energy Display Capabilities
⑥ Long Time Continuous Current Setting
⑦ Long Time Delay Band Setting
⑧ Short Time Pickup Setting
⑨ Short Time Delay Band Setting
⑩ Instantaneous Pickup Setting
⑪ Integral LED Trip Indicators
⑫ Full Communications Capability Via Siemens' ACCESS Network
⑬ LCD Target
⑭ Thermal Memory Switch
⑮ Short Time I^2t Ramp Switch
⑯ Zone Interlock Switch
⑰ Zone Interlocking Input/Output and Future Options

Modifications and Accessories

Molded Case Circuit Breakers

- Alarm Switch for remote indication and/or pilot device operation when breaker is tripped automatically.
- Shunt Trip (electric open-manual close) for remote tripping of breaker. Includes cut-off switch. Specify control voltage.
- Undervoltage Trip automatically trips breaker when voltage is reduced 35%-70% of coil rating. Specify Control Voltage.
- Auxiliary Switch 1A and 1B, 2A and 2B, etc.
- Telemand Motor Operator (electric open and close). Operating Voltage 48V DC; 120, 240V AC.
- Ground Fault Relay (requires shunt trip).

Sentron Molded Case Circuit Breakers with Sensitrip Feature

Ground Fault Protection

NEC Section 230-95 requires ground fault protection on all service disconnects rated 1000 amperes and larger in 600 volt class switchboards when fed by a solidly grounded wye system of more than 150 volts to ground. Ground fault protection is required on 480 and 600 volt, 3-phase 3-wire, i.e., no neutral bus, when the serving transformer is wye connected.

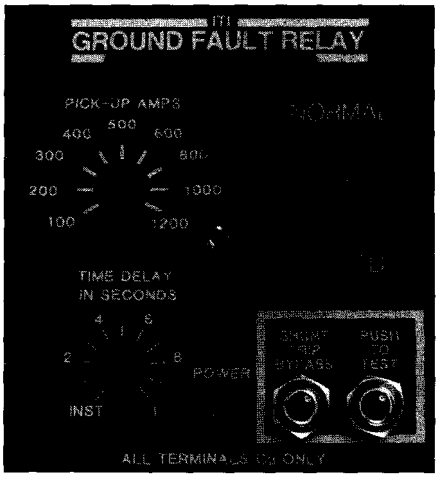
There is an exception to this rule: Ground fault protection is not required on fire pumps or continuous industrial loads where a non-orderly shutdown would cause a hazard.

Health care facilities, such as, hospitals require additional levels of ground fault protection. These requirements are described in NEC article 517.

In the 1990 NEC, new sections 215-10 and 240-13 were added requiring ground fault protection on all 1000 ampere and larger devices, breakers, and switches, applied in a system as described above, unless there is ground fault protection upstream.

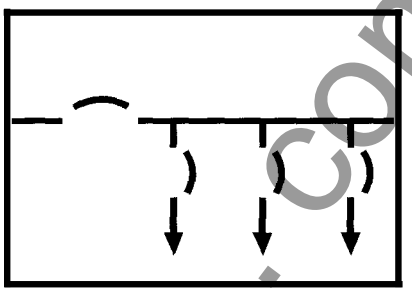
Many utilities use a grounded wye secondary transformer and bring a connection from the grounded midpoint to the service section ground bar. When this is the case, ground fault protection is required.

For a 1000 ampere or larger 480 volt, 3-phase 3-wire service section, an inquiry should be made to determine if the utility is using a 3-wire delta secondary transformer. Should this be the case, no ground fault protection is required.



Ground Fault Relay

Outgoing Section



Vacu-Break® Fusible Switches

All Vacu-Break fusible switches include:

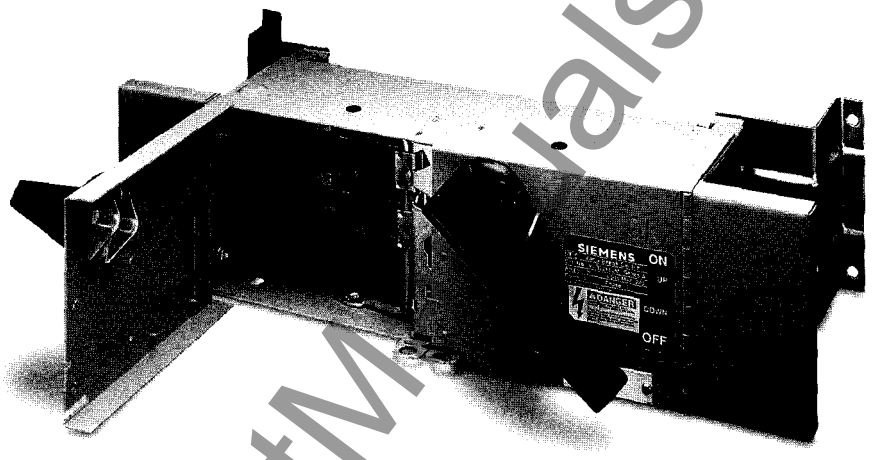
- Voidable Cover Interlock
- Quick-Make, Quick-Break Operation
- Positive ON-OFF Action
- Padlockable Handle Design (at ON or OFF)
- Vacu-Break Arc Control (i.e., enclosed arc chamber, double-break magnetic arc blowout)
- Clampmatic Pressure Spring Force On Closed Contacts
- Spring-Reinforced Fuse Holders

For 250V switches (30 to 600A):

- Class R Rejection Type Fuse Holders for all units except the 2.5 in. (64 mm) high unit, which is suitable only for NEC Class H. K1 and K5 fuses.

For 600V switches (30 to 600A):

- Class R Rejection Type Fuse Holders, Class J Fuse Holders.



Vacu-Break Fusible Switch

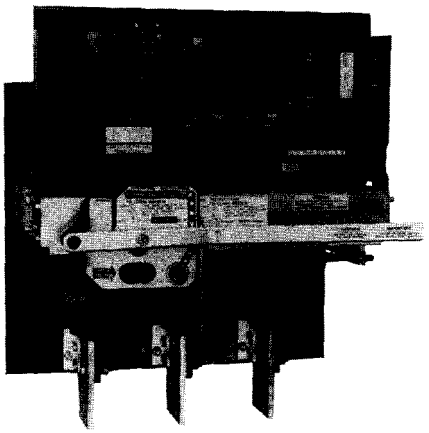
Bolted Pressure Switches

These switches are suitable for use on systems capable of delivering fault current up to 200,000 amperes symmetrical RMS when equipped with Class L fuses. All bolted pressure switches include:

- Fuse Door Interlock
- Quick-Make, Quick-Break Operation
- Bolted Pressure Force On Operation
- Bolted Pressure Force On Closed Contact
- Padlockable Handle (in the "open" position only)

Accessories and modifications:

- Shunt Trip (electrical open-manual close)
- 120V AC Standard Control Voltage
- Electrical Operator (electrical open and close, specify system voltage)
- Ground Fault Relay (requires shunt trip)
- Blown Fuse Trip (switch opens when any one fuse blows—requires shunt trip)
- Blown Fuse Indicating Lights
- Phase Failure Relay With Capacitor Trip (detects failure of any one phase and opens switch—requires shunt trip, specify system voltage)
- Auxiliary Contacts



Bolted Pressure Switch

HCP Fusible Switch

Rated 200,000 amperes RMS symmetrical when equipped with Class L fuses.

Standard features include:

- High Contact Silver Alloy Contacts
- Heavy Duty Quick-Make, Quick-Break

Accessories include:

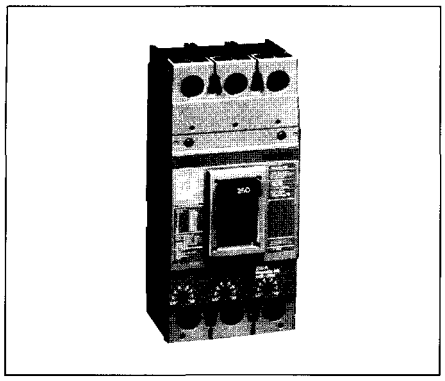
- Undervoltage Release-Instantaneous
- Remote Spring Release Closing
- Remote Trip Signaling
- Bell Alarm With Lockout
- Shunt Trip With Standard Control Voltages OF 120, 240, 480V AC, 12, 24, 48 And 125V DC.

Interrupting Ratings of Disconnect Devices

Molded Case Circuit Breakers

Normal and Heavy Duty

Normal duty breakers are designed for commercial, industrial, institutional and other heavy duty applications. They are rated up to 600 volts AC and 250 volts DC. Heavy Duty breakers have higher interrupting ratings than normal duty breakers.



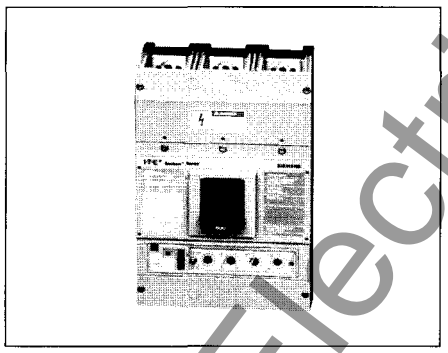
Heavy Duty
Thermal-Magnetic Breaker

Extra Heavy Duty

These are designed for heavy duty applications where the interrupting requirements exceed the ratings of heavy duty breakers. They are rated up to 600 volts AC and 250 volts DC.

Solid State Trip

Equipped with solid state tripping, these are available in heavy duty and extra heavy duty interrupting ratings at 600 volts AC.



Extra Heavy Duty Solid-State Trip

Current-Limiting

These breakers incorporate the exclusive Siemens blow-apart interruption principle and meet the NEC requirements for current-limiting breakers. Current-limiting circuit breakers can limit the let-through I^2t to a value less than the I^2t of one-half cycle wave of the symmetrical prospective current without any fusible elements when operating within their current-limiting range.

Interrupting Ratings of Siemens Molded Case Circuit Breakers

Maximum Ampere Rating	Available Amperage Range	Breaker Type	Maximum Interrupting Capacity: In Symmetrical RMS Amperes for Voltage AC 240V	480V	600V	In DC Amperes for Voltage DC 250V ①	600V ①
Normal Duty — Thermal-Magnetic							
100	15-100	BQH	22,000	—	—	—	—
		BLH					
		BQD	—	14,000	—	—	—
125	15-125	BL	10,000	—	—	—	—
225	60-225	QJ2					
400	200-400	JXD2	65,000	—	—	30,000	—
Heavy Duty — Thermal-Magnetic							
100	15-100	ED2	10,000	—	—	5,000	—
125	15-125	ED4	65,000	18,000	—	30,000	—
		ED6		25,000	18,000		18,000
225	60-225	QJH2	22,000	—	—	—	—
250	70-250	FXD6/FD6	65,000	35,000	22,000	30,000	18,000
400	200-400	JXD6/JD6			25,000		25,000
600	250-600	LXD6/LD6					
800	500-800	MXD6/MD6		50,000			
1200	800-1200	NXD6/ND6					
1600	1200-1600	PXD6/PD6					
2000	1600-2000	RXD6/RD6					
Heavy Duty — Solid-State Trip							
400	40-400	SJD6	65,000	35,000	25,000	—	—
600	60-600	SLD6					
800	120-800	SMD6		50,000			
1200	160-1200	SND6					
1600	240-1600	SPD6					
Extra Heavy Duty — Thermal-Magnetic ②							
100	15-100	HBL	65,000	—	—	—	—
125	15-125	HED4	100,000	42,000	—	30,000	—
	15-125	HED6		30,000	18,000	30,000	25,000
	60-225	QJ2-H	42,000	—	—	—	—
250	70-250	HFD6	100,000	65,000	25,000	30,000	25,000
400	200-400	HJD6/HJXD6		65,000	35,000	30,000	25,000
	200-400	HHJD6/HHJXD6	200,000	100,000	50,000	—	—
600	200-600	HLD6/HLXD6	100,000	65,000	35,000	30,000	35,000
	400-600	HHLD6/HHLXD6	200,000	100,000	50,000	—	—
800	500-800	HMD6/HMXD6	100,000	65,000		30,000	50,000
1200	800-1200	HND6/HNXD6					
1600	1200-1600	HPD6/HPXD6					
2000	1600-2000	HRD6/HRXD6					
Extra Heavy Duty — Solid-State Trip							
400	40-400	SHJD6	100,000	65,000	35,000	—	—
600	60-600	SHLD6					
800	120-800	SHMD6			50,000		
1200	160-1200	SHND6					
1600	240-1600	SHPD6					
Current-Limiting — Thermal-Magnetic							
125	15-125	CED6	200,000	200,000	100,000	30,000	50,000
250	70-250	CFD6					
400	200-400	CJD6	150,000	150,000			
600	400-600	CLD6					
800	500-800	CMD6	100,000	100,000	65,000		
1200	800-1200	CND6					
1600	1200-1600	CPD6					
Current-Limiting — Solid State Trip							
400	40-400	SCJD6	200,000	150,000	100,000	—	—
600	60-600	SCLD6					
800	120-800	SCMD6		100,000	65,000		
1200	160-1200	SCND6					

① All breakers are 2-pole for DC rating.
② Extra heavy duty breakers are inherently fungus-proof and do not require special fungus treatment.

Outgoing Section

Type RL Low Voltage Power Circuit Breakers①

Frame Size Amperes	Breaker Type	Voltage Rating		Insulation Level Dielectric Withstand Volts	Short Time Rating Symmetrical Amperes	Short Circuit Rating Symmetrical Current		Continuous Current Rating Amperes
		Rated Volts	Rated Max. Volts			With Instantaneous Trip Amperes	Without Instantaneous Trip Amperes	
800	RL-800	600	635	2200	30,000	30,000	30,000	75-800
	RLE-800				42,000	65,000	42,000	75-800
	RLI-800				22,000	42,000	22,000	75-800
1600	RL-1600				50,000	65,000	50,000	75-1600
2000	RL-2000				65,000	65,000	65,000	75-2000
	RLE-2000				85,000	85,000	85,000	75-2000
3200	RL-3200				65,000	85,000	65,000	600-3200
4000	RL-4000				85,000	100,000	85,000	800-4000 ②
	RLE-4000				100,000	100,000	100,000	800-4000 ②
800	RL-800	480	508	2200	30,000	30,000	30,000	75-800
	RLE-800				42,000	65,000	42,000	75-800
	RLI-800				22,000	100,000	22,000	75-800
1600	RL-1600				50,000	65,000	50,000	75-1600
2000	RL-2000				65,000	65,000	65,000	75-2000
	RLE-2000				85,000	100,000	85,000	75-2000
3200	RL-3200				65,000	85,000	65,000	600-3200
4000	RL-4000				85,000	100,000	85,000	800-4000 ②
	RLE-4000				100,000	100,000	100,000	800-4000 ②
800	RL-800	240 and 208	254	2200	30,000	42,000	30,000	75-800
	RLE-800				42,000	65,000	42,000	75-800
	RLI-800				22,000	100,000	22,000	75-800
1600	RL-1600				50,000	65,000	50,000	75-1600
2000	RL-2000				65,000	65,000	65,000	75-2000
	RLE-2000				85,000	100,000	85,000	75-2000
3200	RL-3200				65,000	85,000	65,000	600-3200
4000	RL-4000				85,000	130,000	85,000	800-4000 ②
	RLE-4000				100,000	130,000	100,000	800-4000 ②

① All circuit breakers are UL listed.
② With the addition of fan cooling and 5000A copper main bus, a 4200A continuous rating is available.

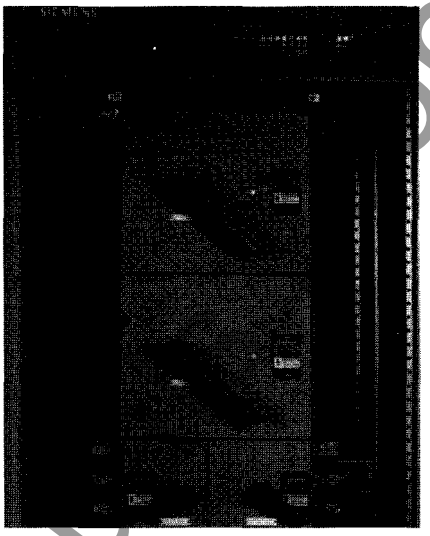
Type RLF Fused Low Voltage Power Circuit Breakers①

Frame Size Amperes	Type	Voltage Ratings		Insulation Level Dielectric Withstand Volts	Short Circuit Ratings Symm. Amps	Range Of Fuse Ratings Amperes	Continuous Current Rating Amperes
		Rated Volts	Rated Max. Volts				
800	RLF-800	208 to 600	600	2200	200,000	250-1600	75-800
1600	RLF-1600					800-3000	75-1600
2000	RLF-2000					4000	75-2000
3200	RLF-3200 & RFC-3200 Fuse Carriage			2200	200,000	2000-5000	600-3200
4000	RLF-4000 & RFC-4000 Fuse Carriage			2200	200,000	4000-6000	800-4000

① All circuit breakers (and drawout fuses and carriage, if applicable) are UL listed.

Type SB Encased Case Systems Breakers

Maximum Ampere Rating	Available Amperage Range	Breaker Type	Maximum Interrupting Capacity In Symmetrical RMS Amperes for Voltage AC			Short Time Ratings In Symmetrical RMS Amperes (30 Cycle)
			240V	480V	600V	
400	200-400	SBA	65,000	65,000	42,000	25,000
800	400-800					
1200	600-1200					35,000
1600	800-1600					
2000	1000-2000				50,000	
400	200-400	SBS	100,000	100,000	65,000	25,000
800	400-800					
1200	600-1200					35,000
1600	800-1600					
2000	1000-2000					
2500	1600-2500	SBS	100,000	100,000	65,000	65,000
3200	1600-3200					
4000	2000-4000				85,000	



Vacu-Break® Fusible Switches

Max. Ampere Rating	Fuse Class	Maximum Interrupting Capacity in Symmetrical RMS Amperes, 240 to 600V AC	Fuse Holder
30 to 600	H, K1, K5 RK1, RK5	10,000	NEC Standard
	RK1, RK5	200,000	Class R Rejection Type
	J	200,000	Rejection Type
800 1200	L	100,000 ①	—

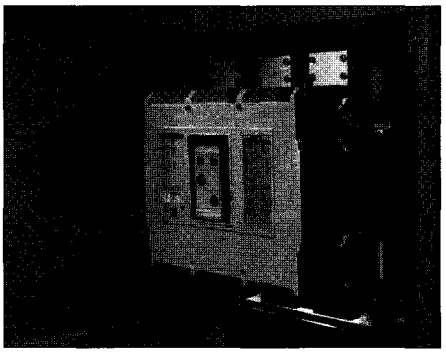
① 200,000A max. on 800A switch with "L" or "T" fuses and 1200A switch at 240V with "T" fuses.

Bolted Pressure Switches All 480V AC Maximum 2 or 3 Poles

Ampere Rating	Class L Fuse Rating (Amps)	Fuse Interrupting Rating (Sym. RMS Amps)
800	600, 700, 800	200,000
1200	1000, 1200	
1600	1500, 1600	
2000	1800, 2000	
2500	2500	
3000	3000	
4000	3500, 4000	
5000	5000	

HCP Fusible Switches

Ampere Rating	Class L Fuse Rating (Amperes)	Fuse Interrupting Rating (Sym. RMS Amps)
800	600, 700, 800	200,000
1200	1000, 1200	



Type SB Encased Systems Breaker

Pressure Wire Connectors

Breaker Type	Connector Applied to Amperage Range	Cables Per Connector	Connector ① Wire Ranges Available
Normal Duty — Thermal-Magnetic			
BQH BLH HBL BQD	15-30	1	#14 - #6 AWG Cu
			#12 - #8 AWG Al
	35-50	1	#8 - #6 AWG Cu
			#8 - #4 AWG Al
	55-70	1	#8 - #4 AWG Cu
			#8 - #2 AWG Al
	80-100	1	#4 - #1/0 AWG Cu
			#2 - #1/0 AWG Al
BL	110-125	1	#2 - #1/0 AWG Cu
			#1/0 - #2/0 AWG Al
QJ2 QJH2 QJ2-H	60-225	1 pc.	#6 AWG - 250 kcmil Cu ②
			#6 AWG - 300 kcmil Cu
			#4 AWG - 300 kcmil Al
JXD2	200-400	1 pc.	#6 AWG - 300 kcmil Cu
			#4 AWG - 300 kcmil Al
Heavy/Extra Heavy Duty, Current-Limiting — Thermal-Magnetic			
ED2 ED4 ED6 HED4 HED6 CED6	15-20	1 pc.	#14 - #10 AWG Cu
			#12 - #10 AWG Al
	25	1 pc.	#10 AWG Cu or Al
	30-60 ③ 1 Pole, CED6	1 pc.	#10 - #4 Cu or Al
	30-100	1 pc.	#10 - #1/0 AWG Cu or Al
	70-100 ③ 1 Pole, CED6	1 pc.	#4 - #1/0 Cu or Al
	110-125	1 pc.	#3/0 - 3 Cu
			#2/0 - 1 Al
	30-125 2-3 Pole	1 pc.	#10 - #3/0 Cu Only
FXD6/FD6 HFD6, CFD6	70-250	1 pc.	#6 AWG - 250 kcmil Cu
			#6 AWG - 350 kcmil Cu ②
			#4 AWG - 350 kcmil Al
JXD6/JD6 HJD6/HJXD6 HHJD6/HHJXD6 CJD6	200-400	1-2 pcs.	3/0 - 500 kcmil Cu
			4/0 - 500 kcmil Al
LXD6/LD6 HLD6/HLXD6 HHLD6 CLD6	250-600	1 pc.	3/0 - 600 kcmil Cu ②
			500 - 600 kcmil Cu ②
			500 - 750 kcmil Al ②
		1-2 pcs.	3/0 - 500 kcmil Cu ②
			4/0 - 500 kcmil Al
MXD6/MD6 NXD6/ND6 HND6/HNXD6 CMD6, CND6	500-600	1-2 pcs.	#1 AWG - 500 kcmil Cu or Al
	700-800	1-2 pcs.	600 - 750 kcmil Cu ②
			600 - 750 kcmil Al ②
		1-3 pcs.	#1 AWG - 350 kcmil ②
			#1/0 AWG - 500 kcmil Cu or Al
	800-1200	1-3 pcs.	250 - 400 kcmil Cu ②
			500 - 750 kcmil Cu ②
			250 - 400 kcmil Al ②
			500 - 750 kcmil Al ②
		1-4 pcs.	250 - 500 kcmil Cu or Al
PXD6/PD6 HPD6/HPXD6 CPD6	1200-1600	1-5 pcs.	750 kcmil Cu ②④
			300 - 600 kcmil Cu or Al
PXD6/PD6 HPD6/HPXD6 RXD6/RD6 HRD6/HRXD6	1600-2000	1-4 pcs.	300 - 600 kcmil Cu or Al ②
		1-6 pcs.	300 - 600 kcmil Cu or Al
SJD6, SHJD6 SCJD6	200-400 ⑤	1-2 pcs.	3/0 - 500 kcmil Cu
			4/0 - 500 kcmil Al
SLD6, SHLD6 SCLD6	250-600 ⑤	1-2 pcs.	3/0 - 500 kcmil Cu
			4/0 - 500 kcmil Al
SMD6, SHMD6 SCMD6 SND6, SHND6 SCND6	500-600	1-2 pcs.	#1 AWG - 500 kcmil Cu or Al
	700-800	1-3 pcs.	#1/0 AWG - 500 kcmil Cu or Al
	800-1200	1-4 pcs.	250 - 500 kcmil Cu or Al
SPD6/SHPD6	1200-1600	1-5 pcs.	300 - 600 kcmil Cu or Al
		1-4 pcs. ④	750 kcmil Cu or Al ②

Vacu-Break Fusible Switches (Branch Connectors)

Ampere Rating	Cables Per Cond.	Wire Range	Type
30 (2.5 in.)	1	14 - #8 AWG	Cu
30	1	#14 - #4 AWG	Cu or Al
60	1	#14 - #4 AWG	Cu or Al
100	1	#1/0 AWG	Cu or Al
200	1	#6 AWG - 350 kcmil	Cu or Al
400	2	#4/0 AWG - 500 kcmil	Cu or Al
600	2	#4/0 AWG - 500 kcmil	Cu or Al
800	3	#4/0 AWG - 600 kcmil	Cu or Al
1200	4	#4/0 AWG - 600 kcmil	Cu or Al

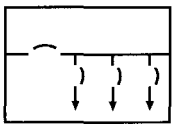
Fusible Bolted Pressure Switches (Branch Connectors)

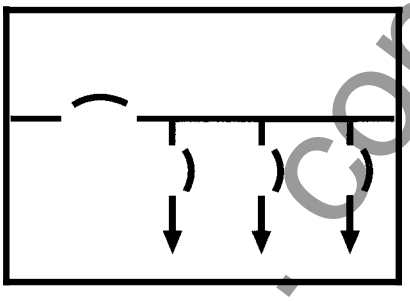
Ampere Rating	Cables Per Cond.	Wire Range	Type
800	2	#4/0 AWG - 750 kcmil	Cu or Al
1200	4	#3/0 AWG - 750 kcmil	Cu or Al
1600	6	#3/0 AWG - 750 kcmil	Cu or Al
2000	6	#3/0 AWG - 750 kcmil	Cu or Al

Starters and Contactors (Lug Data)

NEMA Size	Lugs Per Pole	Wire Range	Type
00-1	1	#14 - #8 AWG	Cu Only
2	1	#14 - #4 AWG	Cu Only
3	1	#14 - #1/0 AWG	Cu/Al

① Terminals are UL listed for 60 / 75°C conductors; CSA listed for copper wire only.
② Optional — use only in cases allowed by local codes.
③ Use on load side only.
④ This connector is of aluminum construction, but rated for copper cable only.
⑤ 200A — Apply this connector when continuous current setting is adjusted for lower ampacities.





Automatic Throwover System—Application

An automatic throwover system provides power to a common load from two or more sources such as utility sources and generator sources. In most systems there is a period of time from approximately 1 to 5 seconds where the load is completely without power as the sources are switched. Thus it is not a "UPS" (uninterruptable power supply) system although most UPS systems incorporate a transfer scheme as a part of their system. Generally, this is sufficient for most loads other than computers which cannot stand even a momentary outage.

Basically, the purpose for having an automatic transfer system is to provide power to critical loads by continuously monitoring the utility source for proper voltage and either switching to an alternate utility source or starting and switching to an on-site generator when the voltage fails. In more elaborate systems other source parameters such as phase failure, phase reversal, frequency, and reverse power might be monitored. Also, several sources might be used with corresponding main and tie breakers—each source will have a main, and each pair of mains will have a tie.

The transfer system will generally feed only the critical load to minimize the frame size of the breakers involved. However, they may be located anywhere in the distribution system and anything may be considered "critical load", depending on the application and user preference.

A two-device transfer scheme generally consists of a normal (utility) main and an emergency (generator) main with no tie. The system sends a generator engine start signal and may also have a cool-down timer, after retransfer to utility power, as an option. If the generator fails the time delay or retransfer to utility power is by-passed.

A three-device transfer scheme generally consists of two main utility breakers and one tie breaker. Normally, the two mains are closed and the tie is open. Upon failure of either source that main opens and the tie closes. Upon restoration of utility source the tie opens and the open main closes. The breakers are electrically interlocked such that any *two* may be closed at one time. Usually, no generators are involved and in more elaborate systems, momentary paralleling of sources may be used. The source sensing and logic controls are very similar and may include the phasefailure, phase reversal, and undervoltage sensing. A time delay on transfer to ride out momentary fluctuations, and a time delay on re-transfer to utility to insure that the power has stabilized, is standard. An "auto-manual" selector switch is provided such that the system will operate automatically and the manual open-close push buttons are bypassed in "auto" and "manual". All automatic functions are by-passed except the electrical interlock and only the open-close pushbuttons are functioning.

This "manual" position allows for transfer under other than emergency conditions for maintenance, testing, etc. Pilot lights located near the open-close buttons provide indications of the positions of each breaker.

Each main source powers a control transformer and a control power selector or relay switches to whichever source is available to insure that the system has control power. Each control transformer has a control power disconnect so if the system is placed in "manual", all control power may be shut off for work on the control system without disturbing the power to the load.

In the event of a short circuit or over current condition such that one of the breakers trips, the system does not transfer to another source and if requested, alarm contacts may be provided to energize a lockout relay and pilot light, which must be manually reset before the system can be returned to normal. Remote alarm contacts are also available if this lockout feature is requested.

By-pass contacts are provided when draw-out breakers are used so that the system will function as close to normal as possible when a breaker is drawn out. Contacts for remote position indication can be provided for customer use.

A transfer switch (such as ASCO, Russelectric, etc.) accomplishes the same purpose as a two device transfer scheme except it generally has no "open" position. These switches must be closed on normal or closed on emergency—there is no middle position. On a two device transfer scheme using breakers, it is possible to have both breakers open and thus isolate the load from either source. A transfer switch cannot be used in a standard double ended switchboard with a tie.

Automatic Throwover Available Functions

Standard Function	**3–Breakers**	**2–Breakers**
Electrical interlock	✓	✓
Mechanical interlock	—	✓
Time delay on transfer	✓	✓
Time delay on retransfer	✓	✓
Voltage sensing both sources	✓	✓
Phase sensing both sources	✓	✓
Auto-manual switch with light	✓	✓
Control transformers and transfer relay	✓	✓
Bypass contacts on drawout breakers	✓	✓
Engine start contacts	—	✓
Bypass of retransfer if emergency fails	—	✓
Open-close pushbuttons and lights	✓	✓
Optional Function	**3–Breakers**	**2–Breakers**
Frequency sensing	✓	✓
Remote alarm/lockout contacts	✓	✓
Synchronization check	✓	—
Current sensing	✓	✓
A and B auxiliary contacts	✓	✓
Reverse power relay	✓	✓
Ground fault	✓	✓
Phase indicating lights	✓	✓
Load voltage release	✓	✓
Time delay for engine cool down	—	✓
Test switch—loss of normal	✓	✓
Plant exerciser	—	✓

480V Metal-Enclosed Switchgear

Siemens low-voltage metal-enclosed switchgear is used in electric power distribution systems for the control and protection of circuits and equipment. The switchgear employs draw-out type low voltage power circuit breakers described in detail on pages 46 through 51.

LV switchgear is typically installed in:

- **Industrial Plants** — for power and lighting networks and feeders, power generation and other auxiliaries, and to provide power for machine tools and material handling equipment drivers.
- **Utility and Co-generation Facilities** — for motor control centers to protect and distribute power to electrical devices such as blowers, compressors, fans, pumps, and motors.
- **Commercial and Residential Buildings** — for protection and distribution of power for lighting, elevators, air conditioning, blowers, fans, motors, and pumps.

Available Types:

- **Type R** — indoor (NEMA 1)
- **Type SR** — outdoor walk-in (NEMA 3R)

Low-voltage switchgear can be applied on distribution systems with:

- 3-phase, 3- or 4-wire feeders
- 50 or 60 Hz
- Voltages of 208, 240, 480, or 600 volts
- Currents up to 4000 amperes

Circuit breakers may be either manually or electrically operated, fused or unfused. The following designations are used:

- RL — Standard Interrupting
- RLE — Extended Interrupting
- RLI — High Interrupting
- RLF — Fused Type

Siemens Static Trip III trip units are provided on all low voltage power circuit breakers. All circuit breakers are UL listed.

Industry Standards

Types R and SR switchgear with power circuit breakers are designed, tested and constructed in accordance with:

- ANSI C37.20.1
- ANSI C37.50
- ANSI C37.51
- Applicable standards of IEEE and NEMA
- Applicable requirements of the National Electric Code (NEC)
- UL 1558

Type RL drawout circuit breakers are in accordance with:

- ANSI C37.13
- ANSI C37.16
- ANSI C37.17
- UL 1066

Features and modifications required by NEC are incorporated when the assembly is used as "Service (Entrance) Equipment."

UL Listing (Optional)

An Underwriters Laboratories listing mark (UL label) can be optionally supplied for each vertical section. The specific section must contain only devices which are UL listed or are UL recognized components found suitable for the intended use. All circuit breaker drawout elements are UL listed.

Outgoing Section

480V Metal-Enclosed Switchgear

General

The Siemens 480 volt switchgear assembly consists of multiple metal-enclosed, vertical sections. Normally the end sections are designed to allow for installation of future sections.

Each vertical section consists of up to four individually enclosed breaker or auxiliary compartments which are sized to provide uniform height.

Included in each assembly are various components such as circuit breakers, instrumentation and control equipment, transformers, relays, three-phase bus work, and all internal wiring, connectors, and other supporting equipment.

In accordance with ANSI C37.20.1, the maximum temperature for parts that are handled is 50°C. The main bus maximum temperature rise is 65°C above 40°C ambient. The temperature rise of the air surrounding the cable connection points is limited to 45°C above 40°C ambient.

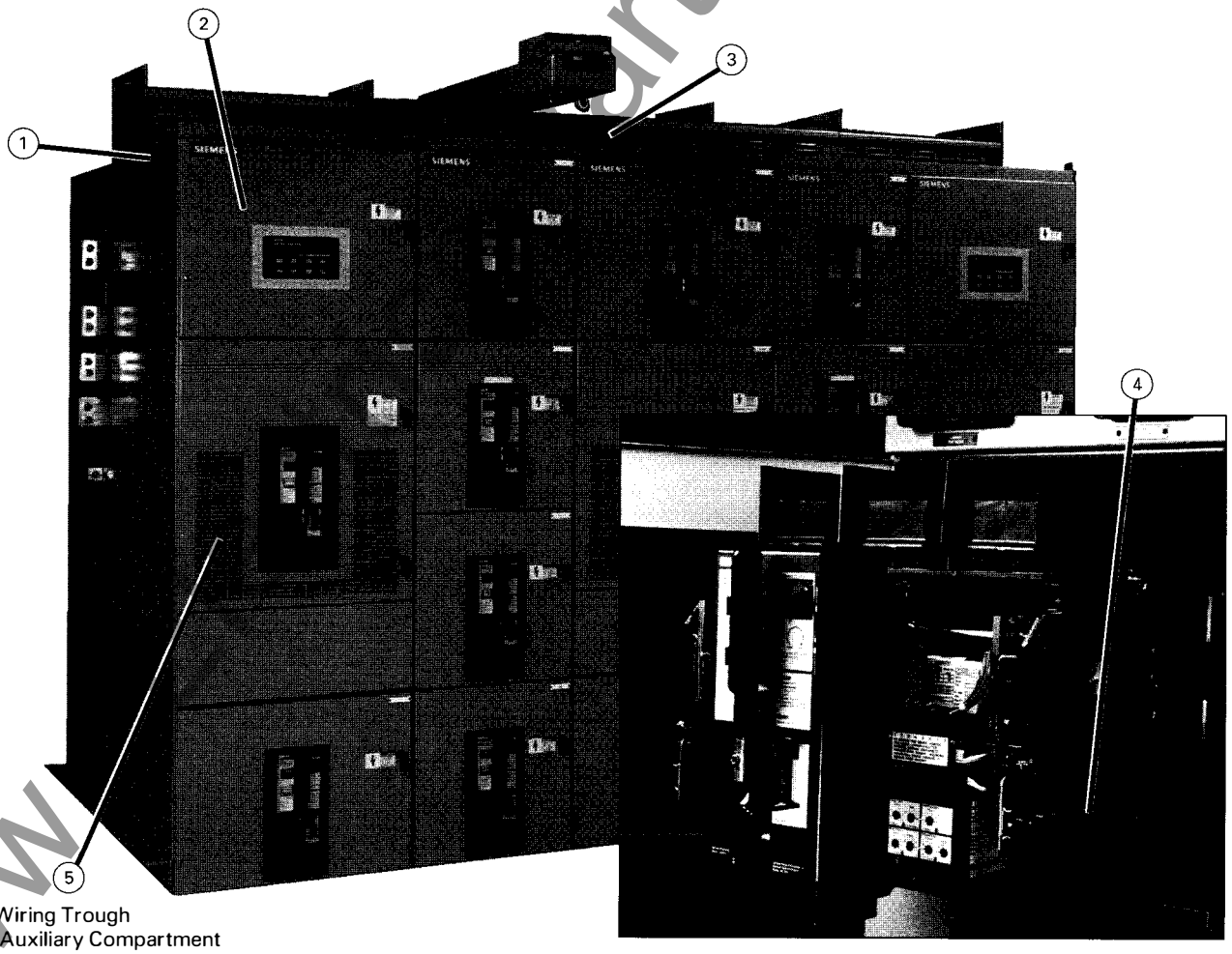
Finish

During construction, the structural steel parts, panels, and compartments are all prepared for painting by a five-stage wash system. Standard finish color is light gray ANSI 61. If a different finish color is required, it is applied over the standard finish with conventional spray equipment and is allowed to air cure. The completed finish has a nominal 2 mils dry film thickness.

Assembly Construction

Siemens metal-enclosed power switchgear is constructed of pre-formed, full-depth, 14-gauge steel sheets bolted together and reinforced with cross-member braces to form a rigid, self-supporting compact assembly. The top and rear plates, and side sheets are all 14-gauge steel. When two vertical sections are mounted together, two sheets of 14-gauge steel separate adjacent circuit breaker compartments. 11-gauge steel barriers separate circuit breakers within the same vertical section.

Bolted steel / glass polyester compartments housing each power circuit breaker are mounted in the vertical section to form the switchgear assembly. This isolates the circuit breakers from the bus / cable section and from adjacent circuit breaker compartments.



① Inter-Unit Wiring Trough
● Meter and Auxiliary Compartment
③ Ventilation and Lifting Structure
④ Telescoping Breaker Drawout Rails
⑤ Ventilation Openings (RL-2000, RL-3200 and RL-4000)

Construction Details

The bus / cable section includes main horizontal bus, riser bus, connections from the main bus to each set of primary disconnects, and load side copper runback bus.

Grounded metal barriers can be provided to isolate the main bus from cable connections. Barriers are also available to isolate the incoming line of the main circuit breakers from the main load bus of the switchgear.

Main and Ground Bus

The typical main bus is silver plated copper. Welded aluminum is also available. Provisions for future extension of aluminum main bus conductors include tin plated joints with high tensile strength steel hardware. Tin plated copper bus is optionally available.

The main three phase horizontal bus is arranged vertically one phase above the other with edge-to-edge alignment to provide high, short circuit strength. Insulated main and vertical bus are optional.

Main bus ratings available are 1600, 2000, 3200, 4000, or 5000 amperes continuous current. A neutral bus is furnished when specified, and can be rated 1600, 2000, 3200 or 4000 amperes continuous current.

A standard copper ground bus extends through all sections. A cable lug can be mounted to the ground bus in each section.

Minimum bus bracing is 65,000 amperes RMS symmetrical. Higher symmetrical bracings are available based on the lowest breaker short circuit rating in the group.

Load side runbacks for feeder circuits are one-piece copper construction, are insulated with sleeve tubing in the main bus area, and are supported by high-strength, glass polyester moldings.

Control Wiring

Standard secondary and control wiring is #14 AWG extra-flexible, stranded copper type SIS. Terminations are made with compression-type, insulated terminals.

For devices not having screw-type terminals, tab-type disconnects are used.

Insulation

The insulation used is Pyro-Shield, a fiberglass-reinforced, polyester material that has high impact strength and low moisture absorption. Other features include high flame retardance, high resistance to chemical fumes, and long life at high temperatures.

Circuit Breaker Compartments

Typical circuit breaker compartments include primary disconnects, ground disconnect, drawout rails, and associated interlocks, and secondary disconnects, if appropriate. Telescoping drawout rails allow the breaker to be withdrawn from the compartment without additional extensions or adapters. Compartments for electrically-operated circuit breakers include secondary disconnects and control circuit fuses. Up to three current transformers for metering or relaying can be mounted in each compartment.

Circuit breaker compartment front panels can be used to hold a variety of auxiliary devices such as breaker control switches, ammeters, and test blocks.

Options

Switchgear Mounted Hoist

The hoist travels along rails on top of the switchgear to ease breaker handling.

TOC and MOC Switches

The Truck Operated Cell (TOC) Switch provides interlocking control or remote indication of the breaker racking position. The cubicle mounted auxiliary switch or Mechanism Operated Cell (MOC) switch provides interlocking control or remote indication based on the main contact position (open or closed).

The switches have field adjustable contacts for simple conversion of contacts from normally open ("a" type) to normally closed ("b" type). Each contact may be adjusted individually without disassembly or removal of wiring.

Shutters

These provide protection against accidental contact with primary disconnects in a compartment when the breaker is removed.

Wire Trough Covers

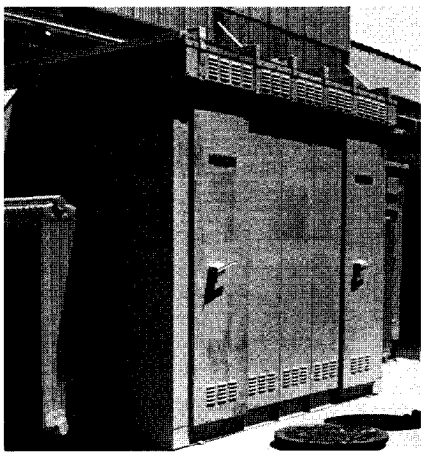
Enclose secondary wiring within each vertical section in the primary bus and outgoing cable areas.

Key Interlock

This holds the key when the circuit breaker is closed, preventing operation of a remote device unless the breaker is open.

PTS4 Test Set

Set allows testing of the full range of protective settings of Static Trip III trip units.



Metering and Auxiliary Compartments

Compartments are available to house devices such as voltage transformers, metering, control power transformers, and supervisory devices.

Instrument and Control Transformers

Voltage transformers and control power transformers are mounted in auxiliary compartments. These transformers are protected by primary pull-out type current-limiting fuses and secondary fuses. Current transformers are normally mounted on the compartment primary disconnect studs where they are readily accessible.

Outdoor Switchgear

Type SR outdoor switchgear is enclosed in a weather resistant (NEMA 3R) steel housing. All exterior doors extend below the floor line and are gasket sealed.

For protection from snow, rain, and dust, the switchgear rests on a six-inch, formed steel base which provides rigid support and a tight bottom seal. A heavy duty, coal tar emulsion protective undercoating is applied to the underside for protection against moisture and corrosion. Shielded ventilation housings permit proper air circulation while excluding dust, dirt, and foreign matter.

A lighted, unobstructed service aisle is provided at the front of the switchgear allowing inspection and maintenance without exposure to the elements. An access door equipped with an emergency bar release is at each end of the aisle. A GFI convenience outlet is included.

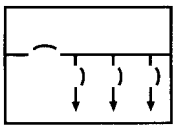
Accessories

Each switchgear assembly includes the following standard accessories:

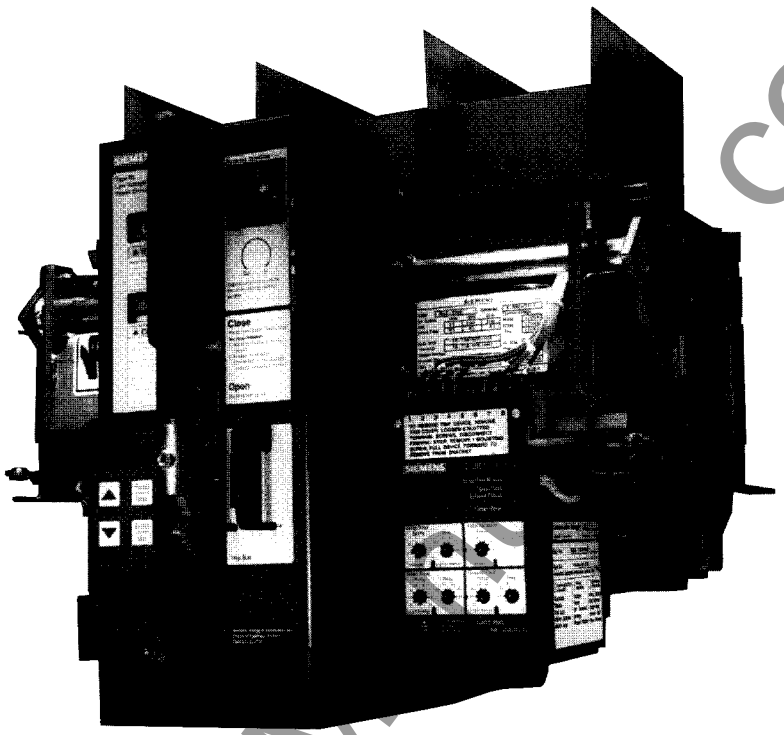
- Crank for circuit breaker racking
- Lifting bar assembly for all circuit breaker types
- Spring charging handle for electrically operated circuit breakers

As an optional accessory, a test cabinet is available for indoor use that is wall mounted with necessary equipment for testing electrically-operated breakers that have been removed from the breaker compartments.

Typical Outdoor Installation
With Liquid Filled Transformer



Outgoing Section



Type RL Circuit Breaker With Static Trip III Trip Unit And Optional Breaker Display Unit (BDU)

The Siemens RL series circuit breakers are designed for up to 600 volt service with current carrying capacities of up to 4000 amperes and interrupting capacities of up to 130,000 amperes unfused or 200,000 amperes fused.

These compact, fast operating circuit breakers incorporate a stored energy closing mechanism, either manually or electrically charged, for fast, positive closing.

A quick-make closing mechanism releases the stored energy for high speed closing of the primary contacts. This positive, controlled closing prevents unnecessary arcing between the movable and stationary breaker contacts and thus lengthens contact and breaker life.

Manual tripping is performed with the push lever on the front of the breaker. Up to three padlocks can be used to lock the breaker contacts in the open position.

Typical Breaker Features

- Arc Quenchers
- Main And Arcing Contact Structures
- Inductive Tripping Sensors
- Control Wiring
- Auxiliary Switches
- Interlocks
- Position Indicators
- Interpole Barriers
- Mechanical Trip Bar

Each circuit breaker is a complete 3-pole, single-throw element that is mechanically and electrically trip-free, with a Static Trip III overcurrent trip unit.

Circuit Breaker Racking

Racking is accomplished by cranking a racking screw on the front of the breaker and may be done with the compartment door open or closed. The racking screws turns U-shaped brackets on each side of the breaker which racks the breaker frame in or out of the compartment.

As the racking screw is turned counterclockwise, the breaker frame moves out of the compartment and disconnects the primary contacts, followed by the secondary contacts.

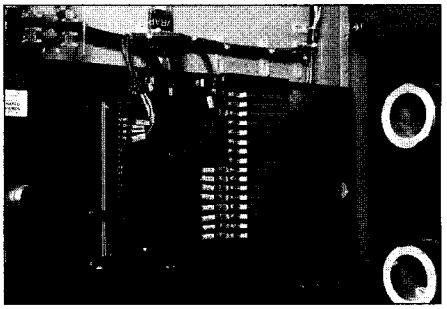
With only the secondary contacts connected (test position), the breaker may be closed and opened for testing without energizing the load. An indicator located on the front of the breaker identifies the position of the breaker in the compartment.

Primary Disconnects

Primary current is applied to the circuit breaker through silver plated disconnects. The stationary contacts are mounted through solid Pyro-Shield insulation sheets in the back of the compartments. The movable contacts are mounted on the back of the breaker. Stainless steel springs provide pressure to the finger contacts in the connected position. Low contact resistance is maintained by these self-aligning contacts. The primary contacts are positioned so that current can flow only in the connected position. In the test position the contacts are separated a safe distance.

Secondary Disconnects

Secondary circuits are connected to the circuit breaker through silver-plated, slide-type contacts which are located below the arc quenching area to avoid contamination from arc product gases. The position of these contacts is visible with the panel door open. The stationary contacts are silver plated copper strips mounted on a Pyro-Shield molded base. The contacts are recessed to guide the movable, self-aligning contacts and to prevent accidental short circuiting. Secondary connections are made automatically in both the connected and test positions.



Secondary Disconnects in Cell
Left = Communications
Right = Breaker Control

Main and Arcing Contacts — Similar Design for all Ratings

Ground Connection
A ground contact is located on the circuit breaker to connect with the ground circuit. The breaker is grounded in both the connected and test positions.

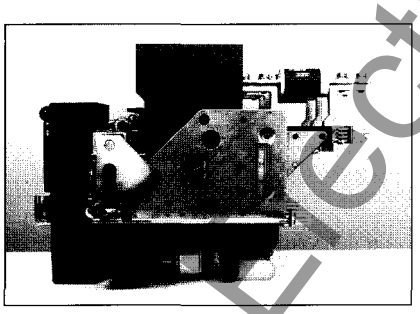
Drawout Interlocks
All circuit breakers have drawout interlocks to:

- prevent racking closed breaker
- prevent closing breaker until fully racked to connected position, or in test position
- prevent inserting or withdrawing breaker from compartment while closing springs charged

Arc Interruption
When a fault occurs, the main contacts open first, transferring the fault current to the arcing contacts. As the arcing contacts open, the thermal and electromagnetic characteristics force the arc into the arc chute, where the metal plates lengthen, constrict, and cool the arc.

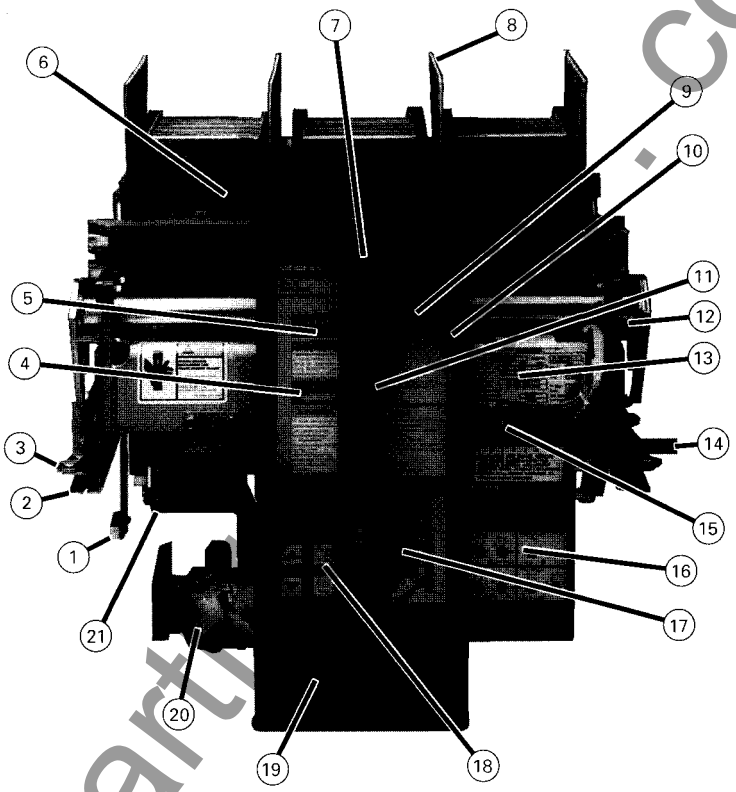
Current Limiting Fuses
The 800, 1600 and 2000 ampere circuit breakers are available with integrally mounted current limiting fuses to increase interrupting rating and/or to limit short circuit (let-through) current. The fuses are bolted in series with the upper set of primary disconnects. The breakers meet all required standards and are UL listed based on current limiting fuses.

An open fuse tripping device is wired in parallel with the main fuses to insure that the circuit breaker opens if a main fuse interrupts, thus preventing single phasing. This device holds the circuit breaker trip-free until it is reset and also indicates which main fuse has interrupted.



Integrally Fused RLF-800 Circuit Breaker

The higher rated circuit breakers, 3200 and 4000 ampere, are available with current limiting fuses mounted on a separate drawout carriage, which is key interlocked with the circuit breaker, allowing racking of the fuse carriage with the associated circuit breaker in the open position. The carriage mounts in the same vertical section as the circuit breaker element.



1. Ground shoe contact
2. Mounting rails
3. Racking position detent
4. Stored energy mechanism position indicator
5. Contact position indicator
6. Arc chutes
7. Handle for manually charging stored energy closing springs (optional on electrical breakers)
8. Inter-phase barriers
9. Racking mechanism shutter (with packlocking provisions)
10. Racking position indicator
11. Contact closing release lever (behind charging handle)
12. Clevis attached to racking drive screw
13. Circuit breaker rating nameplate
14. Racking interlock bar
15. Static Trip III trip unit test points
16. Static Trip III overcurrent device
17. Tripping lever (with padlocking provisions) with guard
18. Breaker Display Unit (optional)
19. Power switch for spring charging motor (electrically operated breaker only)
20. Spring charging motor (electrically operated breaker only)
21. Auxiliary switch (optional on manual breakers)

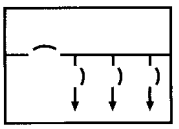
RL Circuit Breaker Features (Electrically Operated Breaker Shown)

Current Sensors
The tripping system of the RL breaker is self-powered from the current sensors mounted on the primary contacts of the breaker element (four-wire ground applications include a fourth sensor mounted in the cable compartment). A signal from the current sensors, proportional to primary current is applied to the trip device which then operates the actuator to trip the breaker based on a pre-set time delay versus current magnitude relationship.

Available Sensor Ratings①

Frame Size and Max Amp Rating	Sensor Ratings
800	150, 200, 300, 400, 600, 800
1600	150, 200, 300, 400, 600, 800, 1200, 1600
2000	150, 200, 300, 400, 600, 800, 1200, 1600, 2000
3200	1200, 1600, 2000, 3200①
4000	1600, 2000, 3200①, 4000①

① Optionally available with integral 2000A ground sensor winding to meet NEC 230–95 requirements.



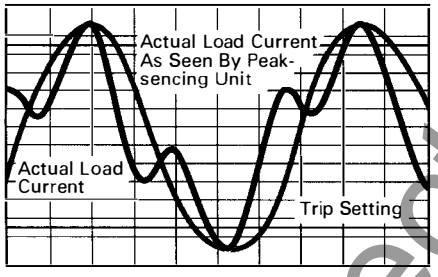
Static Trip® III Trip Unit

Static overcurrent tripping devices have been standard on Siemens circuit breakers for over thirty years. The Static Trip III trip unit features microprocessor-controlled tripping, while providing RMS sensing for standard overcurrent protection, and optional metering and communications functions. Located in the lower right side of the breaker, the trip unit is readily accessible for simple reading and adjustment of all settings and indicators. Static Trip III trip units are interchangeable on all ratings of low voltage circuit breakers.

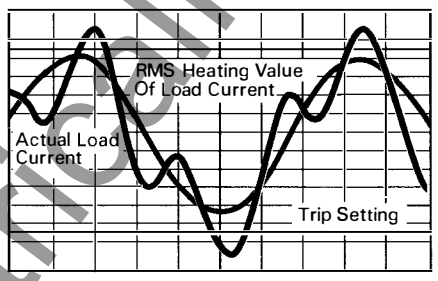
All communicating Static Trip III trip units include a local communication port that supports the breaker-mounted display unit or BDU. The BDU features a high-visibility alpha-numeric display. Real-time metered values, min/max values, event log data and setpoint data can be read on the BDU in straightforward engineering units. Alarm and relay setpoint can be configured using the BDU keypad.

This data can also be communicated to other devices or computers for control monitoring via Siemens' ACCESS system.

Static Trip® III Trip Unit (right) and Breaker Display Unit (left)



Harmonics distort the current wave shape and can increase its peak value. Normal peak-sensing units may trip, causing nuisance shutdowns.



Siemens RMS sensing samples the entire current wave shape and calculates the effective heating value of the current. Static Trip III trip units provide accurate protection and avoid unnecessary trips.

Static Trip III Settings

T: Long Time	
Setting① (X Sensor Rating)	Delay (Seconds @ 6X Setting)
.5, .55, .6, .65, .7, .75, .8, .85, .9, .95, 1.0	3.5, 6, 10 17, 30
S: Short Time	
Pickup (X LT Setting)	Delay (Seconds)
2, 3, 4, 5, 6, 7, 8, 12	.08, .15, .22 .30, .40
I: Instantaneous	
Pickup (X Sensor Rating)	Delay (Seconds)
2, 4, 6, 8, 12, 15	No Intentional Delay
G: Ground Fault	
Pickup (% Ground Sensor)	Delay (Seconds)
20, 30, 40, 50, 60	.10, .25, .40

① Pickup is fixed at 1.1 times long time setting.

Static Trip III Trip Unit Functions

Function	Model			
	III	IIIC	IIICP	IIICPX
Self-Powered Overcurrent Protection	✓	✓	✓	✓
RMS Sensing	✓	✓	✓	✓
Switchable Thermal Memory	✓	✓	✓	✓
Ground Fault Protection	opt	opt	opt	opt
LCD Target	✓	✓	✓	✓
Protective Microprocessor Watchdog	✓	✓	✓	✓
Pickup LEDs	✓	✓	✓	✓
Zone Interlocking ①	opt	opt	opt	opt
Retrofit Universal Mounting Package	opt	opt	opt	opt
RS-485 Communications Port	—	✓	✓	✓
Breaker Display Unit Port ②	—	✓	✓	✓
Communications Microprocessor Watchdog	—	✓	✓	✓
Comm Watch LED	—	✓	✓	✓
Backup Shadow Protection	—	✓	✓	✓
Trip Log	—	✓	✓	✓
Alarm Relay Output ①	—	opt	opt	opt
Trip Unit Status Indication	—	✓	✓	✓
Breaker Position Indication	—	✓	✓	✓
Breaker Operation Counter	—	✓	✓	✓
Communication Open/Close/Trip ① ③	—	opt	opt	opt
Event Log	—	✓	✓	✓
Phase Current Metering	—	✓	✓	✓
Ground Current Metering ④	—	✓	✓	✓
Neutral Current Metering ⑤	—	opt	opt	opt
Min/Max Current Log	—	✓	✓	✓
Power Metering Functions	—	—	✓	✓
Min/Max Power Log	—	—	✓	✓
Extended Protective Relaying	—	—	—	✓
Extended Trip Log	—	—	—	✓

Static Trip IIICPX Protective Relay Functions

Protective Function	Setting Range	Typical Applications		
		Motors	Generators	Mains
Current Unbalance	5-50%	✓	✓	—
Voltage Unbalance	5-50%	✓	—	✓
Overvoltage	60-660V	—	✓	—
Undervoltage	60-660V	✓	✓	—
Reverse Power	10-2000kW	—	✓	✓
Overfrequency	50.0-70.0 Hz	—	✓	—
Underfrequency	45.0-60.0 Hz	—	✓	—

Static Trip III Metering Functions

Measured Parameter	Model	
	IIIC	IIICP
Phase Currents	✓	✓
Avg Phase Currents	✓	✓
Ground Current ④	✓	✓
Neutral Current ⑤	opt	opt
Phase Voltage ⑥	—	✓
Avg Phase Voltage ⑥	—	✓
Line Voltages	—	✓
Avg Line Voltages	—	✓
kW	—	✓
kW Demand	—	✓
kW Hours	—	✓
kW Hours Reverse	—	✓
kVA	—	✓
kVAR	—	✓
kVAR Hours	—	✓
Power Factor	—	✓
Frequency	—	✓

● Requires additional wiring to meet specific application.
● Supports optional Breaker Display Unit accessory.
③ Open command uses alarm relay output and restricts use for other alarm functions. Close command requires electrically operated breaker.
④ Included when ground fault protection specified.
⑤ Requires "N" option and neutral current sensor.
● Only displayed for four wire systems.

RL Breaker Accessories/Modifications

Type RL circuit breakers feature several options, including:

- Shunt Trip (for MO breakers)
- Operation Counter
- Undervoltage Trip Device
- Electrically Operated Interlock
- Automatic Trip Alarm Contact (with or without Lockout Bell Alarm)

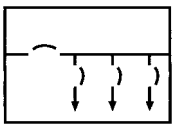
Tripping Actuator
The tripping actuator is a low energy, flux-shifting device that allows fast action tripping of the breaker.

Shunt Trip
The shunt trip is used to electrically trip the circuit breaker from a remote device, such as pushbutton, switch, or relay. The shunt trip is standard on all electrically operated breakers, optional on manually operated breakers.

The shunt trip coil is designed for a momentary duty cycle. Thus, an "a" type auxiliary contact switch is used to interrupt the shunt trip circuit immediately after the breaker is tripped. When the coil is energized, the armature picks up and rotates the trip latch, thereby tripping the breaker. A compression spring returns the armature to the normal position.

Shunt Trip Coil Ratings

Nominal Control Voltage		Operating Voltage Range	Shunt Trip (Amperes) Seal-In/Inrush
60 Hz AC	120	104-127	1.65/7.7
	240	208-254	0.71/3.4
DC	48	28-56	5.45
	125	70-140	2.76
	250	140-280	1.85



RL Breaker Accessories/ Modifications, cont'd

Operation Counter

A mechanically-operated, 5-digit non-resetable counter can be mounted beneath the breaker auxiliary switch. The counter is incremented by the action of the auxiliary switch operating mechanism.

Undervoltage Trip Device

The undervoltage trip device protects against a drop in normal bus voltage and functions to directly trip the breaker. Pickup occurs at 85 percent or less of rated value and dropout between 30 and 60 percent of rated value. Pickup and dropout are individually adjustable. Instantaneous or time-delayed operation can be provided. The static timing unit is adjustable from 0.04 to 4 seconds for time delay. This allows the system to distinguish between undervoltage conditions and momentary voltage dips.

Undervoltage Trip Ratings

Nominal Control Voltage		Pickup Voltage	Dropout Voltage
60 Hz AC	120	100	60
	240 or 480 ⓘ	—	—
DC	48	40	24
	125	105	62

ⓘ Not available. Use 120V AC undervoltage device with appropriate 240-120 or 480-120 voltage transformer in cubicle.

Electrically Operated Interlock

This can be added to interlock two breakers, preventing both from being closed at the same time. These electromechanical devices add an additional solenoid that must be energized before the breaker can be closed. When the interlock is de-energized, the breaker is held trip-free and cannot be closed electrically or manually. The interlock has a mechanical link that goes to the main shaft of the breaker. The interlock is held in the picked-up position when the breaker is closed. Once closed the interlock can be de-energized without tripping the breaker. There are no adjustments for pickup or dropout voltages. The interlocks are continuously energized.

Interlock Coil Ratings

Nominal Control Voltage		Voltage Range	
		Max. Pickup	Min. Dropout
60 Hz AC	120	104	36
	240	208	72
DC	48	38	15
	125	100	38
	250	200	75

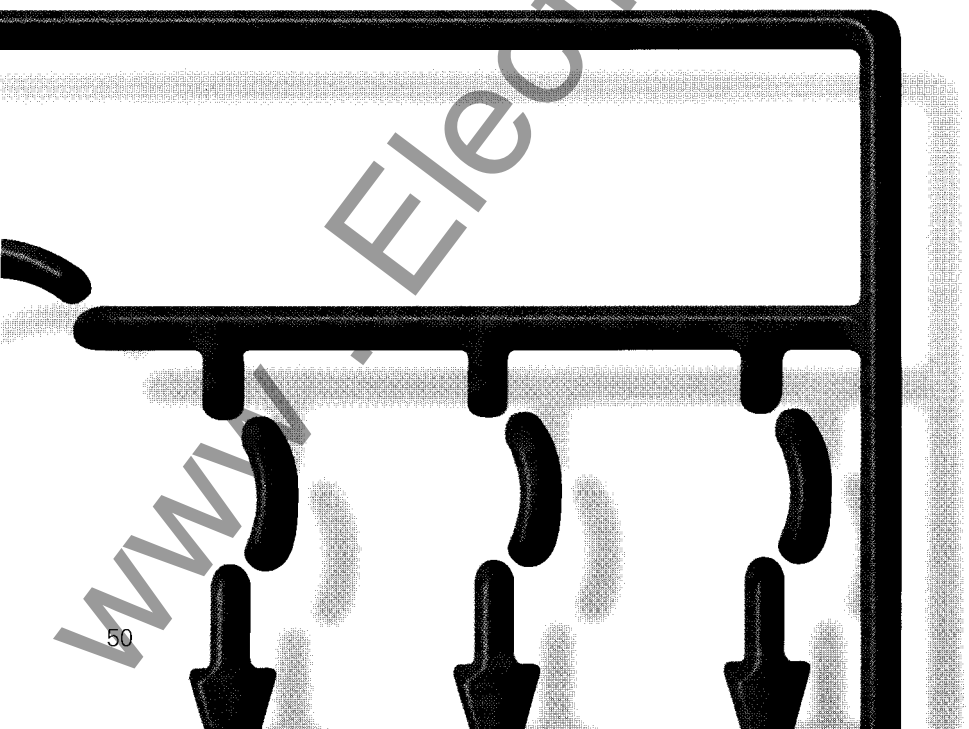
Automatic Trip Alarm Contact (with or without Lockout) (Bell Alarm)

The trip bell alarm is initiated by the Static Trip III trip unit through an optional contact circuit. This can control an auxiliary alarm contact locally, or remotely for indication of an automatic trip. The circuit must be reset manually or electrically (optional). Two types of contacts are available: a single-pole, double-throw or a double-pole, double-throw. A lockout feature can be added to prevent reclosing after a fault occurs. This is accomplished by connecting the contact in series with the breaker closing coil.

If desired, a mechanical lockout option can be provided. This consists of a manual reset for the tripping actuator, with the normal automatic reset disabled. The breaker is held trip free following an overcurrent trip, until the lockout is manually reset.

Bell Alarm Contact Ratings

Nominal Control Voltage		Bell Alarm Contact Ratings (Amperes)		
		Continuous	Make	Break
60 Hz AC	120	10.0	10.0	10.0
	240	10.0	10.0	10.0
DC	48	0.5	10.0	0.5
	125	0.5	10.0	0.5
	250	0.25	10.0	0.25



Type RL Low-Voltage Power Circuit Breaker Ratings At 50/60 Hertz

Frame Size Amperes	Breaker Type	Voltage Ratings		Insulation Level Dielectric Withstand Volts	Short Time Rating Symmetrical Amperes	Short Circuit Rating Symmetrical Current		Continuous Current Rating Amperes
		Rated Volts	Rated Max. Volts			With Instantaneous Trip Amperes	Without Instantaneous Trip Amperes	
800	RL-800	600	635	2200	30,000	30,000	30,000	75-800
	RLE-800				42,000	65,000	42,000	75-800
	RLI-800				22,000	42,000	22,000	75-800
1600	RL-1600				50,000	65,000	50,000	75-1600
2000	RL-2000				65,000	65,000	65,000	75-2000
	RLE-2000				85,000	85,000	85,000	75-2000
3200	RL-3200				65,000	85,000	65,000	600-3200
4000	RL-4000				85,000	100,000	85,000	800-4000①
	RLE-4000				100,000	100,000	100,000	800-4000①
800	RL-800	480	508	2200	30,000	30,000	30,000	75-800
	RLE-800				42,000	65,000	42,000	75-800
	RLI-800				22,000	100,000	22,000	75-800
1600	RL-1600				50,000	65,000	50,000	75-1600
2000	RL-2000				65,000	65,000	65,000	75-2000
	RLE-2000				85,000	100,000	85,000	75-2000
3200	RL-3200				65,000	85,000	65,000	600-3200
4000	RL-4000				85,000	100,000	85,000	800-4000①
	RLE-4000				100,000	100,000	100,000	800-4000①
800	RL-800	240 and 208	254	2200	30,000	42,000	30,000	75-800
	RLE-800				42,000	65,000	42,000	75-800
	RLI-800				22,000	100,000	22,000	75-800
1600	RL-1600				50,000	65,000	50,000	75-1600
2000	RL-2000				65,000	65,000	65,000	75-2000
	RLE-2000				85,000	100,000	85,000	75-2000
3200	RL-3200				65,000	85,000	65,000	600-3200
4000	RL-4000				85,000	130,000	85,000	800-4000①
	RLE-4000				100,000	130,000	100,000	800-4000①

① With the addition of fan cooling and 5000A copper main bus, a 4200A continuous rating is available.

Type RLF Fused Circuit Breaker Ratings At 50/60 Hertz

Frame Size Amperes	Type	Voltage Ratings		Insulation Level Dielectric Withstand Volts	Short Circuit Ratings Symmetrical Amps	Range Of Fuse Ratings Amperes	Continuous Current Rating Amperes
		Rated Volts	Rated Max. Volts				
800	RLF-800	208 to 600	600	2200	200,000	250-1600	75-800
1600	RLF-1600					800-3000	75-1600
2000	RLF-2000					4000	75-2000
3200	RLF-3200 & RFC-3200 Fuse Carriage			2200	200,000	2000-5000	600-3200
4000	RLF-4000 & RFC-4000 Fuse Carriage			2200	200,000	4000-6000	800-4000

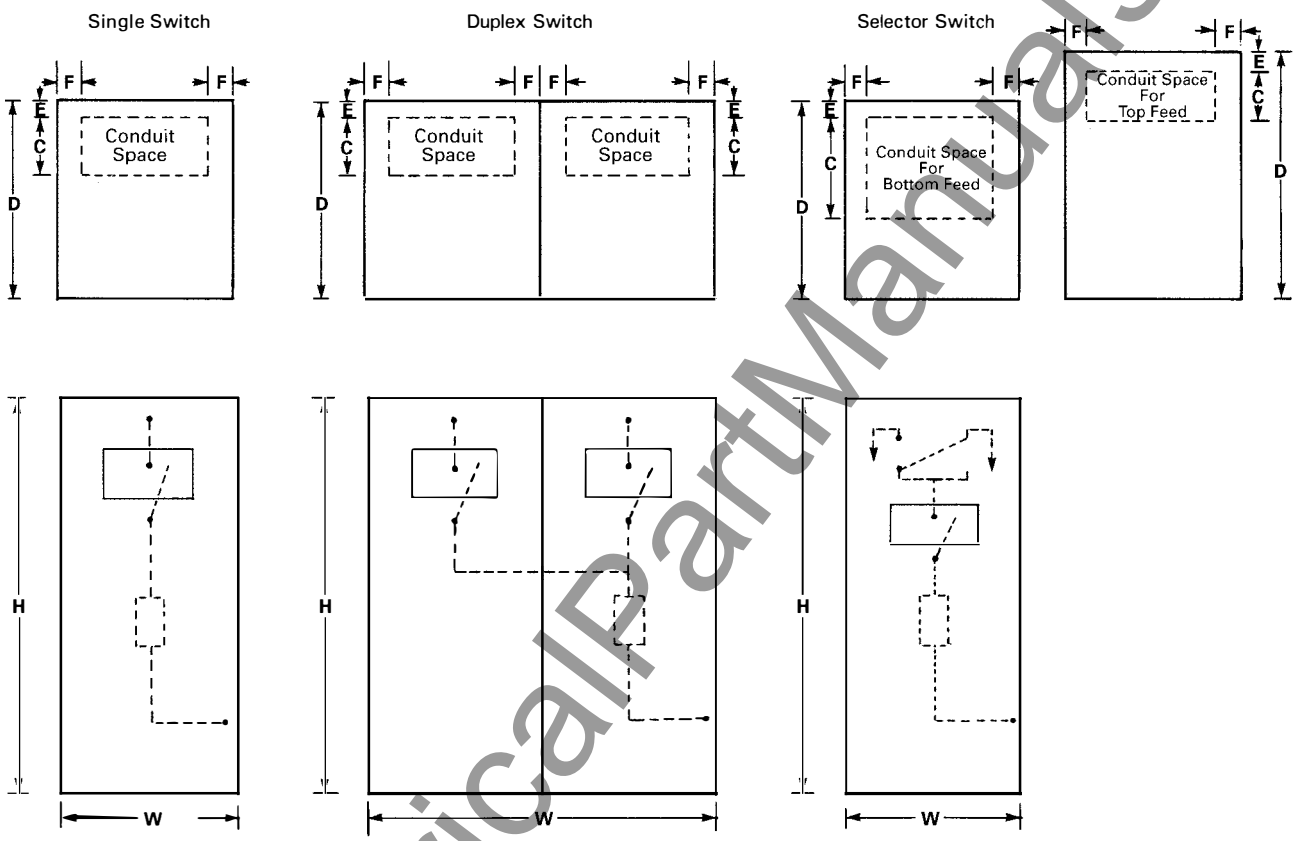
Type RL Circuit Breaker Operating Data (60 Hertz Basis)

Description		Type			
		RL-800 RLE-800 RLI-800 RLE-800	RL-1600 & 2000 RLE-2000 RLF-1600 & 2000	RL-3200 RLF-3200	RL-4000 RLE-4000 RLF-4000
Time from Energizing Shunt Trip Coil Unit (Cycles):	Contacts Part Open	1.5-3.0	1.25-3.0	1.0-3.0	2.0-3.0
	Contacts Fully Open	2.2-3.7	2.2-3.5	2.2-3.5	3.0-4.0
Time from Energizing Closing Control Relay Until (Cycles):	Contacts Touch	2.5-5.0	2.0-5.0	2.2-5.0	2.5-5.5
	Contacts Fully Close	2.8-5.3	2.3-5.3	2.5-5.7	2.5-5.7
Average Spring Charging Time (Seconds):	Minimum Voltage	15	17	19	22
	Nominal Voltage	10	12	13	15
	Maximum Voltage	8	8	8	10
Length of Break, Inches (mm)	Between Main Contacts	1.00 (25 mm)	1.00 (25 mm)	1.00 (25 mm)	1.00 (25 mm)
	Between Arcing Contacts	1.10 (28 mm)	1.10 (28 mm)	1.10 (28 mm)	1.10 (28 mm)

Incoming Line Section

Dimensions

Primary Switch ①



5 kV and 15 kV Primary Switch, Indoor

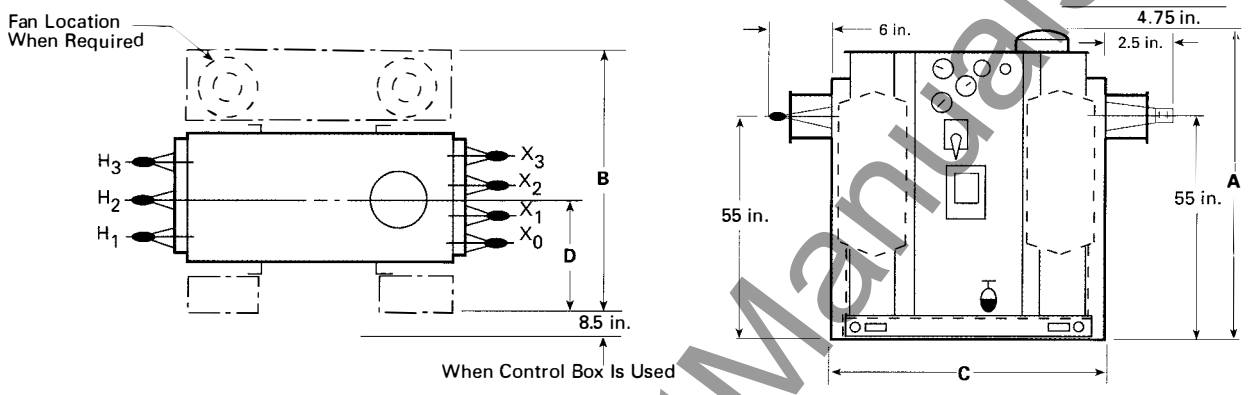
Voltage Class Rating						
5 kV				15 kV		
Switch Arrangement—Fused or Non-Fused						
Dimensions in inches	Single Switch ②	Duplex Switch ②	Selector Switch	Single Switch	Duplex Switch	Selector Switch
H	90.00	90.00	90.00	90.00	90.00	90.00
W	36.00	72.00	36.00	36.00	72.00	36.00
D	48.00 or 58.00	48.00 or 58.00	88.00	58.00	58.00	88.00
C	12.00 or 20.00	12.00 or 20.00	40.00 (Bot. Feed) 10.00 (Top Feed)	12.00 or 20.00	12.00 or 20.00	40.00 (Bot. Feed) 10.00 (Top Feed)
Conduit Area E	2.50	2.50	2.50	2.50	2.50	2.50
Conduit Area F	3.00	3.00	3.00	3.00	3.00	3.00
Weight (Lbs.)	1200	2600	2200	1200	2600	2200

● **Dimensions for estimating purposes only; not for construction.**

② Top entry will be 48 in. deep. Bottom entry will be minimum 60 in. deep for UL listed units, or 58 in. deep for non-UL listed units.

Transformer Section
Dimensions

Liquid Filled ①



5 kV and 15 kV Liquid-Filled Transformer

5 kV and 15 kV Oil Filled Transformers

kVA Rating	65°C Temp. Rise Dimensions in inches A	B	C	D	Weight Lb.	55°C/65°C Temp. Rise Dimensions in inches A	B	C	D	Weight Lb.
225	7.5	49.5	51.87	21.5	3150	70.5	53.5	51.87	21.50	3250
300	70.5	53.5	51.87	21.5	3425	70.5	64.0	51.87	32.00	3545
500	70.5	53.5	58.00	21.5	4100	70.5	53.5	58.00	21.50	4270
750	70.5	58.5	59.00	24.0	6200	70.5	75.0	59.00	40.50	6420
1000	70.5	64.5	62.00	24.0	7140	70.5	81.0	62.00	40.50	7720
1500	72.5	64.5	65.00	24.0	8800	72.5	81.0	65.00	40.50	9550
2000	76.5	78.0	65.00	36.0	10250	76.5	98.5	65.00	49.25	10650
2500	76.5	84.0	65.00	42.0	13730	76.5	106.5	65.00	53.25	14250

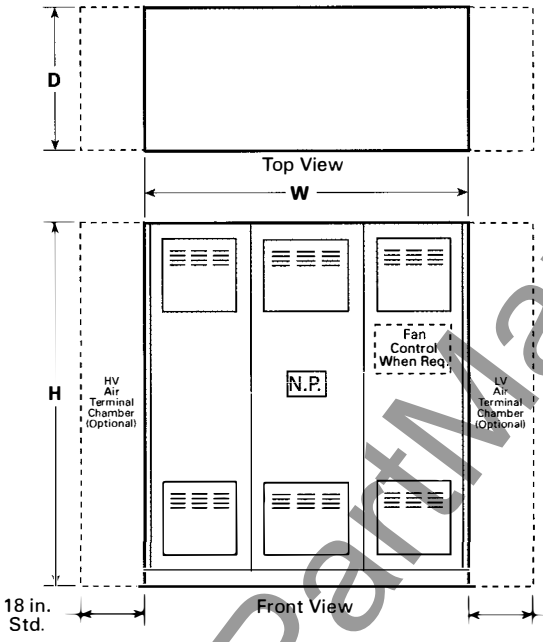
5 kV and 15 kV R-Temp or Silicone Liquid Filled Transformers

kVA Rating	65°C Temp. Rise Dimensions in inches A	B	C	D	Weight Lb.	55°C/65°C Temp. Rise Dimensions in inches A	B	C	D	Weight Lb.
225	70.5	53.5	51.87	21.50	3275	70.5	64.0	51.87	32.00	3435
300	70.5	64.0	51.87	32.00	3550	70.5	76.0	51.87	38.00	3740
500	70.5	59.5	58.00	21.50	4190	70.5	76.0	58.00	38.00	4390
750	72.5	81.0	59.00	40.50	6450	72.5	81.0	59.00	40.50	6890
1000	74.5	75.0	62.00	40.50	7630	80.5	81.0	62.00	40.50	8350
1500	79.5	81.0	65.00	40.50	9500	80.5	103.5	65.00	51.75	11300
2000	79.5	102.5	65.00	53.25	12070	89.5	122.5	65.00	61.25	13920
2500	79.5	110.5	65.00	57.25	14190	89.5	130.5	65.00	65.25	15230

① Dimensions and weights on this page are for estimating purposes only, not for construction.

Transformer Section
Dimensions

Dry Type and Cast Coil ①



5 kV and 15 kV Ventilated Dry Type Transformers

kVA Rating	115°C or 150°C Temp Rise 5 kV = 30 kV BIL, 15 kV = 60 kV BIL				80°C Temp Rise 5 kV = 30 kV BIL, 15 kV = 60 kV BIL				115°C or 150°C Temp. Rise 5 kV = 60 kV BIL, 15 kV = 95 kV BIL				80°C Rise 5 kV = 60 kV BIL, 15 kV = 95 kV BIL			
	Dimensions in inches			Weight in Lbs.	Dimensions in inches			Weight in Lbs.	Dimensions in inches			Weight in Lbs.	Dimensions in inches			Weight in Lbs.
	H	W	D		H	W	D		H	W	D		H	W	D	
225	90	48	48	2,200	90	48	48	2,500	—	—	—	—	—	—	—	—
300	90	78	48	2,500	90	78	48	3,150	90	78	48	3,150	90	78	48	3,300
500	90	78	48 ②	3,150	90	78	48 ②	4,150	90	78	48	4,150	90	78	48 ②	4,400
750	90	78	48 ②	4,150	90	78	48 ②	5,050	90	90	58	5,100	90	90	58	5,500
1000	90	78	48 ②	5,050	90	78	48 ②	6,550	90	90	58	6,600	90	102	58	7,400
1500	90	90	48 ②	6,700	90	90	58	8,050	90	102	58	8,050	90	112	58	14,000
2000	90	90	58	8,050	90	102	58	13,000	90	112	58	13,000	102	112	58	14,000
2500	102	112	58	13,000	102	112	58	16,000	102	112	58	16,000	110	112	58	16,000
3000	110	120	58	14,000	110	120	58	18,000	110	120	58	18,000	110	120	58	18,000

5 kV and 15 kV Cast Coil Dry Type Transformers

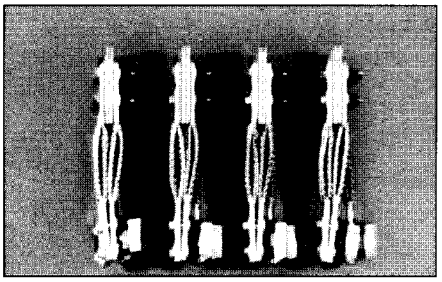
kVA Rating	100°C or 80°C Rise, 5 kV = 75 kV BIL				100°C or 80°C Rise, 15 kV = 95 kV BIL			
	Dimensions in inches			Weight in Lbs.	Dimensions in inches			Weight in Lbs.
	H	W	D		H	W	D	
500	90	90	58	5,200	90	90	58	5,400
750	90	96	58	6,900	90	96	58	7,200
1000	90	102	58	8,400	90	96	58	8,500
1500	96	108	58	11,200	96	102	58	12,900
2000	102	114	58	13,200	102	114	58	13,900
2500	108	120	58	15,300	108	120	58	15,900
3000	114	126	58	18,200	114	126	58	18,900

① Dimensions and weights on this page for estimating purposes only, not for construction.

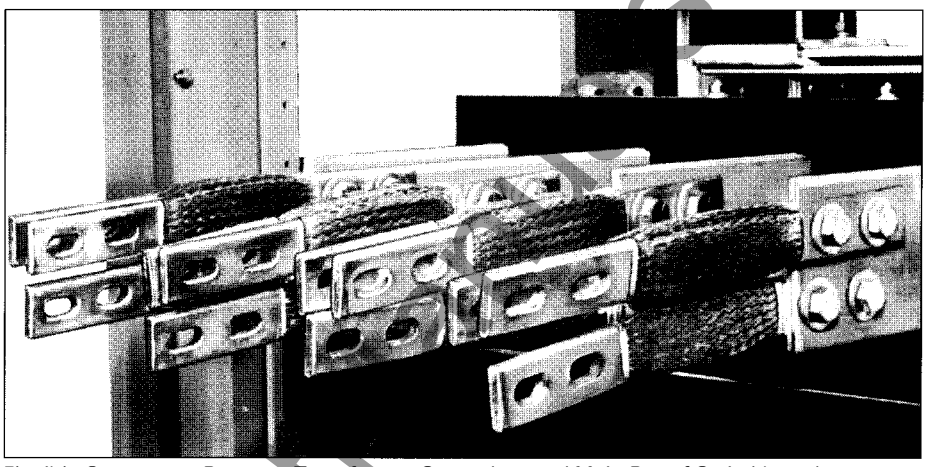
② 208V secondary requires 58 in. deep enclosure.

Transition Section
Dimensions

A transition section between the transformer, the primary section, and the main device section of the switchboard is required for a liquid filled transformer. Connection between the transformer secondary and the main bus of the switchboard is made with flexible connectors.



Transition Section — Switchboard

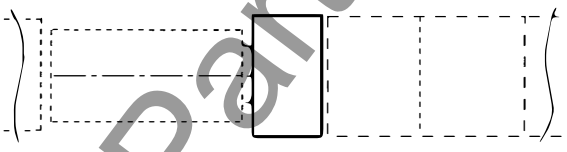


Flexible Connectors Between Transformer Secondary and Main Bus of Switchboard

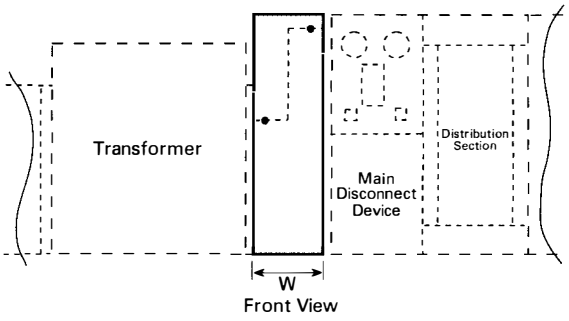
Low Voltage Transition Section Between Transformer and Low Voltage Switchboard

Amp Rating	Dimensions in inches			
	Liquid Filled Transformer		Ventilated Dry Type and Cast Coil Transformer ②	
	W	D	W	D
600 800 1000	20	①	20	①
1200 1600 2000	20	①	20	①
2500 3000 4000	20	①	20	①

① Same depth as switchboard.
② Transition section optional.



Top View

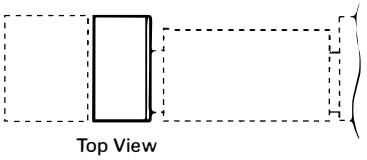


Front View

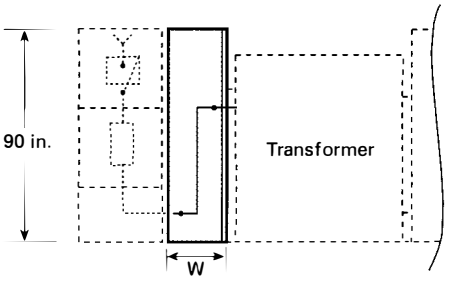
High Voltage Transition Section Between Primary Switch and Transformer

Transformer	Width in inches	Depth
Oil, R-Temp, Silicone	20	④
Ventilated Dry Type ③	20	④
Outdoor Cast-Coil ③	20	④

③ Transition section optional.
④ Same depth as primary switch section.



Top View



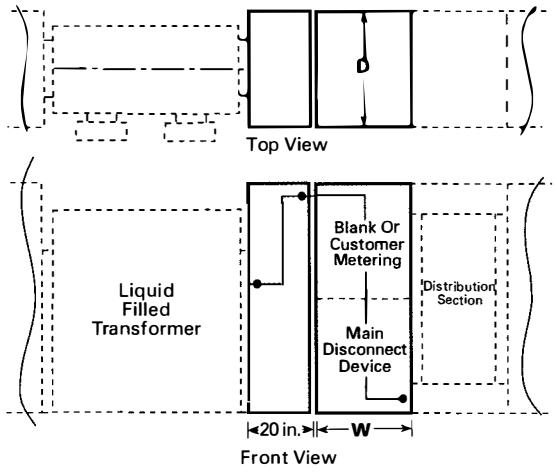
Front View

Transition Section

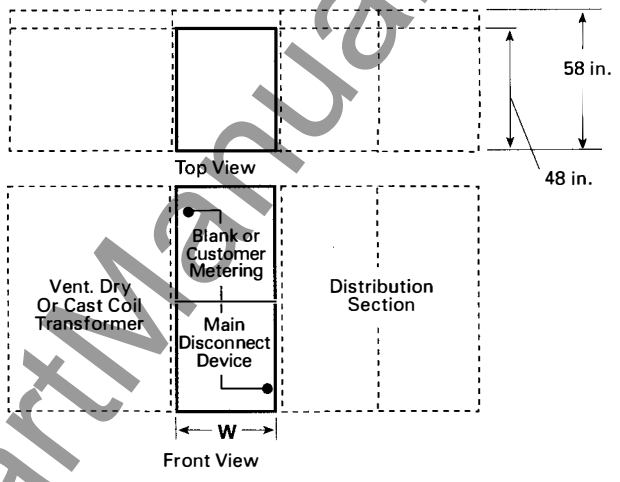
Dimensions

Type SB3 Front-Connected Switchboard

With Liquid Filled Transformer

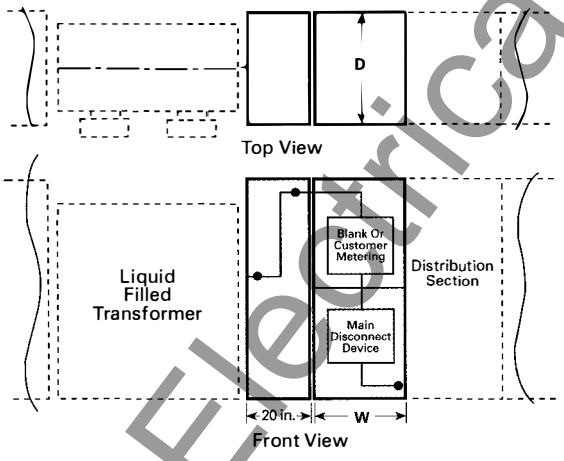


With Ventilated Dry Type or Cast Coil Transformer

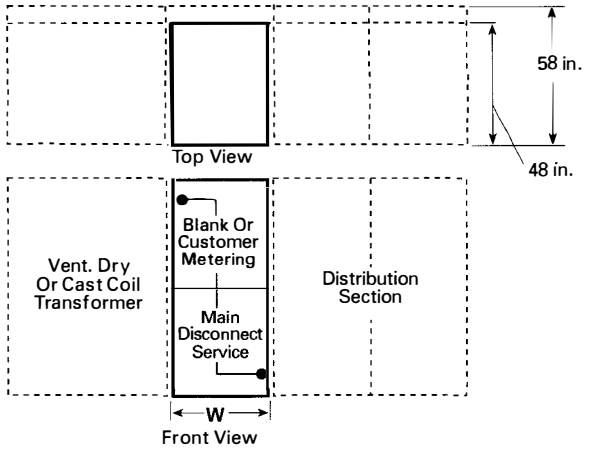


Type RCIII Rear-Connected Switchboard

With Liquid Filled Transformer



With Dry Type or Cast Coil Transformer



Outgoing Section

CT Compartments

Dimensions — Standard Switchboard C.T. Compartments

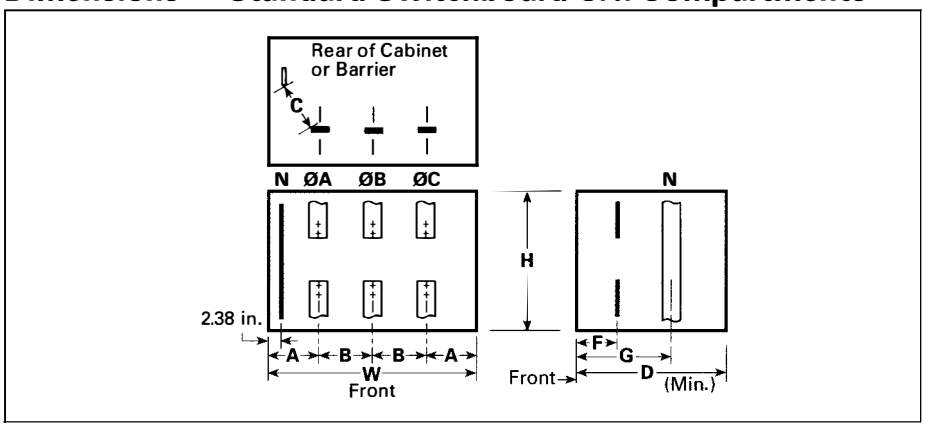


Figure 1

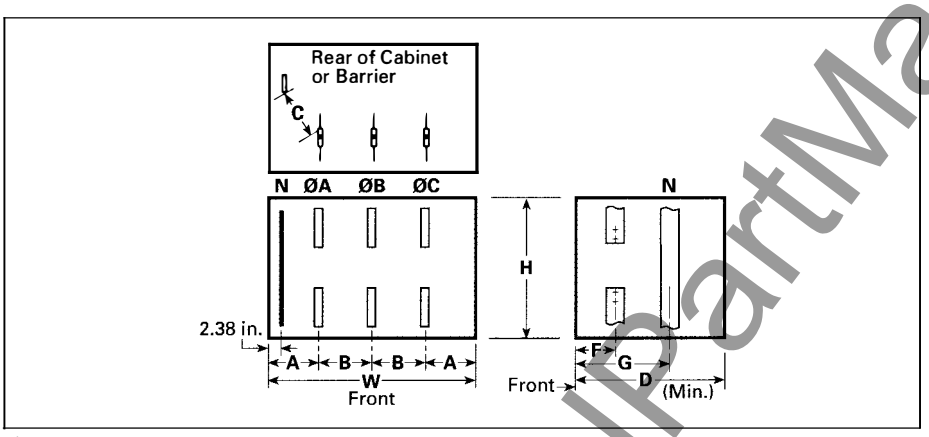


Figure 2

Figure 3

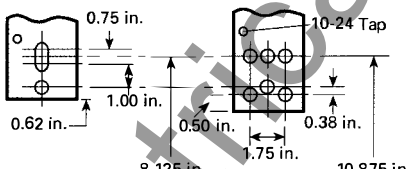
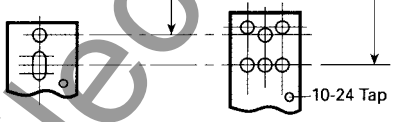
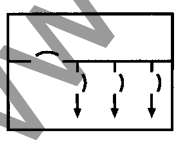


Figure 4



Ampere Rating	Fig.	Compartment Dimensions in inches H	W	D	Bus Drilling Figure	Dimensions in inches A	B	C	F	G
400-800	1	30	38	20	3	10.00	9.00	6.44	7.50	10.50
400-800	1	30	38	28	3	10.00	9.00	10.88	7.50	17.50
1200-2000	2	30	38	28	4	7.50	11.50	6.02	9.00	17.50
1200-2000	2	30	38	38	4	7.50	11.50	6.82	9.00	19.00
2500	2	30	38	38	4	7.50	11.50	7.07	9.00	19.00
3000-4000	2	30	46	48	4	11.50	11.50	8.137	9.00	19.00



Service entrance switchboards often require that a utility current transformer compartment be included. The National Electrical Manufacturer's Association (NEMA) has created a section covering utility C.T. compartments for inclusion in PB-2, the existing standard for switchboards.

Siemens C.T. compartments have been designed to conform to this standard. All specific utility requirements take precedence but in the absence of any special requirements, the standard will be used.

PB-25.06 Utility Transformer Compartment

Switchboard assemblies containing current transformer compartments for utility metering shall be arranged as shown in Figures 1 through 4. All indicated dimensions are minimum except the mounting for the current transformer. Mounting shall be for either bar or window type transformers.

The front of the compartment shall be accessible through a sealable hinged, single or double door or removable cover.

Barriers shall be installed as required to prevent access through other than sealable doors or covers.

Notes:

The utility C.T. compartments may be in the upper or lower portion of the Service Section.

Neutral may be located to the rear alongside ØA or ØC; alternate rear location between ØA and ØB, or ØB and ØC.

The neutral need not be located in the C.T. compartment, provided its location complies with 1993 NEC, article 300-20, and with UL as they relate to induced currents.

Quantity and size of aluminum and copper bus per UL 891, or manufacturers UL listed sizes, based on temperature rise

Barrier material and thickness per UL 891.

This standard is intended for C.T.'s built to ANSI C12.11-1978.

Outgoing Section
Busway

Siemens Sentron™ busway is ideal for use with Siemens Types SB3 and RCIII switchboards. It is a low-reactance power duct available with aluminum or copper bars in 3-phase, 3-wire or 3-phase, 4-wire configuration, with or without ground bar.

Dimensions and Phase Sequence
The drawings below show the phase sequence and the location of the center-line of the busway opening for each configuration, referenced to the switchboard front and side planes. Phasing shown conforms to NEMA standards and is preferred, unless alternate phasing is required by special customer terminations.

Figure A
400-2000A Maximum Molded Case Circuit Breaker
2000A Maximum SB Encased Systems Breaker

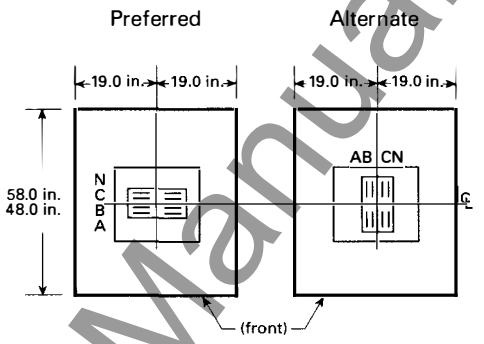


Figure B
800-4000A Maximum RL Breaker

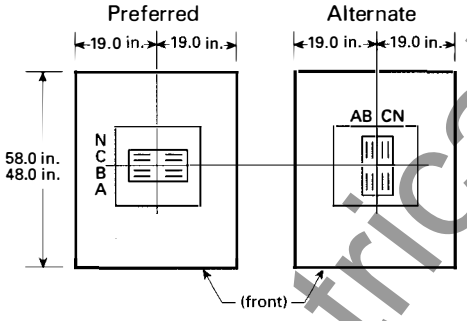


Figure C
800 and 1200A Vacu-Break Switch
800-2000A Maximum Bolted Pressure Switch

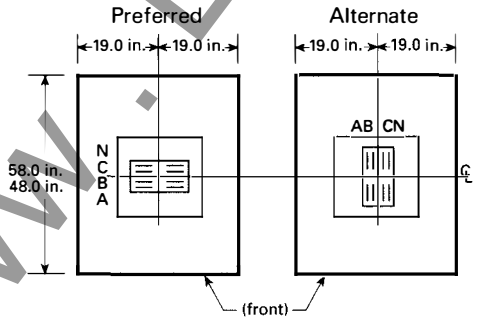


Figure D
2500-4000A Maximum SB Encased Systems Breaker

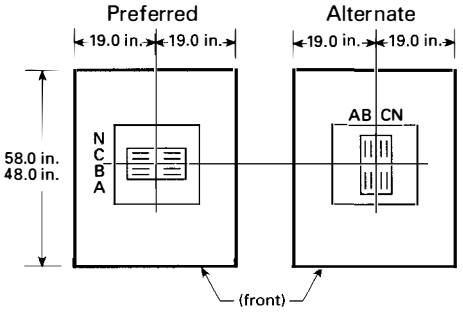
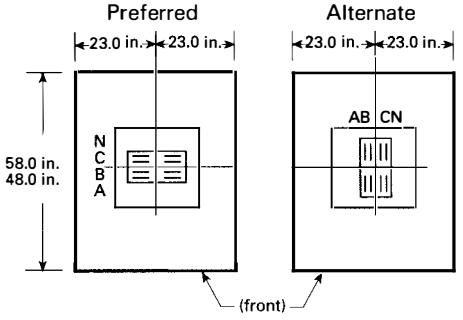


Figure E
2500-4000A Maximum Bolted Pressure Switch

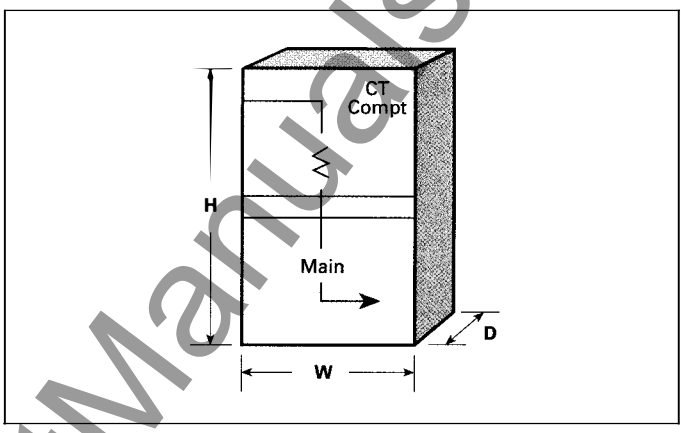


Outgoing Section
Service Sections

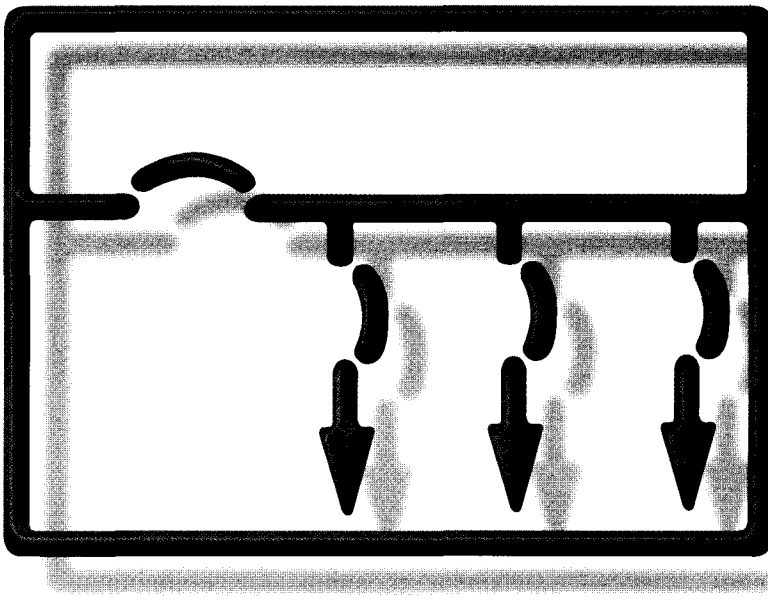
Dimensions — SB3 Service Sections
Utility Metering and Single Main Disconnects

Standard Utility — Hot Sequence
(C.T.'s on Line Side of Main)

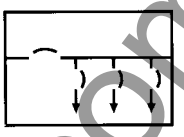
Maximum Ampere Rating	Device Type	Dimensions in inches Height H	Width W	Depth D
Molded Case Circuit Breakers				
400	JXD2, JXD6, JD6, HJD6	90	38	48 or 58 ⑦
	SJD6			
	CJD6, SCJD6			
600	LXD6, LD6, HLD6			
	SLD6			
	CLD6, SCLD6			
800	MXD6, MD6, HMD6			
	SMD6			
	CMD6, SCMD6			
1000	NXD6, ND6, HND6			
	SND6			
	CND6, SCND6			
1200	NXD6, ND6, HND6			
	SND6			
	CND6, SCND6			
1600	PXD6, PD6, HPD6			
	SPD6			
	CPD6, SCPD6			
2000	RXD6, RD6, HRD6			
	SB2000S			
2500 ③	SB2500S			
3000 ③	SB3000S			
Insulated Case Circuit Breaker — Stationary Mounted ④				
800	Type SB Encased Systems Breaker	90	38	48 or 58 ⑦
1600				
2000				
2500 ③				
3000 ③				
4000 ③				
Low Voltage Power Circuit Breaker — Draw-Out Fusible and Non-Fusible				
800	Type RL, RLF Low Voltage Power Circuit Breaker	90	38	48 or 58 ⑦
1600				
2000				
2500 ⑤			46	
3000 ⑤				
4000 ⑤				
Switches				
800	Vacu-Break Switch	90	38	48 or 58 ⑦
1000				
1200				
800	Bolted Pressure Switch			
1000				
1200				
1600				
2000				
2500			46	
3000				
4000				



① C.T. compartment must be mounted in a bussed pull section.
② Drawout SB breakers are available as an option. Minimum depth 38 in.
③ For fusible RLF breaker, utility compartment must be mounted in a bussed pull section.
④ 48 or 58 in. depth to match transformer.



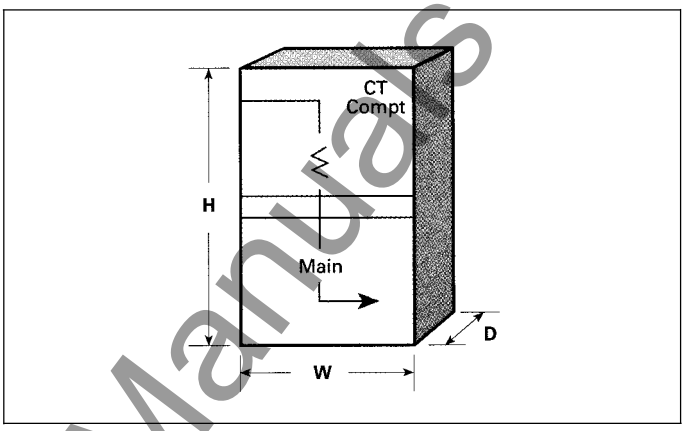
Outgoing Section
Service Sections



Dimensions — SB3 Service Sections
Utility Metering and Single Main Disconnects-EUSERC Utilities

Hot Sequence (C.T.'s on Line Side of Main)

Maximum Ampere Rating	Device Type	Dimensions in inches Height H	Width – Minimum W	Depth D
Molded Case Circuit Breakers				
400	JXD2, JXD6, JD6, HJD6	90	32	48 or 58 ⑦
	SJD6			
	CJD6, SCJD6			
600	LXD6, LD6, HLD6			
	SLD6			
	CLD6, SCLD6			
800	MXD6, MD6, HMD6			
	SMD6			
	CMD6, SCMD6			
1000	NXD6, ND6, HND6			
	SND6			
	CND6, SCND6			
1200	NXD6, ND6, HND6		38	
	SND6			
	CND6, SCND6			
1600	PXD6, PD6, HPD6			
	SPD6			
	CPD6, SCPD6			
2000	RXD6, RD6, HRD6			
	SB2000S			
2500 ③	SB2500S			
3000 ③	SB3000S			
Insulated Case Circuit Breaker — Stationary Mounted ④				
800	Type SB Encased Systems Breaker	90	38	48 or 58 ⑦
1600				
2000				
2500 ③				
3000 ③				
4000 ③				
Low Voltage Power Circuit Breaker — Draw-Out Fusible and Non-Fusible				
800	Type RL, RLF Low Voltage Power Circuit Breaker	90	38	48 or 58 ⑦
1600				
2000				
2500 ⑤			46	
3000 ⑤				
4000 ⑤			—	
Switches				
800	Vacu-Break Switch	90	38	48 or 58 ⑦
1000				
1200				
800	Bolted Pressure Switch			
1000				
1200				
1600				
2000				
2500			46	
3000				
4000				

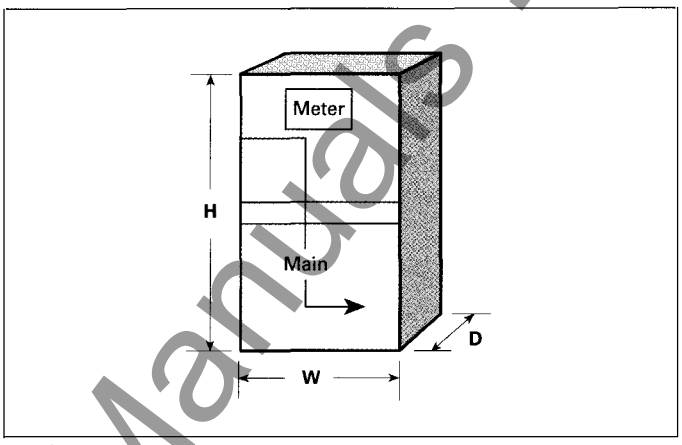


① C.T. compartment must be mounted in a separate section.
② Drawout, SB breakers are available as an option. Minimum depth 38 in.
③ For fusible RLF breaker, utility compartment must be mounted in a bussed pull section.
④ 48 or 58 in. depth to match transformer.

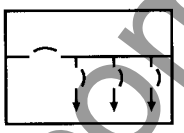
Dimensions — SB3 Service Sections

Non-Utility Type With or Without Customer Metering and Main Disconnect

Maximum Ampere Rating	Device Type	Dimensions in inches Height H	Width W	Depth D
Molded Case Circuit Breakers				
400	JXD2, JXD6, JD6, HJD6	90	32	48 or 58 ③
	SJD6			
	CJD6, SCJD6			
600	LXD6, LD6, HLD6			
	SLD6			
	CLD6, SCLD6			
800	MXD6, MD6, HMD6		38	
	SMD6			
	CMD6, SCMD6			
1000	NXD6, ND6, HND6			
	SND6			
	CND6, SCND6			
1200	NXD6, ND6, HND6			
	SND6			
	CND6, SCND6			
1600	PXD6, PD6, HPD6			
	SPD6			
	CPD6, SCPD6			
2000	RXD6, RD6, HRD6			
	SB2000S			
2500	SB2500S			
3000	SB3000S			
Insulated Case Circuit Breaker — Stationary Mounted ①				
800	Type SB Encased Systems Breaker	90	38	48 or 58 ③
1600				
2000				
2500				
3000				
4000				
Low Voltage Power Circuit Breaker — Draw-Out Fusible and Non-Fusible				
800	Type RL, RLF Low Voltage Power Circuit Breaker	90	38	48 or 58 ③
1600				
2000				
2500 ②			46	
3000 ②				
4000 ②				
Switches				
800	Vacu-Break Switch	90	38	48 or 58 ③
1000				
1200				
800	Bolted Pressure Switch			
1000				
1200				
1600				
2000				
2500			46	
3000				
4000				



① Drawout SB breakers are available as an option. Minimum depth 38 in.
② For fusible RLF breaker, utility compartment must be mounted in a bussed pull section.
③ 48 or 58 in. depth to match transformer.



Dimensions — SB3 Distribution Sections

Unit Space for Disconnect Devices

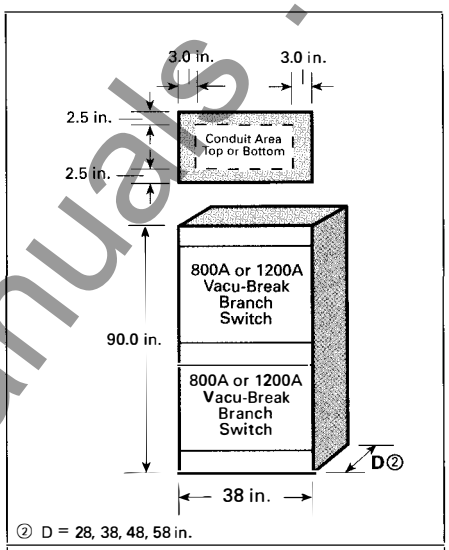
Unit Space Requirements — Molded Case Circuit Breakers

Maximum Ampere Rating	Breaker Type	Dimensions in inches: Height — Unit Space H2 — Twin Mounted	Height — Unit Space H2 — Single Mounted	Width — Enclosure Minimum W
Branch Breakers				
100	BL, BLH, HBL	3.75	—	32.00
	ED2, ED4, HED4			
125	ED2, ED4, ED6			
	HED4, HED6 With Access.	6.25		
	CED6	3.75		
	With Access.	6.25		
225	QJ2, QJH2, QJ2-H	5.00		
250	FXD6, FD6, HFD6	5.00		
	CFD6	—	5.00	32.00
400	JXD2, JXD6, JD6, HJD6	8.75	—	38.00
	SJD6, SHJD6	—	8.75	32.00
	CJD6			
	SCJD6			
600	LXD6, LD6, HLD6,			
	SLD6, SHLD6			
	CLD6			
	SCLD6			
800	MXD6, MD6, HMD6		10.00	38.00
	SMD6, SHMD6			
	CMD6			
1200	NXD6, ND6, HND6			
	SND6, SHND6			
	CND6			
Main Breakers				
250	FXD6, FD6, HFD6	—	5.00	32.00
	CFD6, SHFD6			
400	JXD2, JXD6, JD6, HJD6		8.75	
	SJD6, SHJD6			
	CJD6, SCJD6			
600	LXD6, LD6, HLD6, SLD6, SHLD6			
	CLD6, SCLD6			
800	MXD6, MD6, HMD6		10.00	38.00
	SMD6, SHMD6			
	CMD6			
1200	NXD6, ND6, HND6			
	SND6, SHND6			
	CND6			

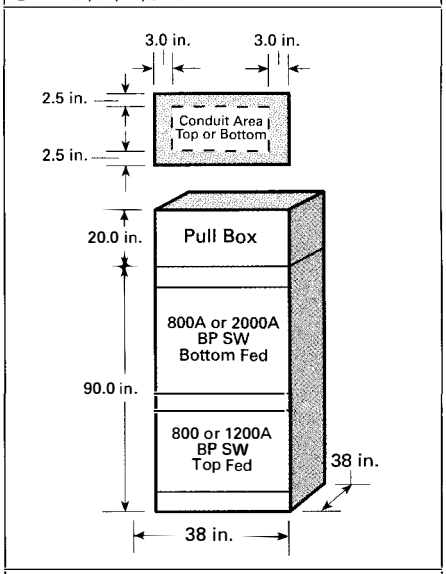
Unit Space Requirements — Branch Switches

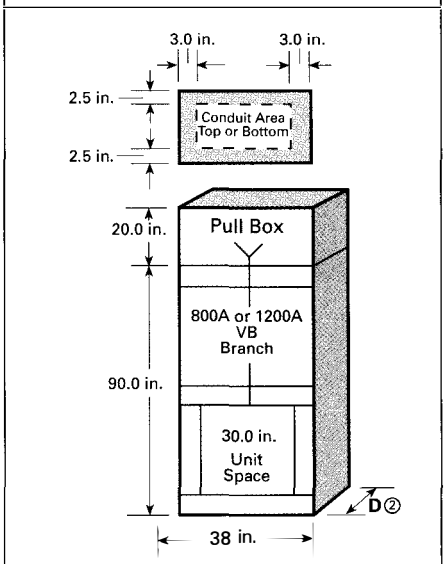
Max. Amp. Rtg.	Switch Type	Dimensions in inches: Mounting Height 240V Twin	240V Single	600V Twin	600V Single	Width — Enclosure Minimum W
30-30	Vacu-Break	2.50 ①	—	—	—	32.00
30-30		5.00		7.50		
30-60						
60-60						
60-100		7.50				
100-100						
200-200		10.00		10.00		
100		—	—	—	7.50	
200		—	10.00	—	10.00	
400			15.00	—	15.00	38.00
600						

① The 2.5 in. high unit is suitable for NEC Class H, K1, and K5 fuses only. Class R rejection type fuse holders are not available.



② D = 28, 38, 48, 58 in.





● D = 28, 38, 48, 58 in.

Dimensions — SB3 Distribution Sections

Through-Bus Fed

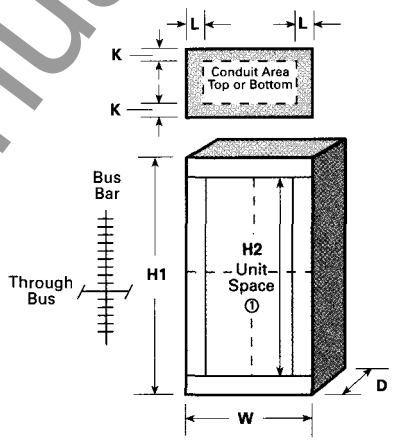
Maximum Riser Amperage	With Maximum Through-Bus Amperage	Dimensions in inches						
		Height		Width		Depth Available Letters Reference Chart Below	Conduit Area	
		H1	Unit Space H2 ①	W		SB1	K	L
2000	2000	90.0	65.0	32.0	38.0	D1	2.5	3.0
	3000					D1		
	4000					D2		
3000	4000		62.5	38.0	46.0	D2		

① See page 128 for unit space of disconnect devices.

Depth Reference Chart

D1	20, 28, 38, 48, 58 in.
D2	38, 48, 58 in.

Through-Bus Fed Distribution Sections

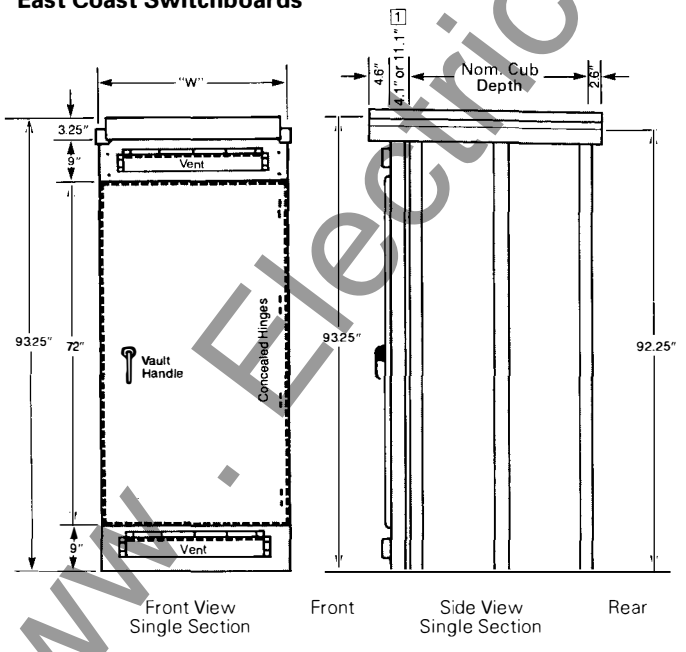


Outdoor Enclosure

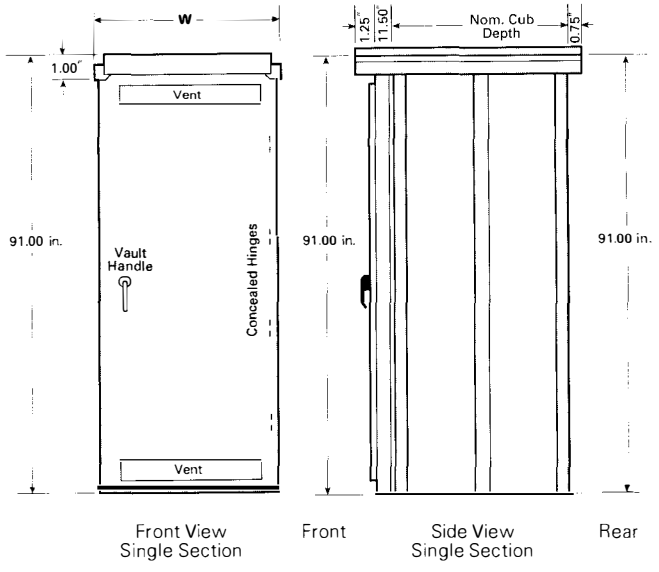
For SB3 Service and Distribution Sections

Dimensions (in inches)	
W (Width)	Nom. Cubicle Depth
14, 20, 32, 38, 46, 52, 58	20, 28, 38, 48, 58

East Coast Switchboards



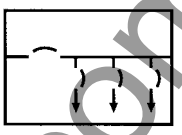
West Coast Switchboards



1 4.1 in. is standard. 11.1 in. is for extra deep cover mounted accessories.

Note: Flat top and flush rear construction is available. Consult sales office.

Outgoing Section
Distribution Sections



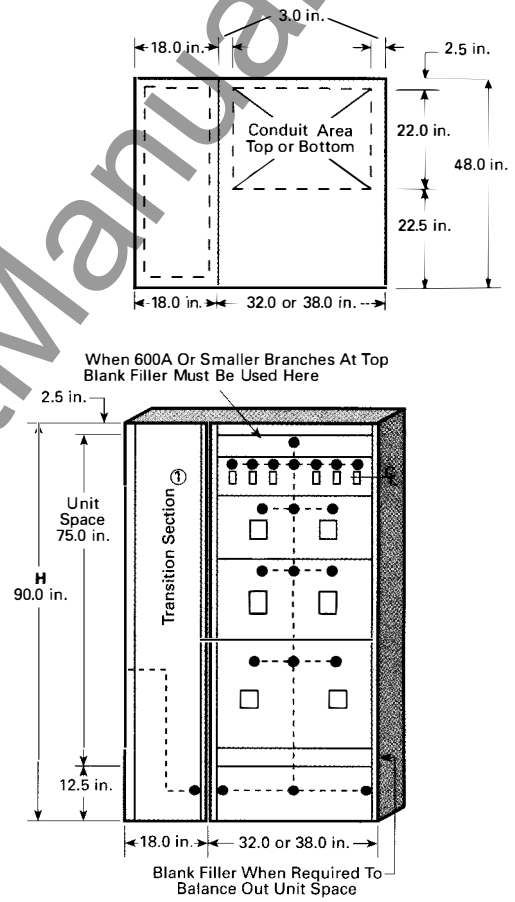
Dimensions — RCIII Distribution Sections

Individually Mounted Molded Case Circuit Breakers

Maximum Ampere Rating	Breaker Type	Mounting		Unit Space in Inches	Number of Breakers For Width:	
		Fixed	Plug-in		32 in.	38 in.
100	ED2, ED4, ED6 HED4, HED6	√	√	7.50	1 to 6	1 to 8
	CED6	√	√	12.50	1 to 6	1 to 8
250	FXD6, FD6, HFD6	√	√	10.00	1 to 4	1 to 6
	CFD6	√	√	15.00	1 to 4	1 to 6
400	JXD6, JD6, HJD6, SJD6, HHJXD6, HHJD6, SHJD6	√	√	12.50	1 or 2	1 or 2
	CJD6, SCJD6	√	√	20.00	1 or 2	1 or 2
600	LXD6, LD6, HLD6, SLD6, HHLXD6, HHLD6, SHLD6	√	√	12.50	1 or 2	1 or 2
	CLD6, SCLD6	√	√	20.00	1 or 2	1 or 2
800	MXD6, MD6, HMD6, SMD6, HHMXD6, HHMD6, SHMD6	√	√	22.50	1 or 2	1 or 2
	CMD6, SCMD6	√	√	22.50	1 or 2	1 or 2
1200	NXD6, ND6, HND6, SND6, HHNXD6, HHND6, SHND6	√	√	22.50	1 or 2	1 or 2
	CND6, SCND6	√	√	22.50	1 or 2	1 or 2
1600	PXD6, PD6, HPD6, SPD6, HHPXD6, HHPD6, SHPD6	√	—	27.50	1 or 2	1 or 2
	CPD6, SCPD6	√	—	27.50	1 or 2	1 or 2
2000	RXD6, RD6, HRD6, HRXD6	√	—	27.50	1 or 2	1 or 2

Standard Branch Load Connectors — Bolt-On and Plug-In

Ampere Rating	Wires per Barrel	No. of Barrels Per Phase
100	1-1/0—#14 Cu or 1-1/0—#12 Al	1
225	1-350 kcmil—#6 Cu-Al	1
400	1-750—250 kcmil or 2-250 kcmil—3/0 Cu-Al	1
600	1-750—250 kcmil or 2-250 kcmil—3/0 Cu-Al	2
800	1-750 kcmil—4/0 Cu-Al or 2-3/0—400 kcmil Al or 2-3/0—300 kcmil Cu	3
1200	1-750 kcmil—4/0 Cu-Al or 2-3/0—400 kcmil Al or 2-3/0—300 kcmil Cu	4
1600	1-750 kcmil—3/0 Cu-Al	6
2000	1-750 kcmil—3/0 Cu-Al	7

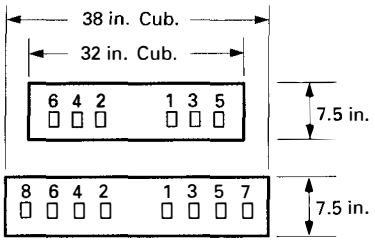


℄ 78 in. from floor max. allowed by NEC 380-8(a)

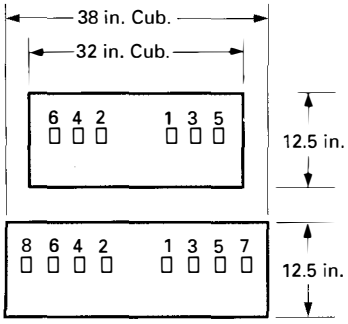
● Transition section required when main disconnect is
Molded Case Circuit Breaker 400A—4000A
Vacu-Break Switch 800A—1200A
Bolted Pressure Switch 800A—4000A
Low Voltage Power Air Circuit Breaker 800—4000A
Insulated Case 800—4000A

Dimensions — RCIII Distribution Sections

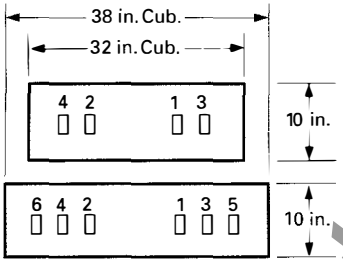
Breaker Arrangement and Layout Guide



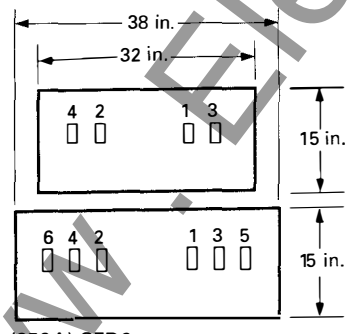
(100A) ED2, 4, 6, HED4, 6
Stationary or plug-in mounted
7.50 in. min. blank cover above when this is top row of circuit breakers.



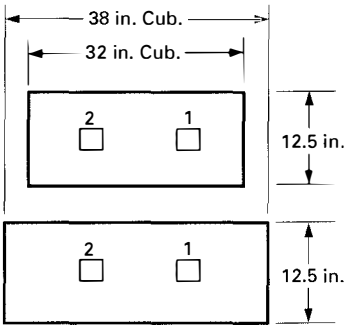
(100A) CED6
Stationary or plug-in mounted
7.50 in. min. blank cover above when this is top row of circuit breakers.



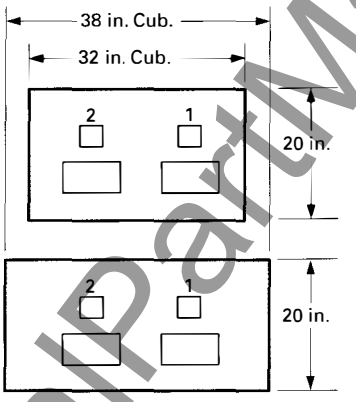
(250A) FXD6, FD6, HFD6
Stationary or plug-in mounted
5 in. min. blank cover above when this is top row of circuit breakers.



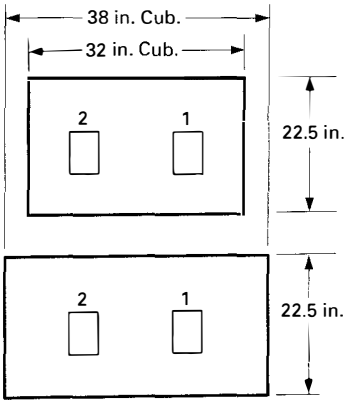
(250A) CFD6
Stationary or plug-in mounted
5 in. min. blank cover above when this is top row of circuit breakers.



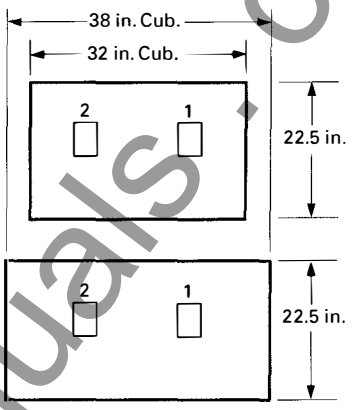
(400A) "J" frame may be mixed if (600A) "L" frame, larger bus is used
Stationary or plug-in mounted
5 in. min. blank cover above when this is top row of breakers.



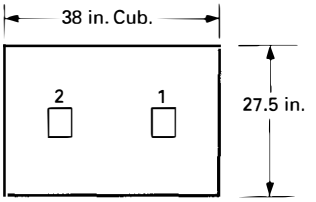
(400A) CJD6, SCJD6 do not mix
(600A) CLD6, SCLD6 do not mix
Stationary or plug mounted
5 in. min. blank cover above when this is top row of circuit breakers.



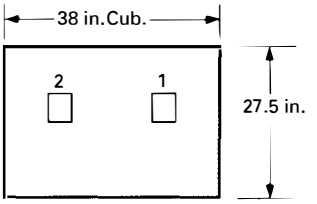
(800A) "M" frame do not mix
(1200A) "N" frame
Stationary or plug-in mounted
may be mounted in top position.



(800A) CMD6, SCMD6
(1200A) CND6, SCND6
Stationary or plug mounted
may be mounted in top position.



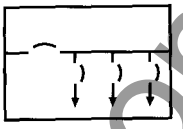
(1600A) "P" frame
(2000A) "R" frame
Stationary mounted only
May be mounted in top position.



(1600A) CPD6, SCPD6
Stationary mounted only
may be mounted into position.

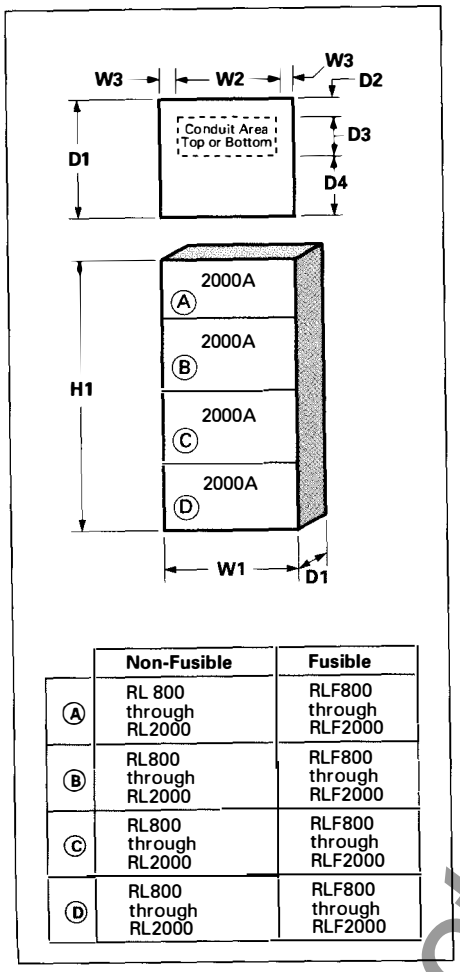
Note: Numbers on breaker positions indicate sequence in which standard design criteria picks out correct bus and covers for particular quantity of breakers or provisions required. Space only not available.

Outgoing Section
Distribution Sections



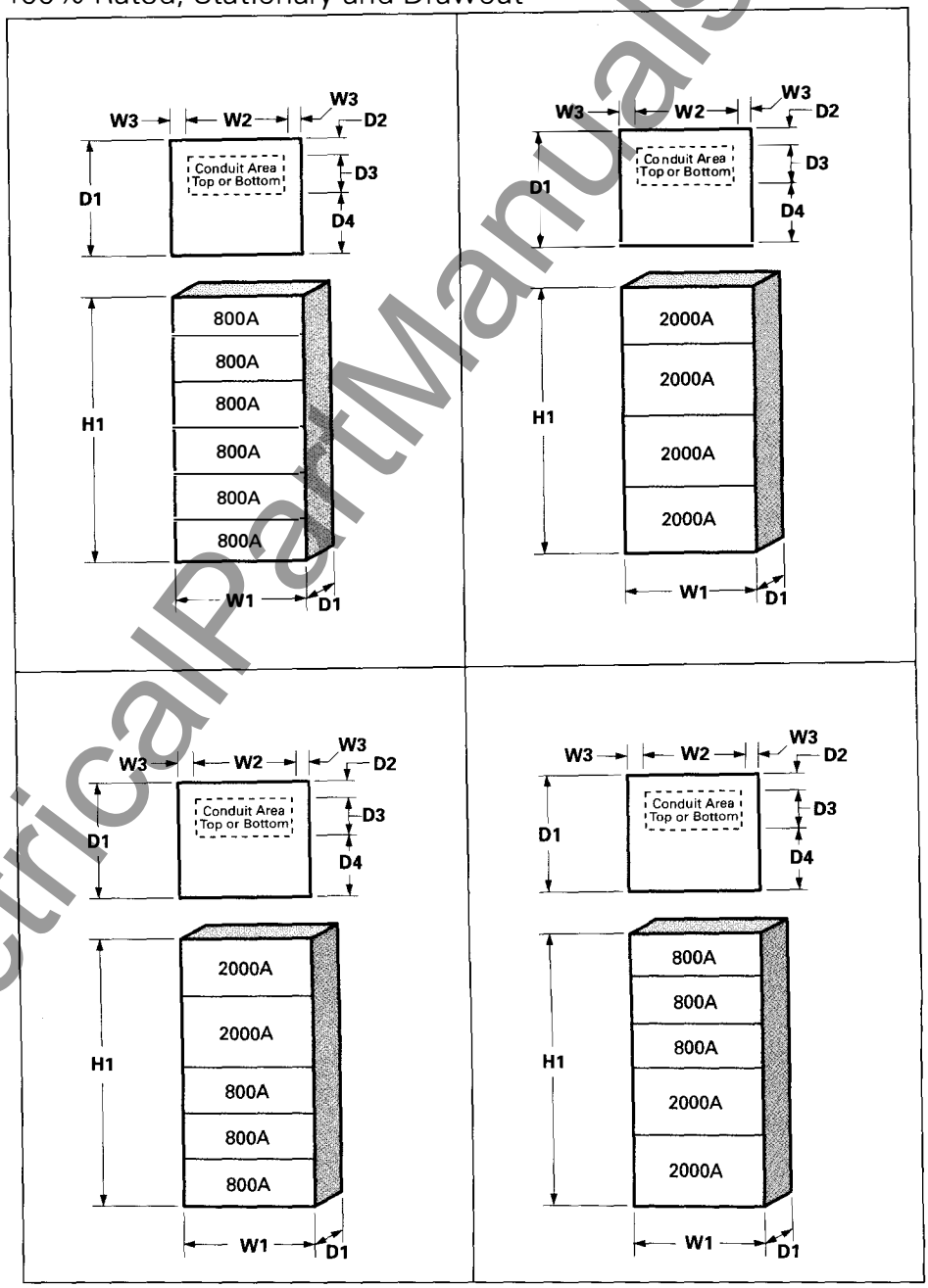
Dimensions — RCIII Distribution Sections

Type RL Drawout Circuit Breakers



	Non-Fusible	Fusible
A	RL 800 through RL2000	RLF800 through RLF2000
B	RL800 through RL2000	RLF800 through RLF2000
C	RL800 through RL2000	RLF800 through RLF2000
D	RL800 through RL2000	RLF800 through RLF2000

Type SB Insulated Case Circuit Breaker—100% Rated, Stationary and Drawout



Ratings for Both Type RL and SB Breakers:

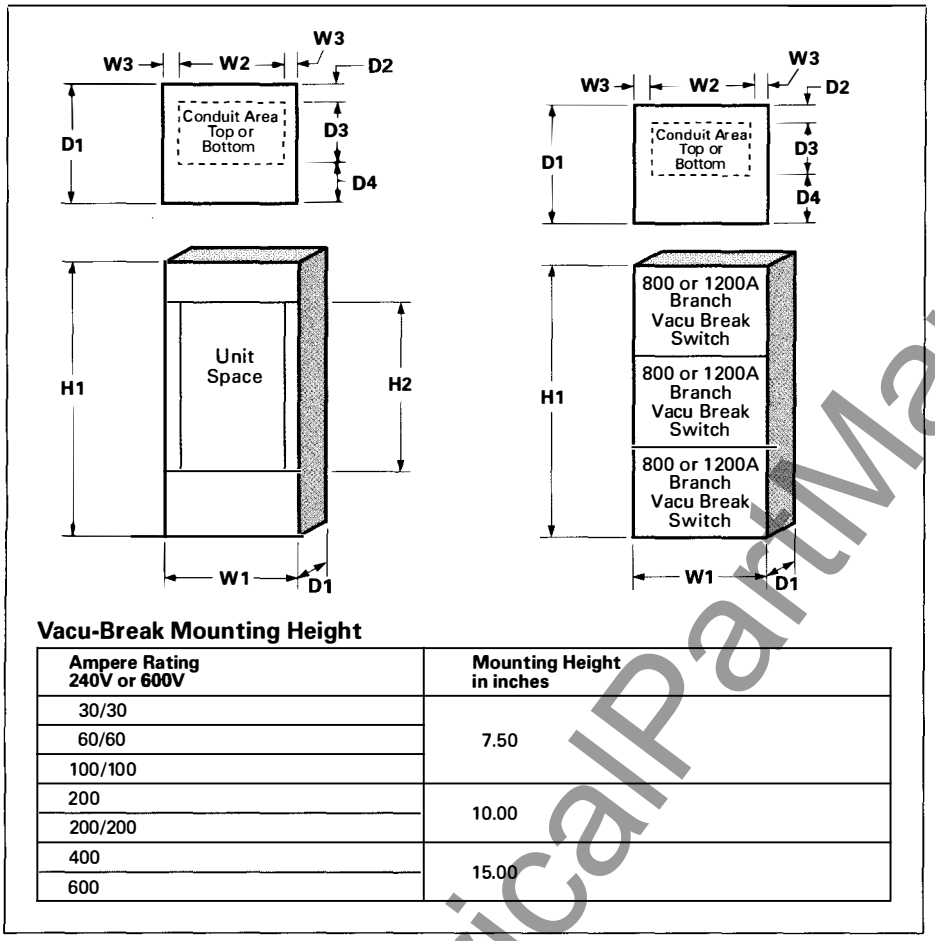
- Maximum thru bus rating — 4000A
- Maximum section rating — 4000A
- Maximum voltage rating — 600V

RCIII Distribution Sections for RL and SB Breakers

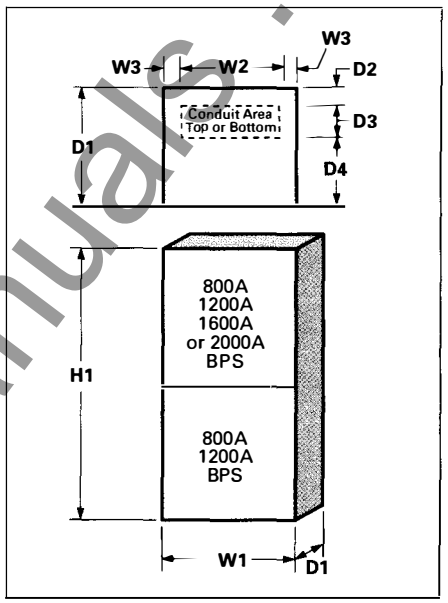
Ampere Rating	Breaker Type	Dimensions in inches							
		Height H1	Width W1	Depth D1	Conduit Area W2	W3	D2	D3	D4
800 to 2000	RL	90.0	25.0	58.0	19.0	3.0	2.5	13.0	42.5
	SB							15.0	40.5

Dimensions — RCIII Distribution Sections

Vacu-Break Switches 100A—600A



Bolted Pressure Switches



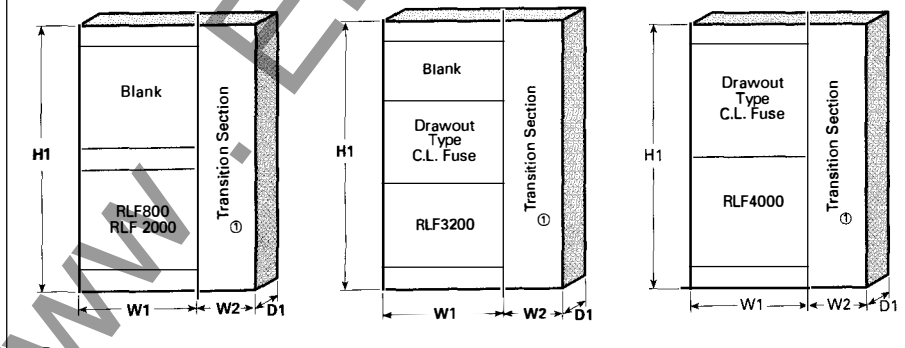
Vacu-Break Mounting Height

Ampere Rating 240V or 600V	Mounting Height in inches
30/30	7.50
60/60	
100/100	
200	10.00
200/200	
400	15.00
600	

RCIII Distribution Sections for Vacu-Break, Bolted Pressure Switches

Ampere Rating	Switch Type	Dimensions in inches								
		Height H1	Width W1	Depth D1	Unit Space H2	Conduit Area W2	W3	D2	D3	D4
800 to 2000	Vacu-Break	90.0	38.0	48.0	55.0	32	3	2.5	22	23.5
	Bolted Pressure								7.5	38

Tie Breaker Section, Power Circuit Breaker Type RLF — Draw-Out Fused



① Transition section can be on either side of Tie Breaker Section.

RCIII Tie Breaker Section with RLF LV Power Breaker

Ampere Rating	Dimensions in inches			
	Height H1	Width W1	Depth D1	Transition Section ① W2
800 to 4000	90	38	58	18

Outgoing Section

480 Volt Metal-Enclosed Switchgear

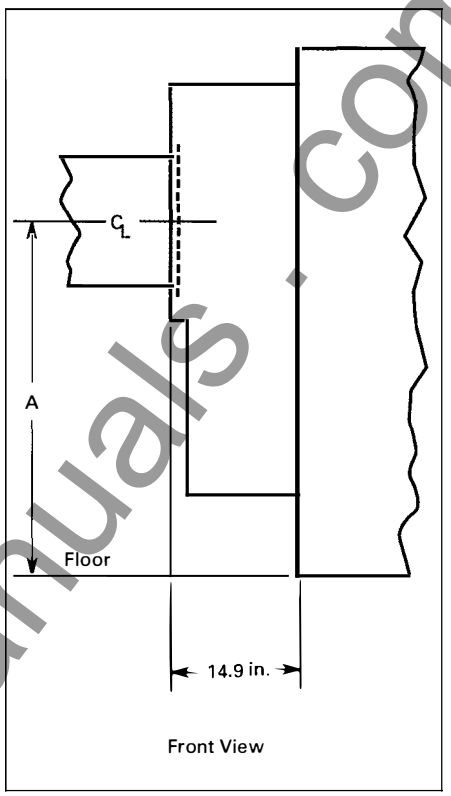
Siemens 480 volt switchgear can be configured in many ways by combining different section types. Up to five vertical sections plus a transition section can be shipped together as a unit. If all vertical sections are not to be shipped as a unit, specifications need to be provided that describe the limiting factors (e.g., low door or narrow hallway).

Normal indoor vertical sections are 101 in. high and 60 in. deep. A top-mounted hoist, which is shipped as an accessory in a separate container, adds 2 in. for a total installed height of 103 in.

The outdoor switchgear assembly contains the indoor assembly in an outdoor housing. The overall height is 113 in. and the depth is 119.40 in.

The major assembly sections include:

- **Transition Sections** — used as transition to liquid filled transformer or to outdoor dry type transformers.
- **Auxiliary Sections** — used as incoming bus duct or cable entrance when a main breaker is not used.
- **Main Sections** — used to contain main breaker and may house metering and feeder breakers.
- **Feeder Sections** — used to contain feeder breakers and other equipment such as instrumentation.
- **Tie Sections** — used to contain tie breaker and other equipment such as feeder breakers.



Switchgear Transition Sections For Liquid Filled and Outdoor Dry Type Transformers

	Dimension A in inches	Weight in lbs.
Indoor	55	500
Outdoor	61	550

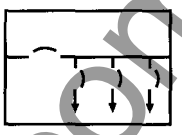
Breaker Element Weight in lbs.

	Element Type								
Operation	**RL-800**	**RLE-800**	**RLI-800**	**RL-1600**	**RL-2000**	**RLE-2000**	**RL-3200**	**RL-4000**	**RLE-4000**
Manual	140	170	175	180	210	215	290	350	355
Electrical	150	180	185	190	220	225	300	360	365
Additional Weight for Shipping	45	45	45	45	45	45	50	50	50

Fused Element Weight in lbs.

	Element Type						
Operation	**RLF-800**	**RLF-1600**	**RLF-2000**	**RLF-3200**	**RFC-3200①**	**RLF-4000**	**RFC-4000②**
Manual	195	310	325	290③	390③④	350④	450③④
Electrical	205	320	335	330④		360④	
Additional Weight for Shipping	45	45	45	50	50	50	50

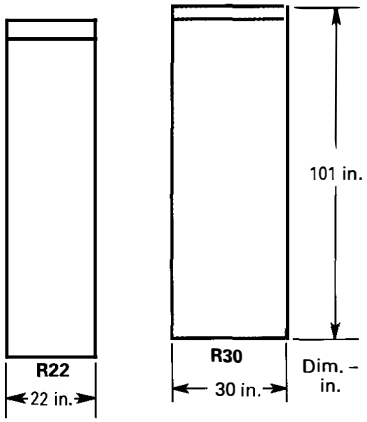
① For use with RLF3200 breaker.
② For use with RLF-4000 breaker.
③ For total weight, add weight of breaker element and separate fuse carriage.
④ Fuses mounted on separate drawout carriage and located in separate compartment.



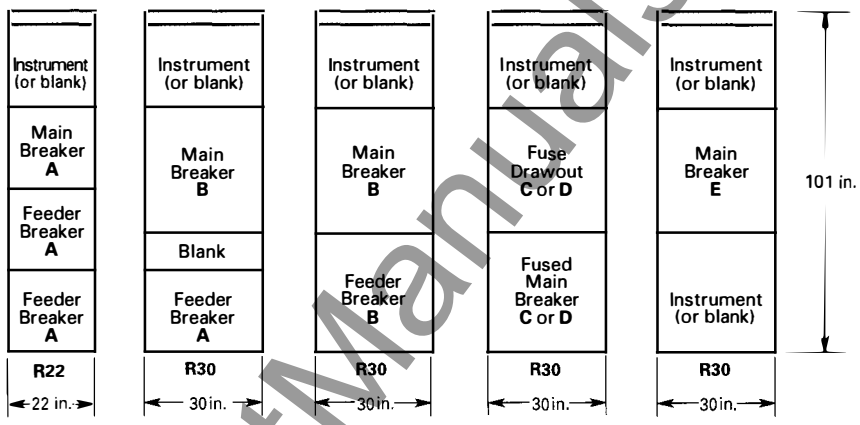
Auxiliary / Breaker Section Dimensions

480V Metal-Enclosed Switchgear

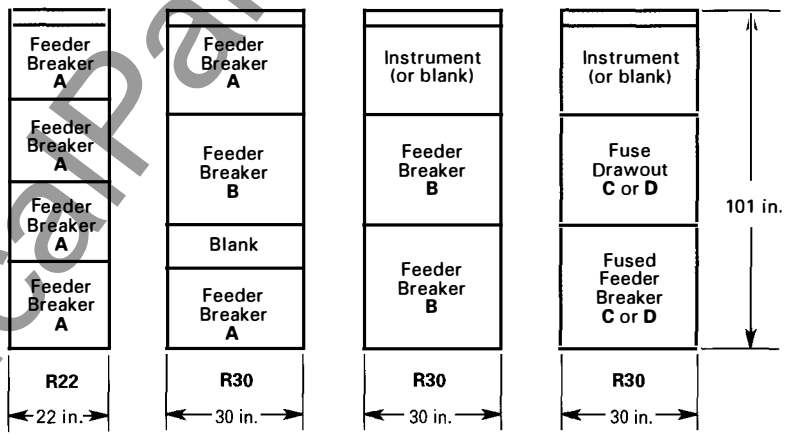
Auxiliary Sections — Front Views



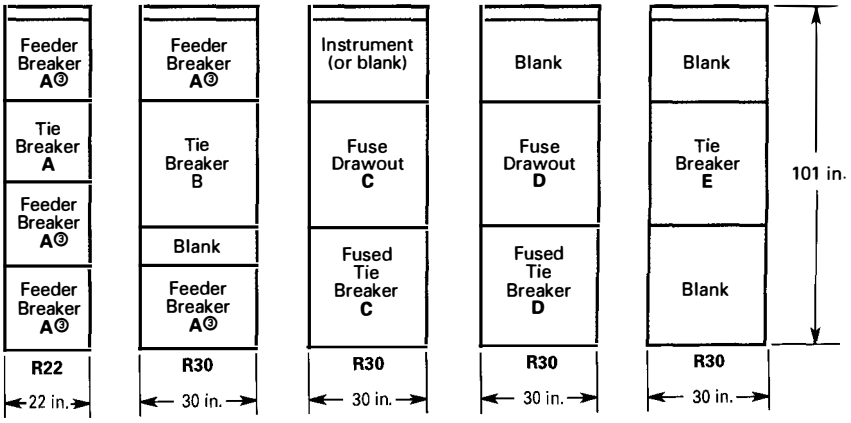
Main Breaker Sections — Front Views



Feeder Breaker Sections and Combinations — Front Views



Tie Breaker Sections and Combinations — Front Views



Auxiliary Section Weight in lbs.

	R22	R30
Indoor	1000	1200
Outdoor	2000	2400

Breaker Section and Connection Weights in lbs. ①

	R22	R30
Indoor	1400	1900
Outdoor	2400	3100

① Weights shown do not include weight of circuit breaker removable elements. For outdoor lineup, add 1200 lb. to total weight of individual sections for end walls and hoist.

Breaker Designations

A = RL-	800/1600/2000, RLF- 800/1600/2000, RLE 800/2000 ②, RLI-800 ②
B = RL-	3200
C = RLF-	3200 in one cell, with fuse drawout (RFC-3200) in other cell
D = RLF-	4000 in one cell with fuse drawout (RFC-4000) in other cell
E = RL-	4000, RLE-4000

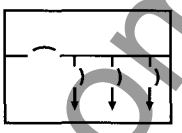
② 22 in. compartment only.

③ Feeder breakers located above tie breaker must be electrically on opposite side of tie breaker from feeder breaker which is located below the breaker.

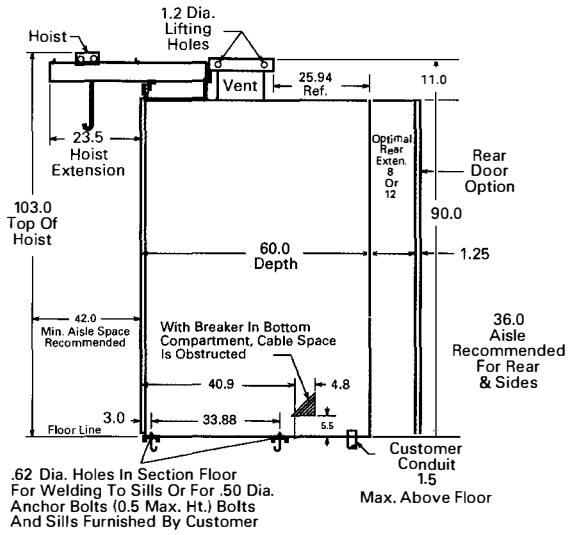
Outgoing Section

480V Metal-Enclosed Switchgear

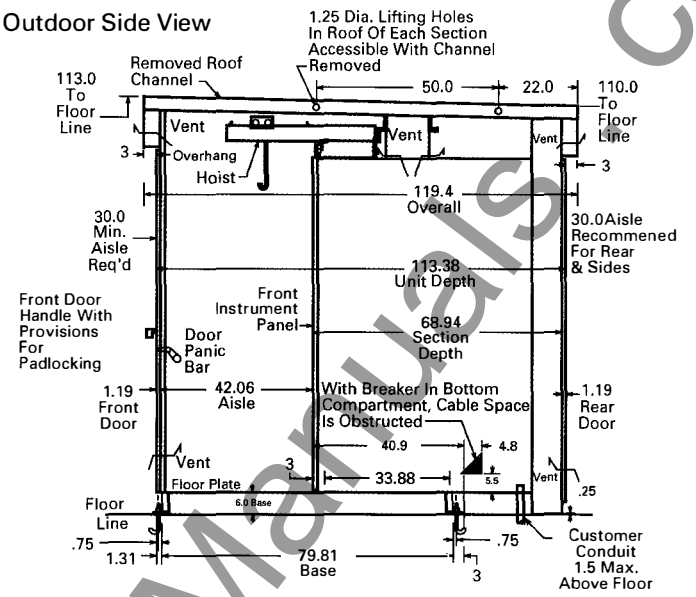
Dimensions in inches



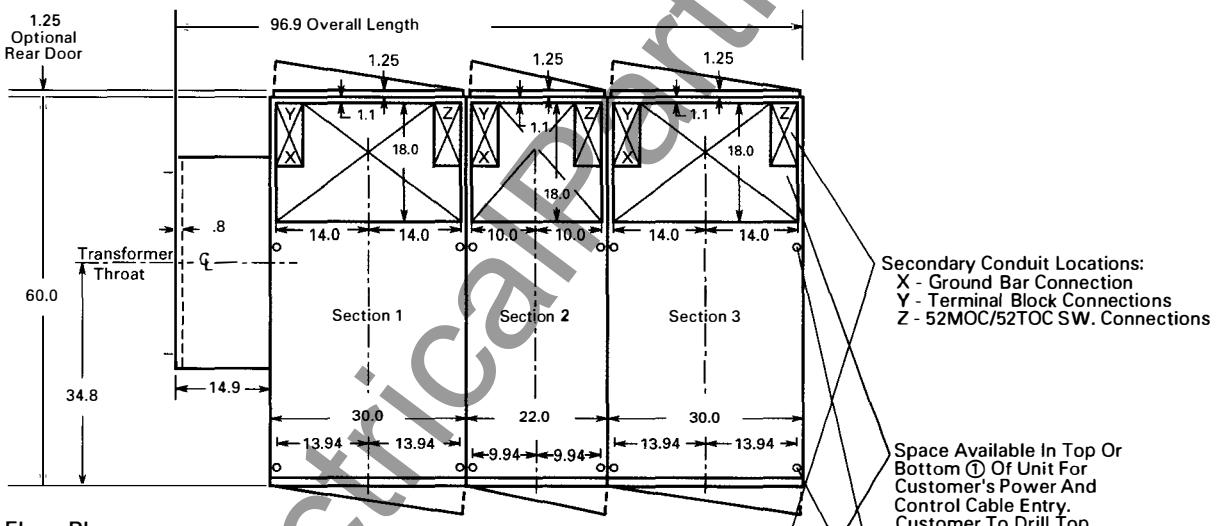
Indoor Side View



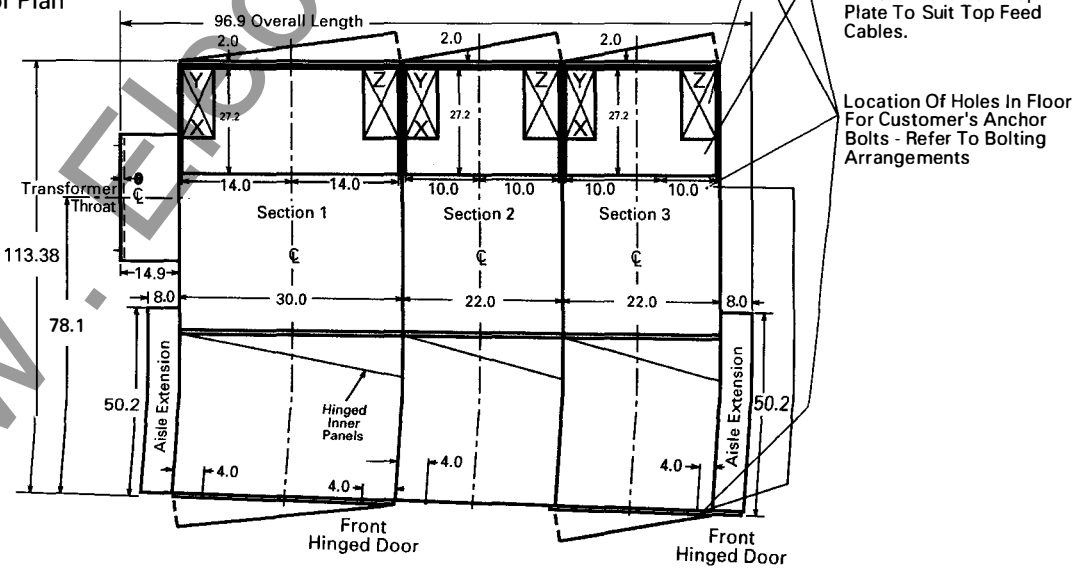
Outdoor Side View



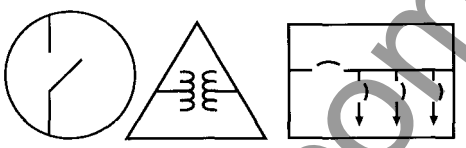
Indoor Floor Plan



Outdoor Floor Plan



Guide Form Specifications



Secondary Unit Substations

I. General

A. Scope
This specification covers an (indoor) (outdoor) secondary unit substation complete from the incoming line terminals to the outgoing feeder terminals.

The unit substation shall be arranged in accordance with sketch_____ accompanying this specification. The substation shall include the following sections, arranged from (left to right) (right to left) when facing the front of the substation:

- Incoming Line Section
- Transformer Section
- Outgoing Switchboard Section

B. Ratings
The substation ratings shall be: Self-cooled____kVA; Fan-cooled____kVA; 3 Phase, 60 Hz____; Incoming (3) (4)-wire circuits____kV; Outgoing (3) (4)-wire circuits____volts.

II. Incoming Line Section (Select one of Item A)

A(1). Air Interrupter Switch
The incoming high voltage switch shall be manually operated, rated (5kV) (15kV), 600 amperes continuous, 600 amperes load break with a fault close rating of 40 kA symmetrical. The switch shall be quick-make, quick-break. The switch shall be floor mounted, metal enclosed and close coupled to the transformer section.

The switch shall be 3-pole, 2-position air insulated. A window in front of the switch shall permit visual inspection of the switch contacts. The switch shall be operable from the front of the unit.

A(2). Duplex Switch
The incoming high voltage switch shall be a 3-pole, 2-position duplex switch which includes two load interrupter switches connected together on the load side. This will permit connection of the transformer to one of two incoming lines. Each switch will be manually operated, rated (5kV) (15kV), 600 amperes continuous, 600 amperes load break, with a fault close rating of 40 kA symmetrical. The two switches will be interlocked to prevent both incoming circuits from being connected to the transformer at the same time. Each switch shall have a window in front to permit visual inspection of the switch contacts. Each switch shall also be operable from the front of its respective unit.

A(3). Selector Switch
The incoming high voltage switch shall be a 3-pole, 2-position (Line 1—Line 2) selector switch in series with a 3-pole, 2-position (On-Off) interrupter switch rated (5kV) (15kV). Mechanical interlocking shall be provided so that the load interrupter switch must be open before the selector switch can be changed from one feeder to another.

A(4). Air Terminal Chamber
This section shall consist of a full height air terminal chamber directly connected to the high voltage side of the transformer. It shall be rated (5kV) (15kV).

B. Fuses (Optional with A1, A3 above)
The switch shall be equipped with three (current-limiting) (expulsion) fuses. Access to fuse compartments will be through single front door. The door shall be Kirk key interlocked with the switch mechanism so that the switch must be in open position before the door can be opened. Conversely, the door must be closed and locked and the key returned to the switch before the switch can be closed.

C. Incoming Cable
Cable is to enter from (above) (below) and terminate in (1) (2) clamp type lugs per phase, or (1-3/C) (2-3/C) (3-1/C) (6-1/C)
pothead(s) for_____single feed, _____loop feed termination. Incoming cable to be (5kV) (15kV),_____ size, type
_____insulation. For potheads, provide the following information:

_____OD over insulation
_____OD conductor
_____OD overall

D. Lightning Arresters
Provide three_____kV (distribution) (intermediate) (station type) arresters for_____kV (grounded) (ungrounded) service.

E. Interlocks
Provide_____key interlock(s) to interlock with_____ .

III. Transformer Section (Select one of Item A)

A(1). Liquid Filled Transformer
Furnish and install transformers of the two winding type, three-phase, 60 Hertz, with ratings as indicated. Unless specified otherwise, provide standard NEMA taps, standard impedance, and standard sound levels.

Transformers shall be liquid filled type designed, manufactured, and tested in accordance with applicable ANSI, NEMA, IEEE standards.

The core and coil construction shall be the most efficient, reliable, and compact design suitable for secondary unit substation application. The self-cooled kVA rating shall be suitable for 30°C average, 40°C maximum ambient temperature.

Rating
The transformer shall be rated 3 phase, 60 hertz as follows: kVA: _____ self-cooled, (AA)

High Voltage _____ delta
Low Voltage _____ wye (delta)
HV taps: Full capacity with 2-2-½% above and below rated high voltage.

Basic Impulse Level
The basic impulse level (BIL) for the transformer shall be standard BIL ratings as indicated (optional ratings as indicated):

Voltage Class	Std. BIL	Opt. BIL
5kV	60kV	75kV
15kV	95kV	110kV

Temperature Rise
Temperature rise shall not exceed 65°C at rated kVA (55/65°C rise optional).

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

Insulation Materials
All insulation materials for the primary and secondary coil assembly shall be rated for continuous 120° total temperature.

Fluid
The transformer insulating and cooling fluid shall be mineral oil (standard); (R-Temp) (Silicone) high-firepoint fluid.

Secondary Unit Substations (cont'd)

Core and Coil Assembly
The core shall be constructed of non-aging, cold-rolled, grain-oriented, high permeability silicon steel.

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 HV and LV coils shall be continuously wound. Coils shall be adequately braced for full short circuit capability.

High Voltage Taps
Provided two 2½% minus and two 2½% plus de-energized full capacity taps. Tap changer handle to be externally accessible and capable of being locked in any tap position.

Enclosure
The enclosure tank shall be welded steel plate construction providing a sealed-tank system. The enclosure tank shall include provisions for rolling, skidding, lifting, and jacking for installation. Paint finish shall be the manufacturer's standard light gray.

Sound Level
The transformer shall be designed to meet the sound level standards for transformers as defined in ANSI.

Future Forced-Air Cooling (optional)
Transformer shall have provisions for future addition of forced air cooling. (OA/FFA).

Forced-Air Cooling (optional)
A complete forced-air cooling system (OA/FA) shall be provided for automatically increasing the self-cooled rating.

Accessories
All NEMA standard accessories shall be provided, including:
- Padlockable no-load tap changer
- Pressure relief device
- Welded tank cover with hand hole
- Pressure vacuum gauge
- Dial type thermometer
- Magnetic liquid level gauge
- Instruction nameplate
- Provision for lifting and jacking
- Filter press connection
- Drain and sampling valve
- Ground pad

Tests
The following tests shall be performed on each unit in accordance with ANSI standards:
- No-load losses
- Excitation current
- Resistance measurement
- Ratio test
- Polarity and phase-relations test
- Impedance and load-loss
- Applied potential test
- Induced potential test

Design coordination for the entire unit substation shall be from one manufacturer and shall be Siemens or approved equal.

A(2). Ventilated Dry Type Transformer
Furnish and install transformers of the two winding type, three-phase, 60 Hertz, with ratings as indicated. Unless specified otherwise, provide standard NEMA taps, standard impedance, and standard sound levels.

Transformers shall be UL listed conventional dry type, and shall be designed, manufactured, and tested in accordance with applicable ANSI, NEMA, IEEE standards.
The core and coil construction shall be the most efficient, reliable, and compact design suitable for secondary unit substation application. The self-cooled kVA rating shall be suitable for 30°C average, 40°C maximum ambient temperature.

Rating
The transformer shall be rated 3 phase, 60 Hertz as follows: kVA: _____ self-cooled, (AA)

High Voltage _____ delta
Low Voltage _____ wye (delta)
HV taps: Full capacity with 2-2½% above and below rated high voltage.

Basic Impulse Level
The basic impulse level (BIL) for the transformer shall be standard BIL ratings as indicated (optional ratings as indicated):

Voltage Class	Std. BIL	Opt. BIL
5kV	30kV	60kV
15kV	60kV	95kV

Temperature Rise:
Temperature rise shall not exceed 150°C at rated kVA (115°C or 80°C rise optional).

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

K-Factor Rated (optional)
Non-linear rated transformers shall be suitable for non-sinusoidal loads and harmonic distortion as indicated in IEEE C57.110, and shall be designed with one of the following K-Factor ratings:

K4 for 50% non-linear load
K13 for 100% non-linear load
K20 for 150% non-linear load
K30 for 200% non-linear load

Non-linear rated transformers shall bear the specified K-Factor rating on the nameplate. Non-linear-rated transformers shall include the following design features:

a) Core designed to withstand voltage distortion and high frequency harmonic currents. Magnetic flux density designed to reduce eddy currents and prevent saturation or overheating of the core.

b) Primary and secondary coils designed to minimize stray losses, skin effect losses, and excessive heating from harmonic currents. Coils shall not exceed the specified winding temperature rise, the corresponding hot spot temperature rating, or the 220°C insulation rating while carrying the specified non-linear load.

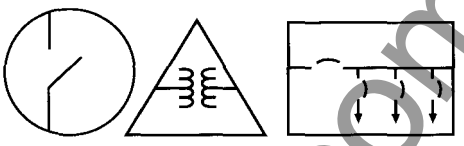
Insulation Materials
All insulation materials for the primary and secondary coil assembly shall be rated for continuous 220°C total temperature (Class H), and shall be UL approved insulation system.

Core and Coil Assembly
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 shall be 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 HV and LV coils shall be continuously wound. Coils shall be adequately braced for full short circuit capability.

Vibration dampening pads shall be provided to isolate core / coil assembly from the base structure.



VPI Process
Transformers shall be sealed and protected using a Vacuum Pressure Impregnation (VPI) process. The preheated windings shall be subjected to a dry vacuum cycle, followed by wet vacuum cycle during which windings are impregnated with resin, then followed by a pressure cycle to force the resin through the insulation. The windings shall be oven cured to bind the resin to the insulation material. The VPI and oven curing process shall completely seal and protect the windings from moisture and dirt, and shall eliminate any voids which could create hot spots, partial discharge, or cause corona formation. Dip and bake impregnation is not acceptable.

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

Enclosure
The enclosure shall be NEMA 1 Indoor type (NEMA 3R outdoor optional) constructed of heavy gauge sheet steel equipped with removable panels for access to the core and coils on the front and rear sides. Ventilated openings shall be furnished to meet NEMA standards. The enclosure shall include provisions for rolling, skidding, lifting, and jacking for installation. Enclosure finish shall be in the manufacturer's standard light gray paint.

Sound Level
The transformer shall be designed to meet the sound level standards for dry type transformers as defined in ANSI C89.2 / NEMA ST-20.

Future Forced-Air Cooling (optional)
Transformer shall have provisions for future addition of forced air cooling (AA/FFA).

Forced-Air Cooling (optional)
A complete forced-air cooling system (AA/FA) shall be provided for automatically increasing the self-cooled rating by 33⅓%. The forced cooling system shall be a solid state device with continuous temperature monitoring within each phase. Features shall incude test switches, digital temperature indication for each phase or highest temperature, manual or automatic fan control switches, audible alarm silencing switch, memory, and self-test.

Accessories
All NEMA standard accessories shall be provided, including:

- HV/LV Bus terminations
- Removable panels
- Provisions for grounding
- Instruction nameplate

Tests
The following tests shall be performed on each unit in accordance with ANSI standards:

- No-load losses
- Excitation current
- Resistance measurement
- Ratio test
- Polarity and phase-relations test
- Impedance and load-loss
- Applied potential test
- Induced potential test
- Partial discharge

Design coordination for the entire unit substation shall be from one manufacturer and shall be Siemens or approved equal.

A(3). Cast Coil Transformer
Furnish and install transformers of the two winding type, three-phase, 60 Hertz, with ratings as indicated. Unless specified otherwise, provide standard NEMA taps, standard impedance, and standard sound levels.

Transformers shall be cast coil type and shall be designed, manufactured, and tested in accordance with applicable ANSI, NEMA, IEEE standards.

The core and coil construction shall be the most efficient, reliable, and compact design suitable for secondary unit substation application. The self-cooled kVA rating shall be suitable for 30°C average, 40°C maximum ambient temperature.

Rating
The transformer shall be rated 3 phase, 60 Hertz as follows: kVA: _____
High Voltage _____ delta
Low Voltage _____ wye (delta)
HV taps: Full capacity with 2-2½% above and below rated high voltage.

Basic Impulse Level
The basic impulse level (BIL) for the transformer shall be standard BIL ratings as indicated (optional ratings as indicated):

Voltage Class	Std. BIL	Opt. BIL
5kV	60kV	95kV
15kV	95kV	110kV

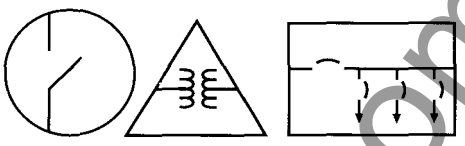
Temperature Rise:
Temperature rise shall not exceed 80°C at rated kVA (80/100°C optional).

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

Insulation Materials
All insulation materials for the primary and secondary coil assembly shall be rated for continuous 185°C temperature.

Core and Coil Assembly
The core shall be cruciform shape constructed of non-aging, cold-rolled, grain-oriented, high permeability silicon steel.

All core laminations shall be free of burrs and shall be 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.



Secondary Unit Substations (cont'd)

The HV and LV coils shall be continuously wound. Coils shall be adequately braced for full short circuit capability. The entire high voltage winding shall be solidly cast in epoxy resin using a vacuum process to insure the absence of voids. Each high voltage winding shall be tested after casting to verify the absence of voids.

The low voltage windings shall be the same construction as used for the high voltage windings, or constructed of sheet wound conductor with epoxy impregnated insulation between the layers which, when baked, forms the coil into a solid epoxy casting.

Vibration dampening pads shall be provided to isolate core / coil assembly from the base structure.

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

Enclosure
The enclosure shall be NEMA 1 Indoor type (NEMA 3R outdoor optional) constructed of heavy gauge sheet steel equipped with removable panels for access to the core and coils on the front and rear sides. Ventilated openings shall be furnished to meet NEMA standards. The enclosure shall include provisions for rolling, skidding, lifting, and jacking for installation. Enclosure finish shall be in the manufacturer's standard light gray paint.

Sound Level
The transformer shall be designed to meet the sound level standards for transformers as defined in ANSI.

Future Forced-Air Cooling (optional)
Transformer shall have provisions for future addition of forced air cooling (AA/FFA).

Forced-Air Cooling (optional)
A complete forced-air cooling system (AA/FA) shall be provided for automatically increasing the self-cooled rating by 33⅓%. The forced cooling system shall be a solid state device with continuous temperature monitoring. Features shall incude test switches, digital temperature indication for each phase or highest temperature, manual or automatic fan control switches, audible alarm silencing switch, memory, and self-test.

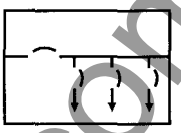
Accessories
All NEMA standard accessories shall be provided, including:

- HV/LV Bus terminations
- Removable panels
- Provisions for grounding
- Instruction nameplate

Tests
The following tests shall be performed on each unit in accordance with ANSI standards:

- No-load losses
- Excitation current
- Resistance measurement
- Ratio test
- Polarity and phase-relations test
- Impedance and load-loss
- Applied potential test
- Induced potential test
- Partial discharge

Design coordination for the entire unit substation shall be from one manufacturer and shall be Siemens or approved equal.



Sentron Switchboards — Types SB3 and RCIII

1. Scope

Furnish and install, as shown on the plans, a service and distribution switchboard as specified herein, for the system indicated below:

☐ 120/240 ☐ 1-phase ☐ 3-wire

☐ 120/208V ☐ 3-phase ☐ 4-wire

☐ 277/480V ☐ -phase ☐ -wire

☐ 480V

☐ _____V

Configuration

The switchboard enclosure shall be:

☐ NEMA 1 indoor construction

☐ NEMA 3R outdoor construction

☐ Non walk-in front accessible

☐ Non walk-in front & rear accessible

Switchboard shall be of the modular type construction with the required number of vertical sections bolted together to form one metal enclosed rigid switchboard. The sides, top and rear shall be covered with removable screw-on code gauge steel plates. Switchboard shall include all protective devices and equipment as listed on drawings with necessary interconnections, instrumentation and control wiring. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips.

Switchboard shall be constructed in accordance with the latest NEMA PB-2 and UL 891 standards.

2. Bus Requirements

The bus shall be ☐ tin plated aluminum, ☐ silver plated copper of sufficient size to limit the temperatur rise to 65°C, based on UL tests. The bus shall be braced for ☐ 50,000, ☐ 65,000, ☐ 100,000, ☐ 200,000 amperes symmetrical and supported to withstand mechanical forces exerted during short circuit conditions when directly connected to a power source having the indicated available short circuit current. Provide a full capacity neutral where a neutral is indicated on the drawings.

The through bus on the end section shall be extended and pre-drilled to allow the addition of future sections with standard splice plates.

Grade 5 bolts will be used at bus joints. Ground bus and lugs shall be furnished — Ground bus shall extend the entire length of the switchboard and shall be firmly secured to each vertical section.

3. Service Section

The service section shall be designed for the system parameters indicated in article 1.0, shall have a ☐ metering compartment per utility requirements, ☐ user metering as indicated in article ____, ☐ and shall have a main protective device indicated in article ____.

4. Distribution Sections (Select one of Item #B)

B1. Switchboard Type Panel-Mounted, Front Accessible.

Switchboard shall be of Siemens or approved equal. Individual sections shall be front accessible, not less than 20" deep, and rear of all sections shall align. Incoming line termination, main device connection and all bolts used to join current-carrying parts shall be installed so as to permit servicing from the front only so that no rear access is required. The branch devices shall be front removable and panel mounted with line and load side connections front accessible.

B2. Switchboard Type Panel-Mounted Rear Accessible

Switchboard shall be of Siemens or approved equal. Individual sections shall be front and rear accessible, not less than 38" deep, and both the front and rear of all sections shall align. The branch devices shall be front removable and panel mounted with line and load side connections front accessible. The bus and main device connections shall be rear accessible.

B3. Switchboard Type Individually Mounted, Rear Accessible (Fixed mounted devices).

Switchboard shall be of Siemens RCIII type, or approved equal. All sections shall align front and rear. All disconnect devices, main and feeders, shall be mounted individually at the front of the switchboard and shall be rear accessible. The load terminals of each feeder device shall be extended by means of insulated bus bars through the bus compartment in to the rear cable compartment.

Optional

☐ barriers shall be provided between bus and cable compartment.

☐ barriers shall be provided between vertical sections.

☐ barriers shall be provided between devices and bus compartment.

☐ barriers shall be provided between individual devices.

Sentron Switchboards — Types SB3 and RCIII (cont'd)

B4. Switchboard Type Individually Mounted Rear Accessible (Insulated Case Breaker).
Switchboard shall be of Siemens RCIII type or approved equal. All sections shall be aligned front and rear. Insulated case breakers shall be individually mounted in their own compartments. Barriers shall be provided at the sides and rear of each compartment and a horizontal barrier between breakers in same vertical section. Breaker shall be accessible through hinged metal door on each breaker compartment.

The insulated case circuit breaker assembly shall be Siemens SB Encased Systems Type, and shall be self-contained to permit quick replacement or inspection and maintenance of breakers without de-energizing the entire switchboard.

The drawout design of circuit breaker shall be such that it makes it possible to place the breakers in a fully withdrawn, disengaged, test or engaged position.

The load side of each feeder breaker shall have bus bars extending from rear of the primary disconnect through the bus compartment in to the rear cable compartment.

Optional:

☐ barriers shall be provided between the bus and cable compartment and between vertical section.

☐ provided traveling type breaker lifting hoist and track mounted on top of switchboard.

B5. Switchboard Type Individually Mounted Rear Accessible (Drawout Power Circuit Breaker)
Switchboard shall be of Siemens RCIII type or approved equal. All sections shall be aligned front and rear. Each vertical section forming part of switchboard lineup shall have one or more individual breaker or instrument compartments, a centralized main bus compartment and a rear cabling compartment. Drawout breakers shall be Siemens RL Power Circuit Breakers with Static Trip III trip unit, and shall be individually mounted in their own compartments. Metal barriers shall be provided at the sides and rear of each compartment and a horizontal metal barrier between breakers in the same vertical section. The breaker shall be accessible through a hinged metal door on each breaker compartment.

The drawout mechanism of power circuit breaker shall be such that it can be moved from connect through test to disconnect position without opening the door. In the "connect" position, both the primary and secondary disconnects are engaged. In the "test" position, the primary disconnect terminals are disengaged; however, the secondary disconnects are maintained to permit the operation of the circuit breaker. In the "disconect" position, the primary and secondary disconnects are engaged. In the "test" position, the primary disconnect terminals are disengaged; however, the secondary disconnects are maintained to permit the operation of the circuit breaker. In the "disconnect" position, the primary and secondary disconnects are disengaged and separated a safe distance from the corresponding stationary terminals. In the "fully withdrawn" position, both primary and secondary contacts are disconnected and the circuit breaker may be inspected as it can be removed for more complete accessibility.

The load side of each feeder breaker shall have bus bars extending from the rear of the primary disconnect through the bus compartment in to the rear cable compartment.

Optional

☐ barriers shall be provided between the bus and cable compartment and between vertical sections.

☐ provide traveling type breaker lifting hoist and track mounted on top of switchboard.

5. Main Protective Device (Select one of Item #C)
The main protective device, to be installed in the main device section, shall be as indicated below:

C-1 Molded case circuit breaker shall be of the quick-make, quick-break, trip-free, (heavy duty) (extra heavy duty) (solid state) type. It shall be an _____ frame (2-pole) (3-pole) 600-volt breaker with a trip current rating of:

☐ 400A ☐ 1600A
☐ 600A ☐ 2000A
☐ 800A ☐ 2500A
☐ 1000A ☐ 3000A
☐ 1200A

of an interrupting capacity of not less than _____ amperes RMS symmetrical at the system voltage.

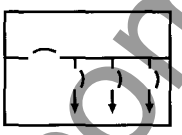
The following accessory features are to be included:

☐ Shunt Trip

☐ Electrical Operator

☐ Integral ground fault trip (for solid state SensiTrip II breakers only)

☐ Other _____ (list)



C-2 Fusible switch of the quick-make, quick-break type. It shall be a (2-pole) (3-pole) (240 V) (600 V) Vacu-Break unit with a continuous current rating of (400) (600) (800) (1200) amperes and with _____ ampere class _____ fuses, suitable for application on a system with _____ amperes symmetrical available fault current.

C-3 Bolted pressure switch of the quick-make, quick-break type. It shall be a ☐ 2-pole, ☐ 3-pole, ☐ 240 V, ☐ 480 V unit with a continuous current rating of:

☐ 800A	☐ 2000 A
☐ 1200 A	☐ 2500 A
☐ 1600 A	☐ 3000 A
	☐ 4000 A

and with _____ ampere Class L fuses suitable for application on a system with _____ amperes symmetrical available fault current.

The following accessory features are to be included:

☐ Shunt Trip

☐ Ground fault relay

☐ Electrical operator

☐ Other _____ (list)

C-4 Type RL low voltage power circuit breaker with a drawout frame and a current rating of:

☐ 600A	☐ 2000A
☐ 800A	☐ 3000A
☐ 1600A	☐ 4000A

It shall be ☐ manually ☐ electrically operated power circuit breaker with a solid-state static-trip III device and an interrupting capacity of _____ amperes RMS symmetrical at the system voltage.

The following accessory features are to be included:

☐ Short time delay

☐ Integral ground fault trip

☐ Shunt trip (M.O. C/B only)

☐ Other _____ (list)

C-5 Type SB Encased Systems insulated case circuit breaker with a ☐ stationary or ☐ drawout frame. Frame size to be _____ ampere, 3-pole, 600-volt with a trip current rating of:

☐ 400 A	☐ 2500 A
☐ 600 A	☐ 2500 A
☐ 800 A	☐ 3000 A
☐ 1000 A	☐ 3500 A
☐ 1200 A	☐ 4000 A
☐ 1600 A	

It shall be a ☐ manually, ☐ electrically operated breaker with a solid state trip device, stored energy type, trip free, an interrupting capacity of not less than _____ amperes RMS symmetrical at the line system voltage.

The following accessory features are to be included:

☐ Short time delay

☐ Integral ground fault trip

☐ Fault trip indicators

☐ Other _____ (list)

6. Branch Protective Devices (Select one of Item #D)

All molded case circuit breakers, fusible switches, insulated case circuit breakers, bolted pressure switches, low voltage power circuit breaker, and/or motor starter units used as a protective device in a branch circuit will meet the requirements of the appropriate paragraph below.

D-1 Molded case circuit breakers shall be of quick-make, quick-break, trip-free ☐ thermal magnetic type, ☐ solid-state, with frame, trip and voltage ratings, either 2-pole or 3-pole, as indicated on the plans. All breakers shall have an interrupting capacity of not less than _____ amperes RMS symmetrical at the system voltage. All breakers shall be removable from the front of the switchboard without disturbing adjacent units. The switchboard shall have space or provisions for future units as shown on the plans.

D-2 Current limiting circuit breakers shall provide inverse time delay, instantaneous circuit protection, and also limit the let-through I^2t to a value less than I^2t of one-half cycle wave of the symmetrical prospective current without any fusible elements. Breakers shall have an interrupting capacity of not less than _____ amperes RMS symmetrical at the system voltage.

D-3 Fusible switches shall be quick-make, quick-break units utilizing the double-break principle of circuit rupturing to minimize arcing and pitting and shall conform to the ratings shown on the plans.

Each switch shall have an individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles. Switches shall be equipped with ☐ NEC standard, ☐ Class R rejection type fuse holders, and Class ☐ H, ☐ K1, ☐ K5, ☐ RK1, ☐ RK5, ☐ J and ☐ L fuses of ampere rating and type as indicated on the plans suitable for application on system with _____ ampere symmetrical available fault current.

D-4 Each bolted pressure switch shall be the quick-make, quick-break type, equipped with Class L fuses suitable for application on a system with _____ amperes symmetrical available fault current. Ampere ratings to be as shown on the plans.

Sentron Switchboards — Types SB3 and RCIII (cont.)

D-5 Each low voltage power air circuit breaker shall be (drawout mounted) stored energy type, trip free, (manually operated) (electrically operated) with solid-state trip device. Frame sizes and trip ratings to be as shown on the plans. All breakers to have an interrupting capacity of not less than _____ amperes symmetrical at the rated voltage.

D-6 Each insulated case circuit breaker shall be (drawout) (stationary) frame, stored energy type, trip free, (manually operated) (electrically operated) with solid-state trip device. Frame sizes and trip ratings to be as shown on the plans. All breakers to have an interrupting capacity of not less than _____ amperes symmetrical at the rated voltage.

7. Ground Fault Protection:

A) General

Furnish and install in the service equipment and/or switchboard Ground Fault protection and indication equipment as specified herein and as shown on drawings in accordance with NEC #230-95.

All parts of the systems specified shall be UL Listed.

All new Ground Fault Protection and Indication equipment shall be factory installed, wired and tested by the switchboard manufacturer.

B) Ground Fault Relay

The Ground Fault Relay shall be a line-powered, self-contained device and shall be designed to mount in the front panel of the equipment in which it is installed.

The Ground Fault Relay shall be supplied with 120 VAC control power from a suitably rated control transformer whose primary is connected phase-to-phase. When control power is present, a "Control Power" indicator shall be lit on the relay panel.

The Ground Fault Relay shall receive a signal from the Sensor proportional to the magnitude of the fault current. Pick-up (trip) and time delay settings shall be incrementally adjustable 100 through 1200 amperes and 0.10-1 second, respectively in various ranges.

The ground fault relay shall be provided with an integral test panel with "push to test" and "shunt trip bypass" pushbuttons for testing the system with or without tripping the protective device.

Ground fault relays shall be zone interlocked.

8. Metering Equipment (When Required)

Provide a multi-function, high accuracy digital power metering instrumentation module equipped with an LCD display. The power metering module shall provide simultaneous measurements for current, voltage, and power parameters. Power meter shall be Siemens type ( ) 4300 ( ) 4700 equipped with a communications port for connection to customer's energy-management network.

9. General

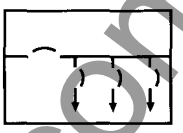
The complete switchboard shall be phosphatized and finished with light grey. ASA-61 paint.

Each switchboard section shall have a nameplate permanently affixed to it, listing the following information:

Name of manufacturer
System voltage
Ampacity
Type
Manufacturer's shop order number and date

Each section of switchboard shall bear a UL listing mark, where qualified, and a short circuit rating label.

In addition, the front, side, rear and top of each switchboard section will have a DANGER label in accordance with NEMA Standard PB-2.



480V Metal-Enclosed Switchgear

This equipment specification guide provides information for describing a typical metal enclosed low voltage power circuit breaker switchgear assembly. Items or features that are non-standard but required for a specific application are preceded by (option). Items preceded or followed by a blank (_) require that additional data be provided in order to complete the specification.

General

The equipment to be supplied shall be metal enclosed low voltage power circuit breaker switchgear with drawout circuit breaker elements. All power circuit breakers and assemblies shall be produced by a single manufacturer and shall be designed, tested and manufactured in accordance with the standards referenced in this specification.

Codes and Standards

The switchgear assemblies and power circuit breakers shall comply with the codes and standards as indicated. Copies of certified design tests shall be furnished if requested to confirm compliance.

- **ANSI / IEEE C37.13-1991**
- **ANSI 37.16-1988**
- **ANSI C37.17-1979**
- **ANSI / IEEE C37.20.1-1987**
- **ANSI / IEEE C37.27-1987**
- **ANSI C37.50-1989**
- **ANSI C37.51-1989**
- **ANSI / NEMA 250-1985**
- **NEMA SG 3**
- **NEMA SG 5**
- **(option) NEMA 210**
- **UL 1066**
- **UL 1558**

Assembly

The switchgear assembly shall be Siemens type R and is to be located indoors, with a NEMA 1 enclosure, ((option) outdoor, NEMA 3R per specifications below) and constructed of multiple, metal-enclosed, ventilated sections. The front of each vertical section is to contain three or four compartments with 14 gauge steel side sheets and compartment barriers of 11 gauge steel. A double thickness of 14 gauge steel is to be provided between vertical sections. The side sheets shall be full height and depth to provide a full metal barrier separating the rear cable compartments between sections. End sections shall include provisions for main bus extension and installation of future vertical sections. The design shall incorporate preformed steel channels, angles, and side sheets bolted together and reinforced to form a rigid, self-supporting, compact assembly.

Horizontal barriers are to be provided to form individual circuit breaker or metering compartments. Circuit breaker compartments are to be barriered from the bus compartment through a primary disconnect assembly. Each circuit breaker or metering compartment shall be provided with a hinged front door secured with rotary latches requiring no tools to operate.

Circuit breaker compartments shall include stationary primary contact disconnects. The primary disconnects shall be copper, silver plated at connection points and shall be of one piece construction. The upper set of disconnects shall bolt directly to the main bus and, for feeder circuit breakers, the lower set shall extend to the rear cable area and shall be insulated where they pass through the main bus compartment. Primary disconnects shall be sized for the maximum continuous current of the circuit breaker which will be located in the compartment. Interlocks shall be provided which will prevent a circuit breaker element of the incorrect frame size or interrupting rating from being inserted into the compartment. A stationary circuit breaker frame grounding contact shall be provided which shall be visible with the circuit breaker installed in any position.

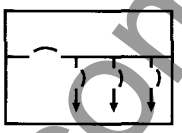
Secondary control contacts, when required, shall be located on the side of the circuit breaker compartment and shall be of the sliding contact, silver plated copper design. Barriers shall be provided between terminal points. The secondary control contacts shall engage the drawout circuit breaker element in the connected and test positions.

Control circuit fuses for electrically operated circuit breakers shall be located on the side of the circuit breaker compartment and shall be contained in a dead-front, pull-out fuse block with a clear cover. Withdrawing the cover from the fuse block shall automatically remove the control circuit fuses and hold them captive. The fuse block cover shall include provisions for being installed in the reverse position in order to maintain the open control circuit for testing or maintenance purposes while continuing to hold the fuses captive.

All control wiring within the assembly shall be continuous and shall terminate on each end at a suitable terminal block. Control wiring shall be 14 gauge, stranded, type SIS, and shall be labeled at each end with sleeve type wire markers. Wire markers shall be machine imprinted with the wire name as indicated on the wiring diagrams. Wrap on wire markers will not be accepted. Terminals shall be insulated locking fork or ring tongue type except where connecting to components that do not accept these terminations. Control wiring for external connections shall be terminated in the rear cable area for ease of access. (option) Metal covers shall be provided over control wiring troughs where they pass through the power cable termination area. (option) Metal covers shall be provided over terminal blocks located in the power cable termination area.

Bus

Main bus shall be three phase, _____ wire, _____ ampere copper with silver plated connection joints (option) aluminum with welded connection points (option) copper with tin plated connection points. (Option) Neutral bus rating shall be _____% of the main bus current rating and shall be located centrally in the structure for ease of terminating cables whether entering from above or below. 600 volt clearances shall be maintained in all horizontal and vertical buses such that insulation is not required. The main horizontal bus shall be run in a vertical, edge-to-edge arrangement for high short circuit strength. Access to the rear cable termination area shall be possible without reaching over the main and vertical bus. Bus bracing shall be equal to the short circuit interrupting rating of



480V Metal-Enclosed Switchgear (cont.)

the lowest rated circuit breaker applied in the assembly. A 0.25 in. by 2.00 in. copper ground bus will be provided. (Option) Barriers shall be provided which isolate the rear cable termination compartment in each vertical section. With these barriers installed, the rear cable area will be completely segregated between vertical sections. (Option) Barriers shall be provided to separate the incoming line connections from the main horizontal and vertical bus.

Circuit Breakers
Circuit breakers shall be Siemens type RL and shall be either electrically or manually operated as indicated on the data sheets (or drawings). Minimum interrupting ratings will be as defined on the data sheets (or drawings) and shall meet or exceed the interrupting ratings as defined by ANSI standards. (Option) Fused circuit breakers are to be the integrally fused type through the 2000 ampere frame size. 3200 and 4000 ampere frame sizes are to be supplied with separate drawout fuse carriages which are mounted in the same vertical section as the circuit breaker element and are to be key interlocked with the circuit breaker element such that the fuse carriage cannot be withdrawn unless the circuit breaker is locked in the open position. All fused circuit breakers are to be equipped with blown fuse lockout devices to prevent single phasing. The application of fused circuit breakers shall not reduce the amount of rear cable termination space which would have been provided with non-fused circuit breakers.

Circuit breakers are to be 600 volt class with nominal ratings as dictated by the system voltage. Circuit breakers shall be three-pole, single-throw, operated by a stored energy mechanism, with arc quenchers, main and arcing contact structure, a three-phase solid state trip overcurrent trip unit, trip actuator, three single ratio tripping sensors, and primary disconnecting devices. In addition, the circuit breaker element shall have connected, test, and disconnected position indicators, spring charged / discharged indicators, and circuit breaker open or closed indicators all of which shall be visible to the operator with the compartment door closed. It shall be possible to rack the circuit breaker element from the disconnect to the connected position with the compartment door closed. Interlocks will be provided that prevent racking a circuit breaker unless the circuit breaker is open and that prevent closing a circuit breaker unless it is in the connected or test position.

Solid State Trip Units
Solid state trip units shall be Siemens

- Static Trip III (basic device)
- (option) Static Trip IIIC (adds communications capability)
- (option) Static Trip IIICP (adds communications and power metering
- (option) Static Trip IIICPX (adds communications, power metering, and relaying functions

Trip units shall be interchangeable so that any trip unit can be used with any frame size circuit breaker. The basic trip unit shall be a self powered, micro-processor based device that measures true RMS currents. Long time, short circuit or ground fault trip indication shall be maintained for a minimum of 48 hours without the need for a separate battery or relay. Peak sensing devices will not be accepted. All adjustment setting switches shall be digitally encoded type with gold contacts. (Note: Refer to catalog section SG3169-1 for specifications on the Siemens Static Trip III trip unit family and all associated options).

Instrumentation and Metering
Provide a multi-function, high accuracy digital power metering instrumentation module equipped with an LCD display. The power metering module shall provide simultaneous measurements for current, voltage, and power parameters. Power meter shall be Siemens type ( ) 4300 ( ) 4700 equipped with a communications port for connection to customer's energy-management network.

Current transformers shall have standard accuracy class ratings as defined by ANSI C37.20.1 and shall be mounted directly on the stationary primary disconnects in the circuit breaker compartment. Voltage transformers shall have a minimum 150VA thermal rating and shall be located in a metal enclosed metering compartment and shall be protected on the primary side with current limiting fuses.

Outdoor
(Option) Outdoor, NEMA 3R, walk-in, weatherproof construction is to be provided. The complete assembly is to rest on a formed steel base provided under each vertical section and running perpendicular to the length of the switchgear. The underside of the enclosure and base structure is to be undercoated with coal tar emulsion material.

Front and rear doors are to be gasketed and hinged. Front doors, located at each end, are to include panic release door hardware, three point latches, and provision for padlocking. Rear doors shall be bolted. All exterior hardware shall be stainless steel.

An indoor access aisle approximately 42 in. deep and accessible from either door is to be provided at the front of the switchgear line-up for inspection and testing of the circuit breakers and associated equipment. A hand-operated traveling hoist, mounted above the switchgear is to be provided for changeout of circuit breakers. The aisle is to have an extension on each end to accommodate end unit doors that have instrumentation and metering, and to provide additional space for circuit breaker handling.

The switchgear is to include space heaters to prevent condensation of moisture. The aisle shall be provided with incandescent lights, convenience receptacle, and an on / off switch to control the lights.

Finish
During construction, the structural steel parts, panels, and compartments shall be prepared for painting by a five-stage wash system consisting of an alkaline cleaner, fresh water rinse, iron phosphate treatment, fresh water rinse, and non-chromate sealer. After cleaning and stabilization, the steel parts shall be coated with a thermosetting polyester powder applied with electrostatic equipment at a nominal 2 mils dry film thickness and then cured at 425 degrees Fahrenheit for 20 minutes. Paint color shall be ANSI 61 light gray. The paint finish shall have a pencil hardness of 2H, a gloss as defined by ANSI D523-78 of 45-55%, a salt spray rating per ASTM B-117-73 of 600 hours, and shall be outdoor rated per UL1332.

Accessories
The following accessories are to be provided:

- crank for racking circuit breakers
- lifting yoke for circuit breakers
- container of touch-up paint
- (optional) portable test set, type PTS4
- (optional) overhead hoist for indoor switchgear
- (optional) test cabinet

Testing
Production tests in accordance with ANSI C37.20.1, ANSI C37.50, ANSI C37.51 and NEMA SG 5 shall be performed on the completed assembly. Certified copies of these tests shall be furnished upon request.

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Grand Rapids
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