

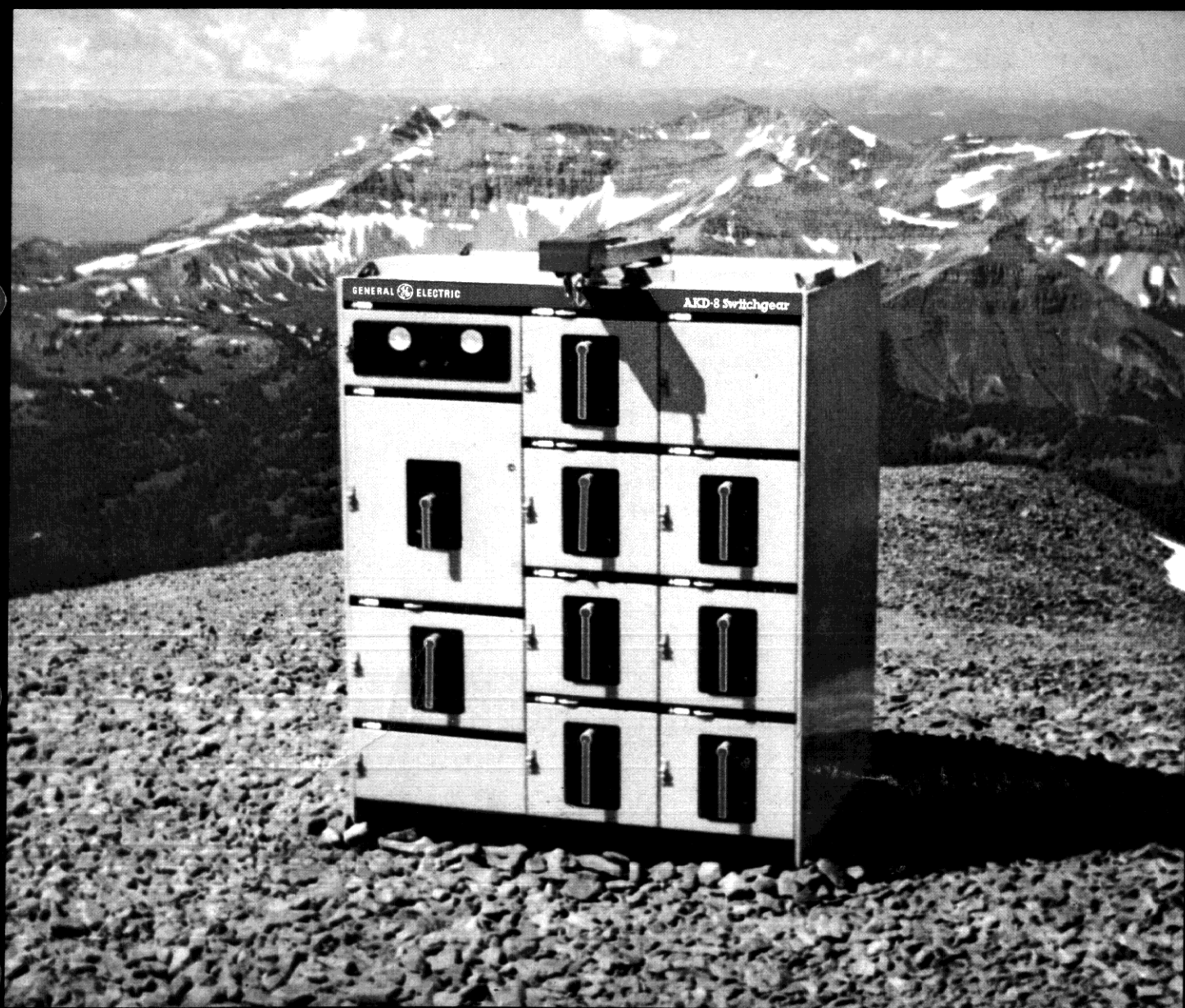
The Pinnacle  
of Protection

GEA-10264A



# AKD-8

## Low-Voltage Switchgear



GENERAL  ELECTRIC

General Electric type AKD-8 Low-Voltage Switchgear has reached new heights in power distribution and protection equipment with a number of equipment and power circuit breaker innovations and improvements. All of the field-proven customer benefits of preceding GE switchgear equipment and breakers have been blended with new design ad-

vances to produce an equipment offering that meets or exceeds your present and future needs for safety, reliability, maintainability, convenience, economy and continuity of service.

### System Safety and Reliability

Both standard and optional features are available with

AKD-8 switchgear to provide electrical distribution equipment that will meet the increasing industry emphasis on system reliability and operating personnel safety.

- True closed-door draw-out (figure 2)—is standard construction with all AKD-8 switchgear equipment. The breaker compartment doors remain stationary and closed

## AKD-8 Specifications Data

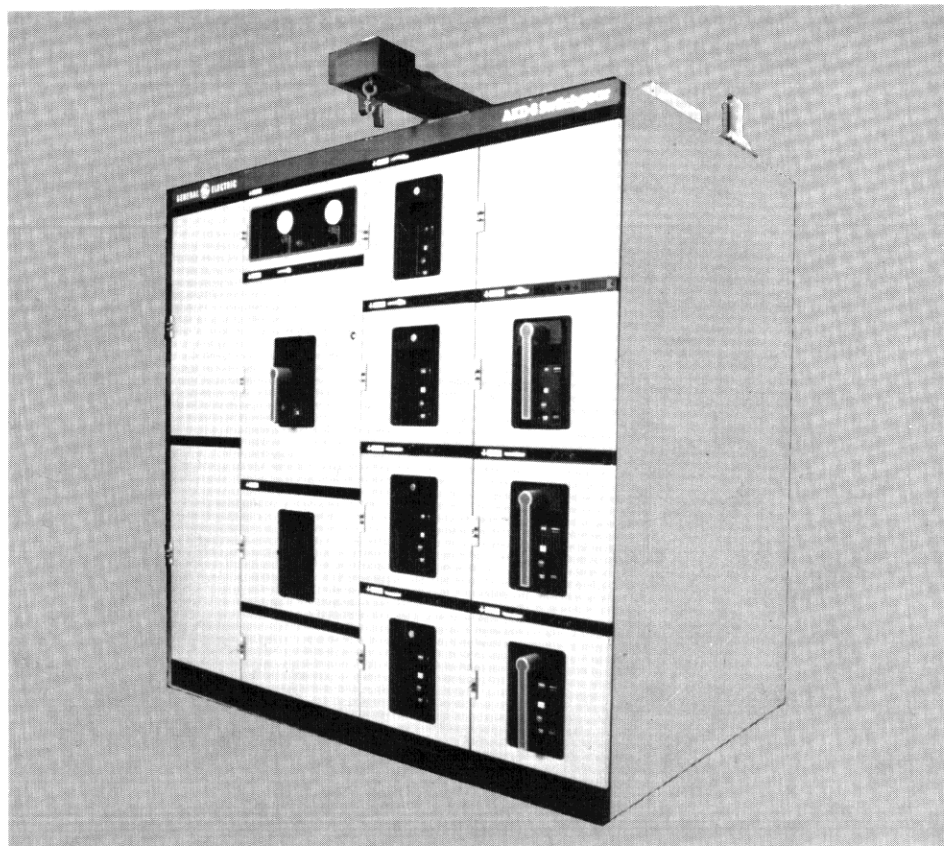


Fig. 1

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*The information contained in this publication is intended to provide only a general summary of application data.*

while the breaker is racked out from the connected, thru test to the disconnected position.

- Breaker compartment doors have no ventilation openings, thus protecting operators from hot ionized gases vented by the breaker during circuit interruption. Additionally the breaker compartment (figure 3) is enclosed in grounded steel bar-

riers to minimize the possibility of fault communication between compartments.

- Primary disconnect shutters (figure 4)—optionally available to provide a protective barrier in front of energized primary disconnects when the breaker is moved to its disconnected position.

- For maximum dependability and short-circuit strength,

vertical buses (figure 5) are nested within a molded, glass-reinforced polyester base providing a rigid support structure and providing solid insulation between adjacent bus bars. Standard bracing is 50,000 RMS symmetrical, with up to 200,000 RMS symmetrical optionally available.

## AKD-8 Specifications Data

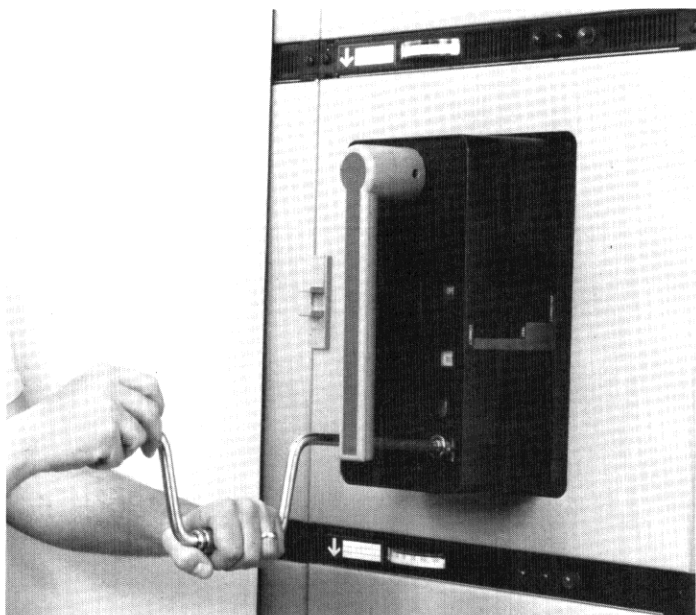


Fig. 2



Fig. 3

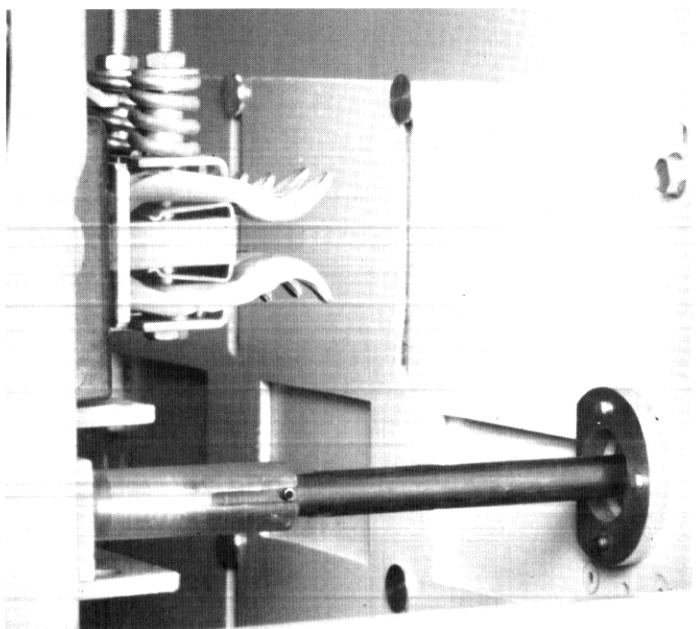


Fig. 4

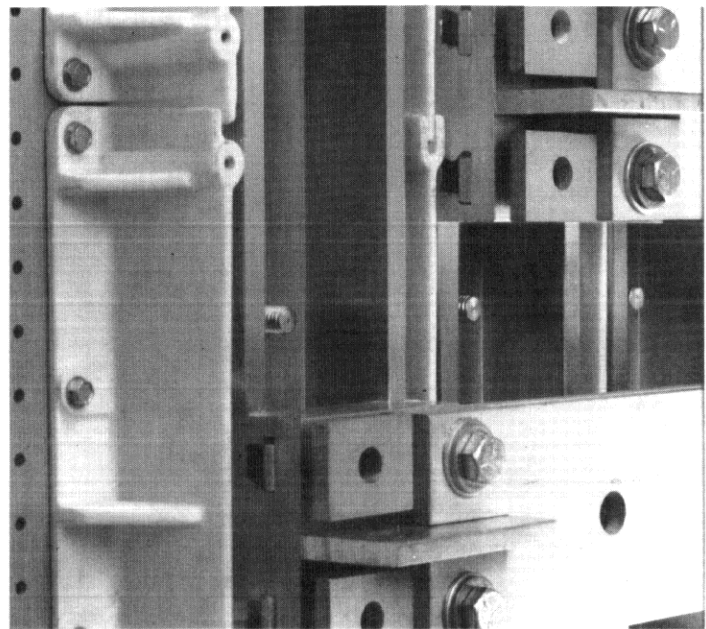


Fig. 5

- An optional completely insulated/isolated bus bar (figure 6) system is available so that the only exposed energized parts in the rear power cable compartment are the outgoing feeder connections.
- Welded aluminum bus is standard with welded main and vertical bus joints throughout. Bolted copper bus is optional. The switchgear bus bar capacity

matches the rating of the main circuit breakers.

- AKD-8 switchgear is designed and manufactured, to meet or exceed ANSI-C37.20 — and NEMA SG-5 switchgear standards. It is also listed by Underwriters' Laboratories, Inc.

#### Ease of Installation and Maintenance

- Conduit entrance area — over 50% more space for outgoing cables than previous designs. This increased space permits easier, faster equipment installation and simplifies routine inspection and maintenance of cable connections.

## AKD-8 Specifications Data

- A standard slide-out instrumentation tray (figure 7) is located above each breaker compartment eliminating cross-hinge wiring. When required, horizontal-edgewise ammeter, ammeter switch and indicating lights can be



Fig. 6



mounted on the front of the tray. Additionally, fuses for close and trip circuits can be mounted inside the tray, being accessible with the tray pulled out. Routine wiring inspections and fuse checks or fuse replacements can be performed with the breaker compartment door remaining closed so that operators are protected from energized primary circuits.

- The design modularity of AKD-8 switchgear provides simplified installation. Switchgear sections are available in two widths—22 and 30 inches, and GE AKR 30/50 low voltage power circuit breakers can be stacked four high all resulting in reduced floor space requirements. The 12 gauge modular designed steel frame results in flexibility in arrangement of

breakers and associated components.

General Electric's new AKD-8 Low-Voltage Switchgear can help you meet today's challenges for greater productivity, increased operator safety and improved equipment reliability and maintainability.

## AKD-8 Specifications Data

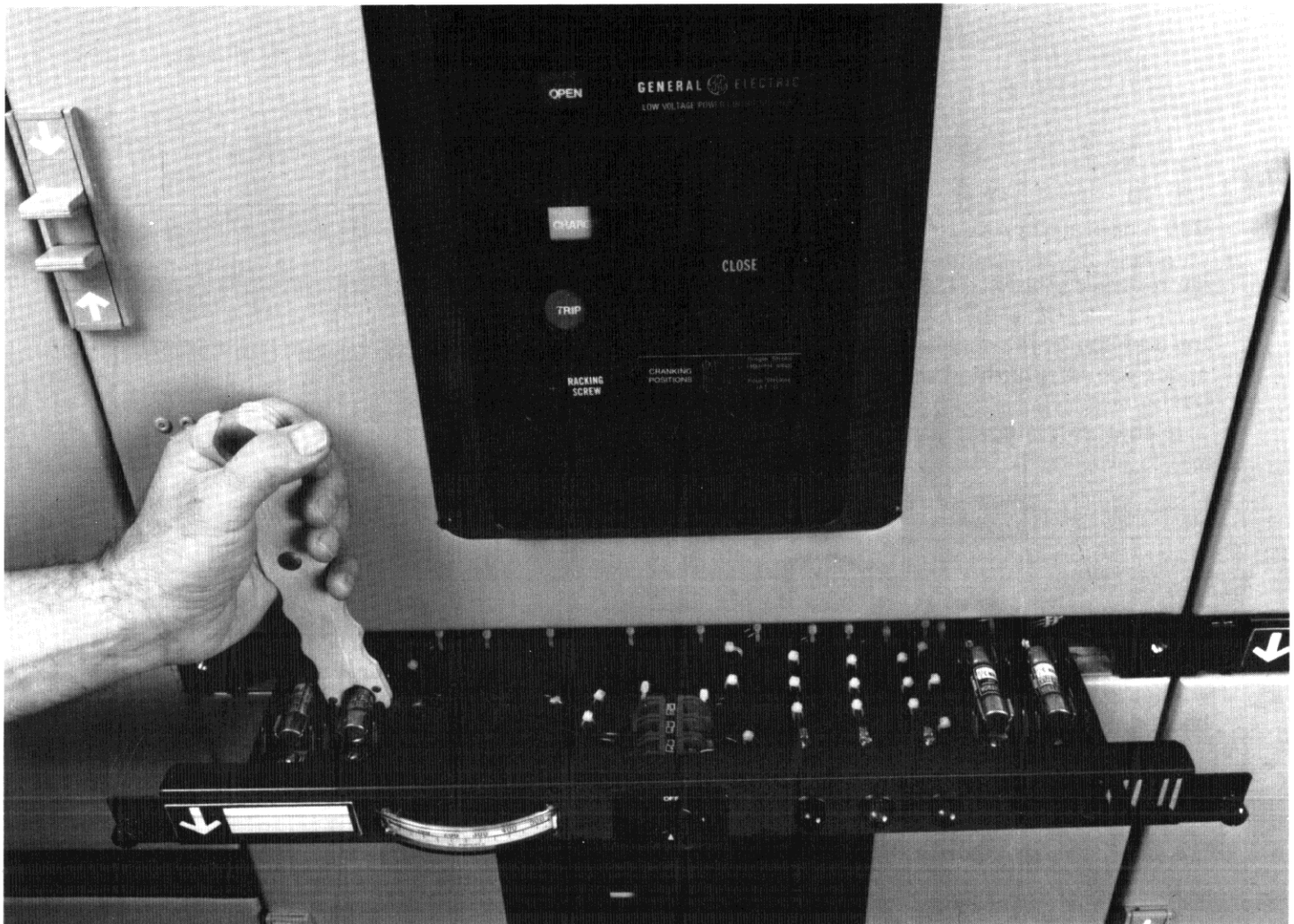


Fig. 7

The time proven, rugged AKR breaker design includes spring-operated, stored-energy mechanisms for manual or electrical operations. The stored-energy mechanism uses a quick-make, quick-break operation to assure positive, high-speed breaker closing independent of the operating force. Positive, controlled closing prevents undesirable arcing be-

tween movable and stationary contacts, resulting in longer contact and breaker life.

AKR breaker elements are rugged switching overload and short-circuit protective devices for main, tie or feeder circuits. They are capable of performing a wide variety of control functions such as motor starting and automatic throwover.

Five AKR breakers now

form the complete family of breakers from 800 to 4000 ampere frame size that are used in AKD-8 Switchgear. They are all built with superior basic breaker features that provide:

- clean, quiet stored-energy interruption
- increased breaker endurance
- simplified maintenance

## **AKD-8 Type AKR Low-Voltage Circuit Breakers with MicroVersaTrip®**

**TABLE 1 — AKR Breakers**

<p><b>AKR-30</b></p> <ul style="list-style-type: none"> <li>• 800-ampere frame size</li> <li>• standard 30,000-ampere interrupting and short-time capability (480 volts)</li> <li>• optional 42,000-ampere extended interrupting and short-time capability (480 volts)</li> <li>• space saving, four-high stacking — 22" wide sections</li> <li>• available with integral fusing</li> </ul>	<p><b>AKR-50</b></p> <ul style="list-style-type: none"> <li>• 1600-ampere frame size</li> <li>• standard 50,000-ampere interrupting and short-time capability (480 volts)</li> <li>• optional 65,000-ampere extended interrupting and short-time capability (480 volts)</li> <li>• space saving, four-high stacking — 22" wide sections</li> <li>• available with integral fusing</li> </ul>
<p><b>AKRT-50H</b></p> <ul style="list-style-type: none"> <li>• 2000-ampere frame size</li> <li>• standard 65,000-ampere interrupting and short-time capability (480 volts)</li> <li>• space saving, four-high stacking — 22" wide sections</li> </ul>	<p><b>AKR-75</b></p> <ul style="list-style-type: none"> <li>• 3200-ampere frame size</li> <li>• standard 65,000-ampere interrupting and short-time capability (480 volts)</li> <li>• three-high stacking — 30" wide sections</li> </ul>
<p><b>AKR-100</b></p> <ul style="list-style-type: none"> <li>• 4000-ampere frame size</li> <li>• standard 85,000-ampere interrupting and short-time capability (480 volts)</li> <li>• three high stacking — 30" wide sections</li> </ul>	<p>All AKR breakers are furnished with:</p> <ul style="list-style-type: none"> <li>• 5-cycle closing</li> <li>• manual or electrical operation</li> <li>• provision for a full line of accessories</li> </ul>

# AKD-8 Type AKR Low-Voltage Circuit Breakers

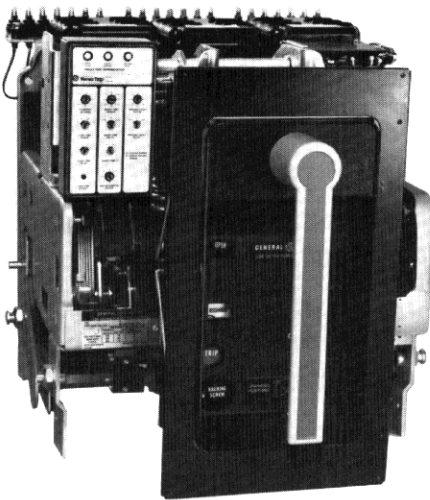


Fig. 8

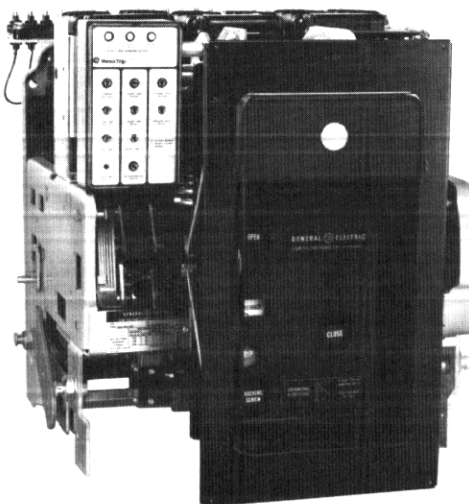


Fig. 9

TABLE 2 — Summary of Breaker Ratings used in AKD-8 Switchgear

AC Voltage Rating 60 Hertz	Breaker Type	Maximum Breaker Frame Rating (Amperes)	30 cycle Short-time Rating in Symmetrical current (Amperes)	Short Circuit Rating Symmetrical current (Amperes)	
				With Instantaneous Trips	Without Instantaneous Trips
600	AKR-30	800	30,000	30,000	30,000
	AKR-30H	800	42,000	42,000	42,000
	AKR-50	1600	42,000	42,000	42,000
	AKR-50H	1600	65,000	65,000	65,000
	AKRT-50H	2000	65,000	65,000	65,000
	AKR-75	3200	65,000	65,000	65,000
	AKR-100	4000	85,000	85,000	85,000
480	AKR-30	800	30,000	30,000	30,000
	AKR-30H	800	42,000	42,000	42,000
	AKR-50	1600	50,000	50,000	50,000
	AKR-50H	1600	65,000	65,000	65,000
	AKRT-50H	2000	65,000	65,000	65,000
	AKR-75	3200	65,000	65,000	65,000
	AKR-100	4000	85,000	85,000	85,000
240	AKR-30	800	30,000	42,000	30,000
	AKR-30H	800	42,000	50,000	42,000
	AKR-50	1600	50,000	65,000	50,000
	AKR-50H	1600	65,000	65,000	65,000
	AKRT-50H	2000	65,000	65,000	65,000
	AKR-75	3200	65,000	85,000	65,000
	AKR-100	4000	85,000	130,000	85,000

TABLE 3 — AKRU Fused Breaker Ratings

AKRU Fused Breaker Type	Frame Size (Amperes)	Maximum AC Voltage	CLF Fuse Ratings Amperes <sup>1</sup>		Interrupting Rating (Amperes) Symmetrical current
			Min.	Max.	
AKRU-30	800	600	300	1600	200,000
AKRU-50	1600	600	450	2500	200,000

NOTE: AKRT-50H, AKR-75 and AKR-100 breakers are not available with integral fusing. Fuses cannot be used in series with all of these breakers, but they must be mounted in a separate switchgear compartment below the breaker compartment. CLF fuse ratings for AKRT-50H are 1000-2500 amperes; for AKR-75 are 2000-3000 amperes, and for AKR-100 are 2000-4000 amperes.

<sup>1</sup> The maximum fuse rating is the largest fuse which tests show will result in proper performance of the breaker and fuse in combination under short circuit conditions. Only GE type CLF fuses should be used for proper coordination.

TABLE 4 — Solid State Trip Devices

Breaker Type	Frame Size (Amperes)	Overcurrent Trip Devices and Ampere Ratings	
		Fixed Sensors	Tapped Sensors
AKR-30	800	100-800 Amperes	100-800 Amperes
AKR-50	1600	300-1600 Amperes	300-1600 Amperes
AKRT-50H	2000	800-2000 Amperes	800-2000 Amperes
AKR-75	3200	1200-3200 Amperes	1200-3200 Amperes
AKR-100	4000	1600-4000 Amperes	1600-4000 Amperes

MicroVersaTrip, with its advanced solid-state circuitry, builds upon our past protection package to result in a miniaturized and standardized state of the art protection programmer.

Expanded functions, allowing increased versatility and coordination are now available in a single, self-contained programmer normally requiring no external relaying, power supply or accessories.

New and unique integral functions, such as a long-time timing light, short-time I<sup>2</sup>t switch, high range instantaneous, and zone selective interlock provide the basis for the most flexible and useful breaker design presently available anywhere.

Gold-plated surfaces on all electrical connectors and adjustments assure long-lasting and positive electrical contact.

Conformal epoxy coatings

are given to each printed circuit card to prevent moisture absorption, fungus growth, and signal leakage. A metallic enclosure protects against hi-fault interruption arcs, magnetic interference, dust, and other contaminants.

Internal circuitry is designed to reduce system down time by analyzing any overcurrent fault and visually identifying its cause as an overload, short circuit, or ground fault. Both local and

## AKR Breakers in AKD-8 Switchgear Use MicroVersaTrip<sup>®</sup> Solid-state Programmers

remote indication is available to aid in testing and identifying the existence of an overcurrent condition.



Fig. 10

### MicroVersaTrip with Fixed or Tapped Sensors for Added Flexibility

STANDARD FUNCTIONS

- Adjustable current setting
- Adjustable long-time pickup
- Adjustable long-time delay
- Long-time timing light (local)
- Adjustable instantaneous pickup
- Remote long-time timing light
- Adjustable short-time pickup and delay

or

- Adjustable short-time pickup and delay with adjustable high range instantaneous
- Short-time I<sup>2</sup>t with in-out switch<sup>1</sup>
- Adjustable ground fault pickup and delay<sup>3</sup>
- Overload and short-circuit fault indication targets for local only or local and remote indication

or

- Overload, short circuit, and ground fault targets for local only or local and remote indication
- Zone selective interlocking for short time only<sup>1</sup> or ground fault<sup>2</sup> only or short time and ground fault

<sup>1</sup> Short time delay if required

<sup>2</sup> Ground fault required

<sup>3</sup> Includes overload, short circuit, and ground fault targets (local)

OPTIONAL FUNCTIONS

TABLE 5—Trip Adjustment Characteristics  
AKR with MicroVersaTrip

Frame Size	Maximum Rating (Amps)	Fixed Sensors	Tapped Sensors	Current Setting (Multiple of Sensor Current Rating)	Long-time		Short-time		Adjustable Instantaneous Pickup (Multiple of Sensor Current Rating)	Short-time I <sup>2</sup> t (Seconds) <sup>1</sup>	Ground Fault	
		Sensor Current Rating (Amps)			Pickup (Multiple of Current Rating)	Delay (Seconds) <sup>1</sup>	Pickup (Multiple of Current Rating)	Delay (Seconds) <sup>2</sup>			Pickup (Multiple of Sensor Current Rating)	Delay (Seconds) <sup>1</sup>
AKR-30 AKR-30H	800	100, 150, 225, 300, 400, 600, 800,	100, 150, 225, 300, or 300, 400, 600, 800,	.5, .6, .7, .8, .85, .9, .95, 1.0	.8, .9, 1.0, 1.1	2.5, 5, 10, 21	1.5, 2, 2.5, 3, 4, 5, 7, 9	0.10, 0.22, 0.36	1.5, 2, 2.5, 3, 4, 6, 8, 10	0.4	.2, .25, .3, .35, .4, .45, .5, .6	0.10, 0.22, 0.36
AKR-50 AKR-50H	1600	300, 400, 600, 800, 1200, 1600,	300, 400, 600, 800, or 600, 800, 1200, 1600,	"	"	"	"	"	"	"	"	"
AKRT-50H	2000	800, 1200, 1600, 2000,	800, 1200, 1600, 2000,	"	"	"	"	"	"	"	"	"
AKR-75	3200	1200, 1600, 2000, 3200,	1200, 1600, 2000, 3200,	"	"	"	"	"	1.5, 2, 2.5, 3, 4, 5, 7, 9	"	.2, .22, .24, .26, .28, .30, .34, .37	"
AKR-100	4000	1600, 2000, 3000, 4000,	1600, 2000, 2000, 3200,	"	"	"	"	"	"	"	.2, .22, .24, .26, .28, .3	"

<sup>1</sup> Time delay shown at 600% of ampere setting at lower limit of each band.

<sup>2</sup> Time delay shown at lower limit of each band.

All pickup tolerances are  $\pm 10\%$

Ground Fault pickup not to exceed 1200 amperes.



## Shunt Trip

Offers remote electrical tripping of breaker. Usually controlled by a switch or pushbutton, it may also be used in conjunction with protective relays for automatic tripping.

The shunt trip coil is rated for intermittent duty. When factory installed it is supplied with a cutoff switch which automatically removes control power following a breaker trip.

## Undervoltage Trip (UV)

Protects against harmful drops in line voltage by automatically tripping the breaker. This device is set to pickup at approximately 85% of bus voltage and drop out between

30% and 60%.

The UV device is also available with an optional static time-delay unit. This offers a field adjustable 2 to 6 second delay between under-voltage fault and breaker trip to prevent potential nuisance tripping due to momentary loss of voltage.

The time-delay unit is mounted external to the breaker. It is rated 125 or 250 VDC or 208/240 VAC, 50 or 60 Hz. For any other AC source voltage, a control power transformer with a 240 volt secondary rated at least 100 VA is required.

## Key Interlock Provision

Prevents operation of a remote function unless the

breaker has been tripped. Provision is made to accept a lock assembly furnished by purchaser (GEE or Kirk).

## Auxiliary Switch

Used for remote indication of breaker main contact position. Available in groupings of four contacts (two stages) or ten contacts (five stages). Each stage is composed of one "a" Type (N.O.) contact and one "b" Type (N.C.) contact. All contacts feature rugged double-break construction.

## Operations Counter

A 5-digit, non-resettable counter actuated by the breaker cam shaft. Mounts on breaker.

# Type AKR Breakers

## Accessories

TABLE 6—Shunt Trip

CONTROL VOLTAGE			Shunt Trip (Amperes)	
Nominal	Operating Range		Inrush	Sustained
Dc	48	28-56	4.5	4.5
	125	70-140	1.9	1.9
	250	140-280	1.0	1.0
60 Hz. Ac	120	104-127	12.3	10.8
	208	175-225	3.2	2.6
	240	208-254	3.9	3.4
	480	416-508	3.4	3.1
	575	475-625	2.8	2.5

TABLE 7—UV Coil

Control Voltage		UV Coil (Amperes)	
		Inrush	Sustained
Dc	48	0.20	0.20
	125	0.07	0.07
	250	0.04	0.04
60 Hz. Ac	120	0.66	0.24
	208	0.51	0.17
	240	0.37	0.12
50 Hz. Ac	480	0.23	0.08
	120	0.75	0.25
	208	0.30	0.10
	240	0.34	0.11
	480	0.20	0.07

TABLE 8—Auxiliary Switch

CB Main Contacts	Auxiliary Switch Position	
	"a" Contact	"b" Contact
Open or Tripped	Open	Closed
Closed	Closed	Open

TABLE 9—Auxiliary Switch Interrupting Ratings

Control Voltage		Auxiliary Switch Interrupting Ratings (Amperes)	
		Non-Inductive	Inductive
Dc	48	25 ①	15 ①
	125	11 ①	6.3 ①
	250	2	1.8
Ac	115	75 ①	50 ①
	240	50 ①	25 ①
	480	25 ①	12 ①

① Limited to 5A continuous rating of #16 wire on drawout breakers.

## Bell Alarm With Lockout

The bell alarm operates one "a" and one "b" contact; or, two "a's" or two "b's". It is activated when the breaker is tripped by any means (automatic) other than the manual trip button or the shunt trip device.

The contacts may be used for remote indication of an automatic trip.

The lockout feature is available to mechanically lock the breaker "open" when the device is activated. "Reset" is accomplished through operation of the manual trip button or shunt trip device.

The bell alarm is available without the lockout feature when so specified.

## Electric Lockout

The electric lockout device provides a means of electrically interlocking breakers so

that two cannot be closed at the same time. This electro-mechanical device consists of a coil whose winding must be energized to close the breaker. Once the breaker is closed, loss of voltage will not trip the breaker. A bypass interlock is provided for initial startup. Refer to the UV device for ratings and coil characteristics.

Auxiliary switches for cross-interlocking breakers must be ordered separately.

## MicroVersaTrip Test Set Cat. No. TVTS1

A portable instrument for field checking the performance of MicroVersaTrip solid-state trip devices.

Verifies the following:

- Pick-up calibrations and time-delay; characteristics of various trip elements;
- Ability of the flux-shift trip device to trip the breaker;

- Target indicator operation;
- Phase sensor continuity.

Required input: 105-125V ac 50/60Hz.

## Remote Close Solenoid for Manually-Operated AKR-30, 50, AKRT-50H Breakers

Provides a means to electrically close the above breakers from a remote location. May be controlled by a switch or pushbutton for five-cycle closing. Breaker must be charged locally. Available ratings:

TABLE 10

Control Voltage		Amperes	
		Inrush	Sustained
Dc	48	2.7	0.58
	125	1.3	0.32
	250	0.68	0.15
60 Hz. Ac	120	2	0.4
	240	1	0.2

## Type AKR Breakers

### Accessories

TABLE 11—Bell Alarm  
Contact Ratings

Control Voltage		Bell Alarm Contact Ratings (amperes)	
		Inrush	Continuous
Dc	48	2.5	10 ①
	125	2.5	2.5
	250	0.9	0.9
60 Hz. Ac	120	30 ①	10 ①
	240	15 ①	5
	480	7 ①	3

① Limited to 5A continuous rating of #16 wire on drawout breakers.

TABLE 12—Closing Mechanism Operating Amperes

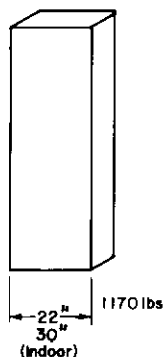
Breaker Frame	120 Volt, 60 Hz (Operating Range 104-127 VAC)			240 Volt, 60 Hz (Operating Range 208-254 VAC)			125 Volt, Dc (Operating Range 100-140 VDC)			250 Volt, Dc (Operating Range 200-280 VDC)		
	Inrush	Sustained	Recommended Fuse Size	Inrush	Sustained	Recommended Fuse Size	Inrush	Sustained	Recommended Fuse Size	Inrush	Sustained	Recommended Fuse Size
AKR-30 AKR-50 AKRT-50	25	5	6	12	3	6	27	5	6	13	3	6
AKR-75 AKR-100	25	8.1	10	12	3.5	10	27	7	10	13	3.2	10

# Typical Dimensions Type AKD-8 Switchgear Sections

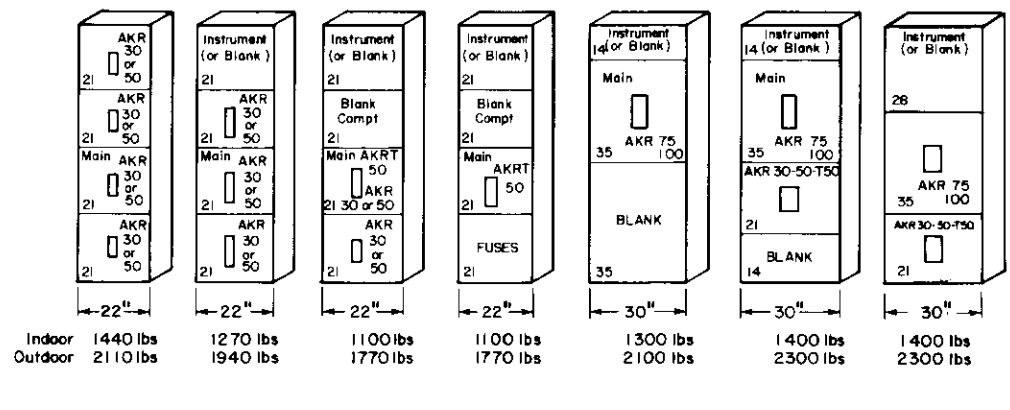
Shortest possible  
shipment assured  
when you select from  
these standard  
arrangements

**Fig. 11 — Auxiliary Section**

1. Transition to transformer
2. Cable or busway entrance unit for free standing switchgear equipment.

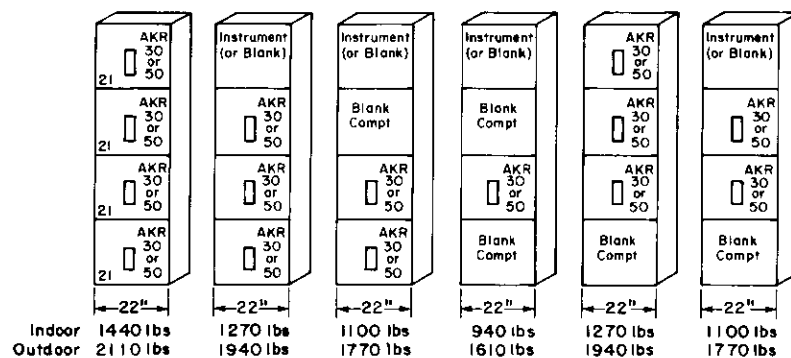


**Fig. 12 — Main Breaker Sections**

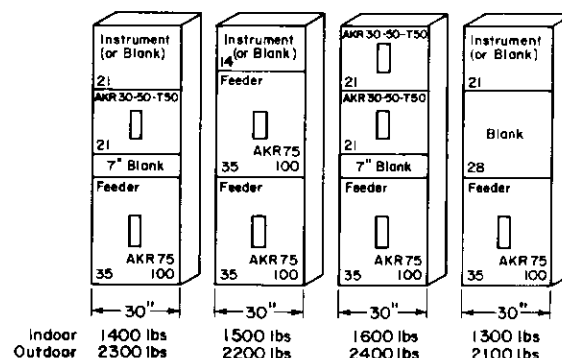


**Fig. 13 — Feeder Breaker Sections (Combinations)**

## FOR AKR-30, AKR-50



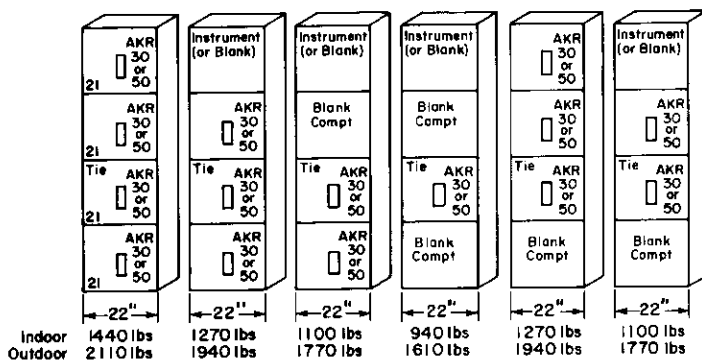
## FOR AKR-30, AKR-50 AKRT-50, AKR-75



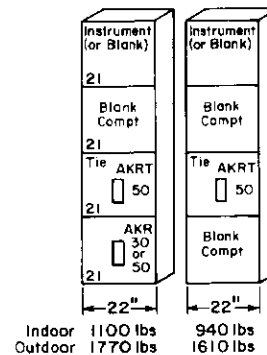
# Typical Dimensions Type AKD-8 Switchgear Sections

Fig. 14—Tie Breaker Sections (Combinations)

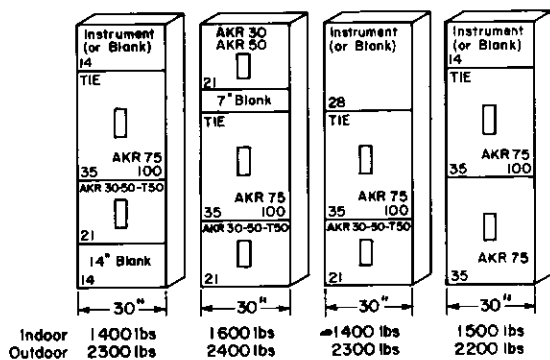
## FOR AKR-30, AKR-50



## FOR AKR-30, AKR-50 AKRT-50



## FOR AKR-30, AKR-50 AKRT-50, AKR-75



## BREAKER WEIGHTS

(Add to switchgear section weight)

	Type	AKR-30	AKR-50	AKRT-50	AKR-75	AKR-100
Operation	Manual	200	210	220	420	495
	Electrical	205	215	225	480	555

## FUSED ROLLOUT WEIGHTS

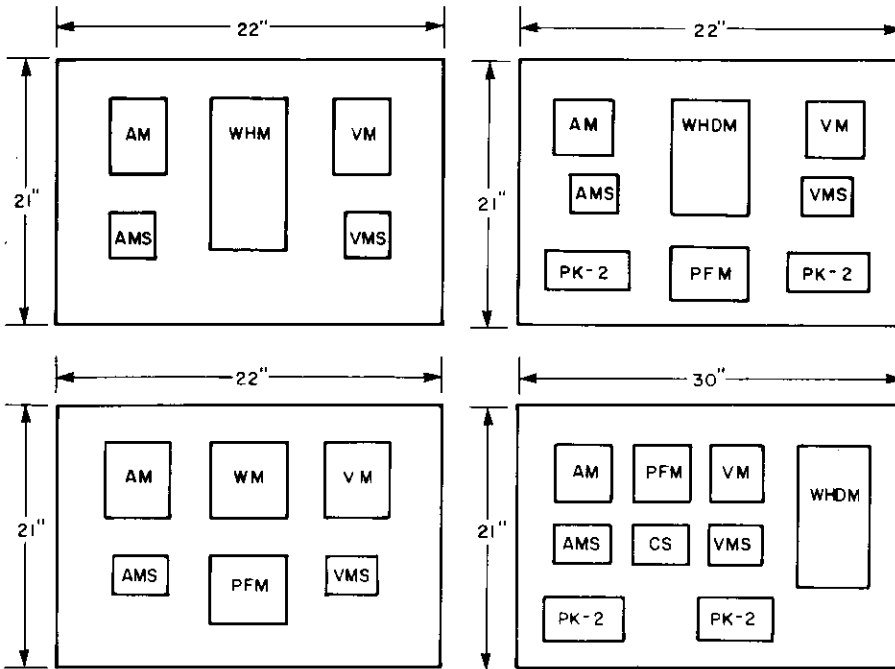
	Type	AKRU-30	AKRU-50	4000A. Fused Rollout For Use With AKR-75 BKR (Bkr. In Separate Comp't)	4000A. Fuse Rollout For Use With AKR-100 BKR (Bkr. In Separate Comp't)	2000A. Fuse Rollout For Use With AKRT-50 BKR (Bkr. In Separate Comp't)
Operation	Manual	245	253	300 ①	400 ①	250 ①
	Electrical	250	260			

① Add breaker weight from table above.

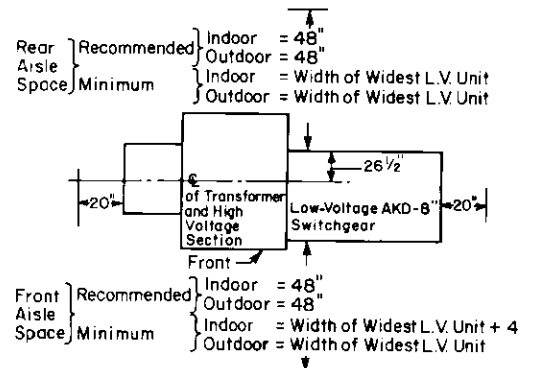


## Typical Dimensions Type AKD-8 Switchgear Sections

**Fig. 15 – Standard Instrument Panel Arrangements**



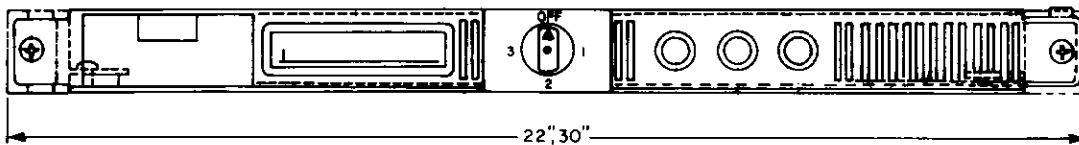
### Typical Floor Plan



**The following devices are most generally used:**

- |                                     |                            |
|-------------------------------------|----------------------------|
| 1 – Ammeter                         | 1 – WHM demand attachment  |
| 1 – Voltmeter                       | 1 – Power factor meter     |
| 1 – Ammeter transfer switch         | 1 – Current test block     |
| 1 – Voltmeter transfer switch       | 1 – Voltage Test block     |
| 1 – Watthour meter (2 or 3 element) | 1 – Breaker control switch |

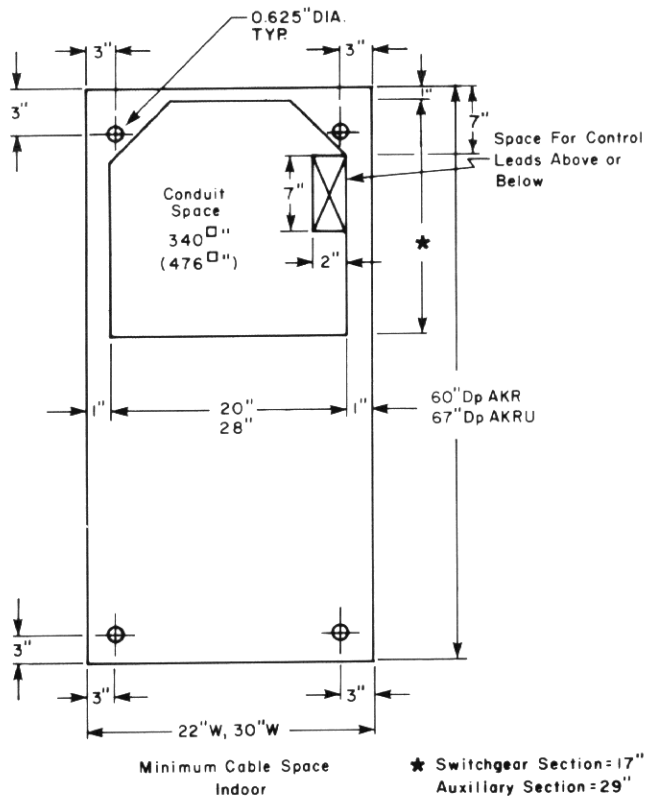
### Fig. 16— Standard Instrument Tray Arrangements



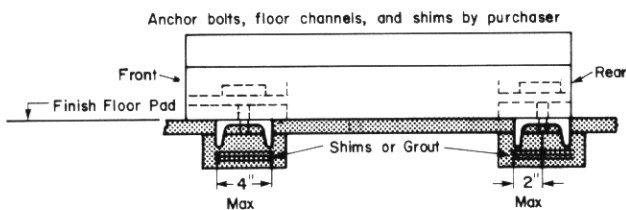
Any instrument tray may be equipped with an ammeter and three-phase transfer switch. Red and green close and trip indication lights are also available. A cardholder is included.

# Typical Dimensions

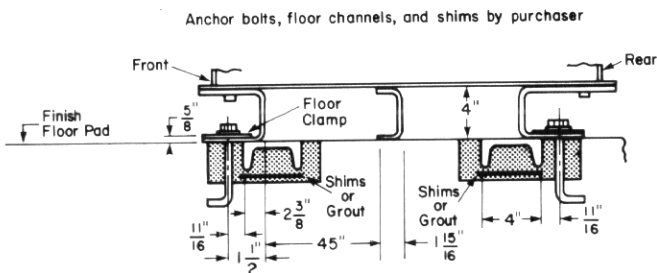
**Fig. 17 — Floor Plan and Cable Space**  
Indoor Sections



**Fig. 18 — Indoor Method of Anchoring**



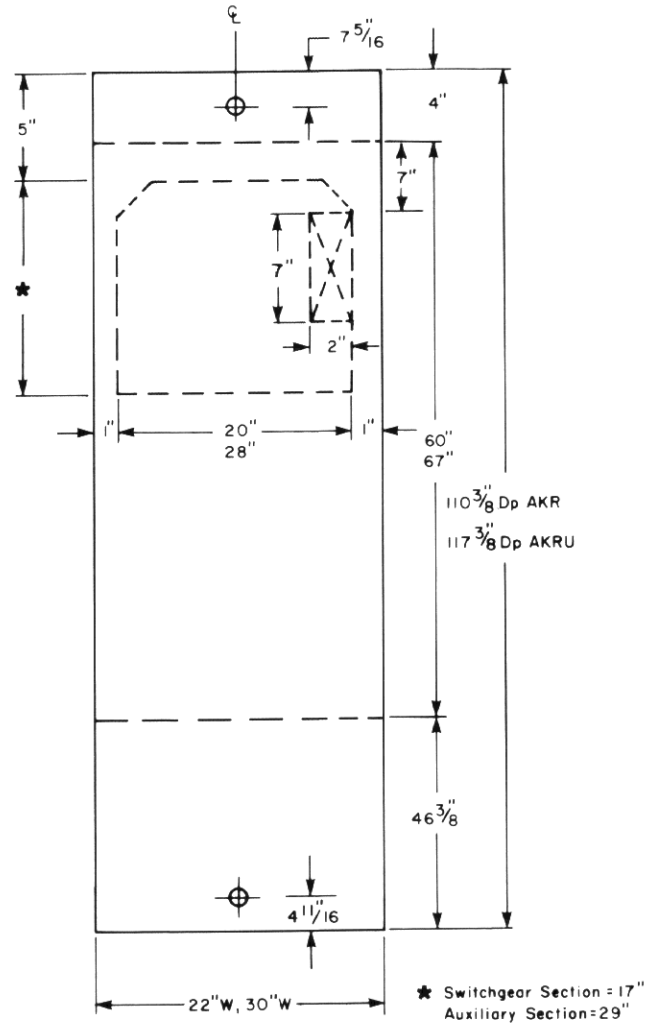
**Fig. 19 — Outdoor Method of Anchoring**



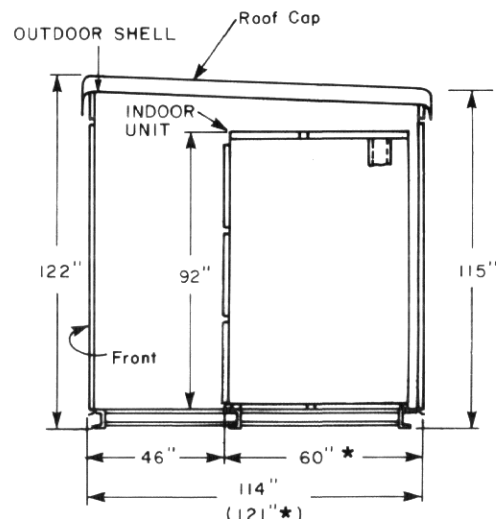
## Foundation Data

Indoor equipment is furnished without channels, and outdoor equipment has a built-in floor frame. Embedded channels should be set level with each other, and should be level over their entire length. Center channel must be supported. 1/4 in. thick formed channels are recommended for leveling purposes. Finished floor should have slight pitch away from mounting channels, and in no case should the finished pad be higher than the mounting channels.

**Fig. 20 — Floor Plan and Cable Space**  
Outdoor Sections



**Fig. 21 — Typical Side View**  
Outdoor Sections



\* 67" = AKRU

Pioneered by General Electric, Load Center Unit substations are the best equipment available to insure dependable power distribution in industrial plants and commercial buildings, and to supply power station auxiliaries and other applications requiring continuity of service.

General Electric offers a complete line of Load Center Unit Substations for indoor or outdoor installations. They consist of an incoming line section a transformer section and a low-voltage switchgear section and are handled as a single packaged unit simplifying engineering coordination and application.

Standard designs free you from unnecessary purchasing and engineering details. Factory assembly reduces installation time and cost.

Mechanical and electrical coordination results in greater reliability. Expert field engineering is available to further assure proper application, installation and operation.

Your investment in GE Load Center Unit Substations featuring AKD-8 switchgear is an investment in dependable electrical power distribution for growth and profit today and tomorrow.

### How to Select Switchgear

The application tables on the following pages list the proper low-voltage power circuit breakers for load center applications. The power circuit breakers have been coordinated with transformer and system capacities—electrically, thermally, and mechanically. For additional details on motor starting and dc machine circuit applications, fused breakers, over-current trip details, etc., refer to ANSI C37. 13-1973, and ANSI C37. 16-1973, for short circuit ratings and analysis procedures.

### Basis for Application Tables

Application tables are based on the following:

1. A three-phase bolted fault at the low-voltage terminals of the substation;
2. Transformer impedances listed in table;
3. Only source of power to the secondary is the substation transformer;
4. Total connected motor kva does not exceed 50 percent of transformer rating at 208Y/120-volts and 100 percent of transformer rating at 240-, 480-, and 600-volts;
5. The motor contribution is taken as 2.0 times the rated current of the transformer at 208Y/120 volts and 4.0 times the rated current at 240, 480 and 600 volts;
6. Tabulated values of short-circuit current are in terms of rms symmetrical current per NEMA Standard SG-3.

These tables should be used only as guidelines, taking into consideration voltage, temperature, power factor, altitude, and other service conditions that may affect application to a particular power system. For instance, under certain circuit arrangements, the total running motor short-circuit current contribution may be greater than that shown in the motor contribution tables. This condition might exist for unit substations having a high ratio of running motor nameplate horsepower to actual demand, such as may occur in heavy machining or stamping press operations found in industrial plants. This condition also could exist when a secondary selective system operates with one main breaker open, and one main and one tie breaker closed so that the feeder breakers can see "twice" the normal motor contribution to a short circuit.

For these types of systems, the use of higher-rated or AKRU fused circuit breakers may be required to stay within the short-circuit rating of the feeder breaker.

Power circuit breakers are available with various com-

binations of long-time delay, short-time delay, and instantaneous trip elements. Care should be taken to specify the combination of trips which will provide the balance of selectivity and protection required by the power system.

A *selectively coordinated* substation uses main and tie breakers with long-time and short-time trip characteristics (LS) to delay the opening of the main circuit breaker until the faulted feeder has had an opportunity to clear. This provides service continuity for all but the faulted circuit and generally allows coordination of main and tie breakers with the various trip characteristics (LS) (LSI) (LI) available on feeder circuit breakers.

Selectivity may be carried a step further in the substation by specifying selective feeder circuit breakers that incorporate long-time, short-time, and high range instantaneous (LSI) to allow downstream devices to clear faults within their area.

A refinement of the selective feeder incorporates the long-time short-time, and instantaneous characteristics (LSI) to provide selectivity without sacrificing instant-

## The Load Center Principle

neous fault protection at high short-circuit currents. This combination of trip characteristics permits application of short-time delay trips to override inrush currents to downstream loads and coordinate with downstream devices for lower fault current values, yet also permits the use of instantaneous trips to provide maximum system protection for high values of fault current. This is called the *Zone-Selective* arrangement and is often desirable when the load-center feeder serves a motor control center or other large load. This system can afford the best feeder protection in many instances.

Long-time and instantaneous trip characteristics (LI) are often used on feeder breakers when short-time delay is not required to coordinate with downstream devices. Depending on the magnitude of fault current and the circuit impedance between breakers, a feeder breaker with LI trips may also be able to coordinate (at least partially) with a similar downstream breaker also having LI trip characteristics. Breakers with LI trips are sometimes referred to as *fully rated* since

### Example for Application Table

The application tables make it easy to select the proper General Electric breakers for use with distribution systems using various trip devices.

For example, a 1500-kVA transformer, with 750-MVA maximum primary short-circuit available and a 480-volt secondary, requires, as minimum, an AKRT-50 H main secondary breaker shown in column 7 of the 480-volt application table. Full utilization of a load center transformer with dual temperature rise (such as 55/65° C) capability or forced (fan) cooling capability would require a larger frame size breaker—or an AKR-75 in this example.

The appropriate feeder circuit breaker is found in columns 8, 9, or 10, depending on the combination of long-time, short-time, and instantaneous trips required by the system design. In this example, the same type breakers (AKR-30H) are required regardless of the type of trip device utilized, although a larger frame breaker may be required in order to meet the continuous load requirement of a particular feeder.

these breakers may have higher interrupting capabilities when provided with instantaneous trips (LI or LSI characteristics). The majority of the breakers manufactured today, however, have the same interrupting rating regardless of the trip characteristic.

Long-time and instantaneous trips (LI) could also be used on main breakers when minimum breaker interrupting time is required for the rare occurrence of a fault on the switchgear main bus or when the system design does not require selective coordination.

## Typical Dimensions Type AKD-8 Switchgear Sections



# Application Table 480 volts, three phase

**TABLE 13**

Transformer Rating 3-phase kVA and Impedance Percent	Maximum Short-circuit Mva Available From Primary System	Full load Continuous Current (amperes)  ①	Short-circuit Rating Symmetrical Current (amperes)			Long-time instantaneous or Long-time Short-time	Long-time Short-time	Long-time Short-time Instantaneous	Long-time Instantaneous
			Trans- former Alone	100% Motor Load	Combined				
						Minimum Rating Breaker			
			Breaker	Breaker	Breaker	Breaker			
1	2	3	4	5	6	7	8	9	10
300 4.5% ②	50	361	7100	1400	8500	AKR-30	AKR-30	AKR-30	AKR-30
	100		7500		8900				
	150		7700		9100				
	250		7800		9200				
	500		7900		9300				
	750		7900		9300				
Unlimited	8000	9400							
500 4.5% ②	50	601	10900	2400	13300	AKR-30	AKR-30	AKR-30	AKR-30
	100		12000		14400				
	150		12400		14800				
	250		12800		15200				
	500		13100		15500				
	750		13200		15600				
Unlimited	13400	15800							
750 5.75%	50	902	12500	3600	16100	AKR-50	AKR-30	AKR-30	AKR-30
	100		13900		17500				
	150		14400		18000				
	250		14900		18500				
	500		15300		18900				
	750		16400		19000				
Unlimited	15700	19300							
1000 5.75%	50	1203	15500	4800	20300	AKR-50	AKR-30	AKR-30	AKR-30
	100		17800		22600				
	150		18800		23600				
	250		19600		24400				
	500		20200		25000				
	750		20500		25300				
Unlimited	20900	25700							
1000 8.0%	50	1203	12100	4800	16900	AKR-50	AKR-30	AKR-30	AKR-30
	100		13400		18200				
	150		14000		18800				
	250		14400		19200				
	500		14700		19500				
	750		14900		19700				
Unlimited	15100	19900							
1500 5.75%	50	1804	20600	7200	27800	AKRT-50	AKR-30	AKR-30	AKR-30
	100		24900		32100		AKR-30H	AKR-30H	AKR-30H
	150		26700		33900				
	250		28400		35600				
	500		29800		37000				
	750		30300		37500				
Unlimited	31400	38600							
2000 5.75%	50	2406	24700	9600	34300	AKR-75	AKR-30H	AKR-30H	AKR-30H
	100		31100		40700		AKR-50	AKR-50	AKR-50
	150		34000		43600				
	250		36700		46300				
	500		39100		48700				
	750		40000		49600				
Unlimited	41900	51500							
2500 5.75%	50	3008	28000	12000	40000	AKR-75	AKR-50H	AKR-50H	AKR-50H
	100		36400		48400		AKR-50	AKR-50	AKR-50
	150		40500		52500				
	250		44500		56500				
	500		48100		60100				
	750		49500		61500				
Unlimited	52300	64300							
3000 5.75%	50	3607	30700	14400	45100	AKR-100	AKR-50	AKR-50	AKR-50
	100		41200		55600		AKR-50H	AKR-50H	AKR-50H
	150		46500		60900				
	250		51900		66300				
	500		56800		71200				
	750		58700		73100				
Unlimited	62700	77100							

## NOTES

① With transformer operating on base temperature rise, without fans. Larger frame size main breaker may be required when dual temperature rise or forced cooled transformers are utilized.

② Minimum impedance.

L = Long-time delay trip (overload tripping).  
S = Short-time delay trip (selective fault tripping).  
I = Instantaneous trip (high fault current fast tripping).  
H = High range instantaneous permits a fully selective system, plus a fully rated system.

# Application Table 240 volts, three phase

**TABLE 14**

Transformer Rating 3-phase kVA and Impedance Percent	Maximum Short-circuit Mva Available From Primary System	Full load Continuous Current (amperes)  ①	Short-circuit Rating Symmetrical current (amperes)			Long-time Instantaneous or Long-time Short-time	Long-time Short-time	Long-time Short-time Instantaneous	Long-time Instantaneous
			Trans- former Alone	100% Motor Load	Combined				
Minimum Rating Breaker						Breaker	Breaker	Breaker	Breaker
1	2	3	4	5	6	7	8	9	10
300 4.5% ②	50	722	14200	2900	17100	AKR-30	AKR-30	AKR-30	AKR-30
	100		15000		17900				
	150		15400		18300				
	250		15600		18500				
	500		15800		18700				
500 4.5% ②	750	1203	15900	4800	18800	AKR-50	AKR-30	AKR-30	AKR-30
	Unlimited		16000		18900				
	50		21900		26700				
	100		24000		28800				
	150		24900		29700				
750 5.75%	250	1804	25600	7200	30400	AKRT-50	AKR-30H	AKR-30	AKR-30
	500		26100		30900				
	750		26300		31100				
	Unlimited		26700		31500				
	50		24900		32100				
1000 5.75%	100	2406	27800	9600	35000	AKR-75	AKR-30H	AKR-30	AKR-30
	150		28900		36100				
	250		29800		37000				
	500		30600		37800				
	750		30800		38000				
1500 5.75%	Unlimited	3609	31400	14400	38600	AKR-100	AKR-30H	AKR-30	AKR-30
	50		31100		40700				
	100		35700		45300				
	150		37500		47100				
	250		39100		48700				
AKR-100	500	3609	40500	14400	50100	AKR-100	AKR-100	AKR-75	AKR-75
	750		41000		50600				
	Unlimited		41900		51500				
	50		41300		55700				
	100		49800		64200				
AKR-100	150	3609	53500	14400	67900	AKR-100	AKR-100	AKR-75	AKR-75
	250		56900		71300				
	500		59700		74100				
	750		60600		75000				
	Unlimited		62800		77200				

## NOTES

① With transformer operating on base temperature rise, without fans. Larger frame size main breaker may be required when dual temperature rise or forced cooled transformers are utilized.

② Minimum impedance.

L = Long-time delay trip (overload tripping).  
S = Short-time delay trip (selective fault tripping).  
I = Instantaneous trip (high fault current fast tripping).  
I<sub>H</sub> = High range instantaneous permits a fully selective system, plus a fully rated system.

# Application Table 208 volts, three phase

TABLE 15

Transformer Rating 3-phase kVA and Impedance Percent	Maximum Short-circuit Mva Available From Primary System	Full load Continuous Current (amperes)  ①	Short-circuit Rating Symmetrical current (amperes)			Long-time Instantaneous or Long-time Short-time	Long-time Short-time	Long-time Short-time Instantaneous	Long-time Instantaneous
			Trans- former Alone	50% Motor Load	Combined				
						Minimum Rating Breaker			
						Breaker	Breaker	Breaker	Breaker
1	2	3	4	5	6	7	8	9	10
300 4.5% ②	50	833	16300	1700	18000	AKR-50	AKR-30	AKR-30	AKR-30
	100		17300		19000				
	150		17700		19400				
	250		18000		19700				
	500		18300		20000				
500 4.5% ②	750	1388	18400	2800	20100	AKR-50	AKR-30H	AKR-30	AKR-30
	Unlimited		18500		20200				
	50		25300		28000				
	100		27800		29600				
	150		28700		31500				
750 5.75%	250	2080	29500	4200	32300	AKR-75	AKR-30H	AKR-30	AKR-30
	500		30200		33000				
	750		30400		33200				
	Unlimited		30800		33600				
	50		28700		32900				
1000 5.75%	100	2780	32000	5600	36200	AKR-75	AKR-30H	AKR-30	AKR-30
	150		33300		37500				
	250		34400		38600				
	500		35200		39400				
	750		35600		39800				
1500 5.75%	Unlimited	4160	36200	8300	40400	No main breaker available	AKR-50H	AKR-50	AKR-50
	50		35800		41400				
	100		41100		46700				
	150		43200		48800				
	250		45100		50700				
	500		46600		52200		AKR-100	AKR-75	AKR-75
	750		47300		52900				
	Unlimited		48200		52800				
	50		47600		53900				
	100		57500		65800				
	150		61700		70000				
	250		65600		73900				
	500		68800		77100				
	750		69900		78200				
	Unlimited		72400		80700				

## NOTES

- ① With transformer operating on base temperature rise, without fans. Larger frame size main breaker may be required when dual temperature rise or forced cooled transformers are utilized.
- ② Minimum impedance.

L = Long-time delay trip (overload tripping).  
 S = Short-time delay trip (selective fault tripping).  
 I = Instantaneous trip (high fault current fast tripping).  
 I<sub>H</sub> = High range instantaneous permits a fully selective system, plus a fully rated system.

# Application Table 600 volts, three phase

**TABLE 16**

Transformer Rating 3-phase kVA and Impedance Percent	Maximum Short-circuit Mva Available From Primary System	Full load Continuous Current (amperes) ①	Short-circuit Rating Symmetrical Current (amperes)			Long-time instantaneous or Long-time Short-time	Long-time Short-time	Long-time Short-time Instantaneous	Long-time Instantaneous
			Trans- former Alone	100% Motor Load	Combined				
Minimum Rating Breaker									
Breaker	Breaker	Breaker	Breaker						
1	2	3	4	5	6	7	8	9	10
300 4.5%	50	289	5700	1200	6900	AKR-30	AKR-30	AKR-30	AKR-30
	100		6000		7200				
	150		6100		7300				
	250		6200		7400				
	500		6300		7500				
500 4.5% ②	750	481	6400	1900	7600	AKR-30	AKR-30	AKR-30	AKR-30
	Unlimited		6400		7600				
	50		8700		10600				
	100		9600		11500				
	150		10000		11900				
750 5 75%	250	722	10200	2900	12100	AKR-30	AKR-30	AKR-30	AKR-30
	500		10500		12400				
	750		10500		12400				
	Unlimited		10700		12600				
	50		9900		12800				
1000 5 75%	100	962	11100	3800	14000	AKR-50	AKR-30	AKR-30	AKR-30
	150		11500		14400				
	250		11900		14800				
	500		12200		15100				
	750		12300		15200				
1500 5 75%	Unlimited	1444	12500	5800	15400	AKR-50	AKR-30	AKR-30	AKR-30
	50		12500		16300				
	100		14300		18100				
	150		15000		18800				
	250		15700		19500				
2000 5 75%	500	1924	16200	7700	20000	AKR-50	AKR-30	AKR-30	AKR-30
	750		16400		20200				
	Unlimited		16800		20600				
	50		16500		22300				
	100		19900		25700				
2500 5 75%	150	2406	21400	9600	27200	AKRT-50	AKR-30H	AKR-30H	AKR-30H
	250		22700		28500				
	500		23800		29600				
	750		24200		30000				
	Unlimited		25100		30900				
3000 5 75%	50	2886	19700	11500	27400	AKR-75	AKR-30H	AKR-30H	AKR-30H
	100		24800		32500				
	150		27200		34900				
	250		29400		37100				
	500		31200		38900				
	750		32000		39700	AKR-75	AKR-30H	AKR-30H	AKR-30H
	Unlimited		33500		41200				
	50		22400		32000				
	100		29200		38800				
	150		32400		42000				
	250		35700		45300	AKR-75	AKR-50H	AKR-50H	AKR-50H
	500		38500		48100				
	750		39600		49200				
	Unlimited		41900		51500				
	50		24600		36100				
	100		33000		44500	AKR-75	AKR-50H	AKR-50H	AKR-50H
	150		37300		48800				
	250		41600		53100				
	500		45500		57000				
	Unlimited		47000		58500				
			50200		61700				

## NOTES

① With transformer operating on base temperature rise, without fans. Larger frame size main breaker may be required when dual temperature rise or forced cooled transformers are utilized.

② Minimum impedance

L = Long-time delay trip (overload tripping).  
S = Short-time delay trip (selective fault tripping).  
I = Instantaneous trip (high fault current fast tripping).  
IH = High range instantaneous permits a fully selective system, plus a fully rated system.



## Air-Filled Terminal Compartment

This is a simple metal enclosure to safeguard personnel when the substation is connected directly to the incoming high-voltage line. It can be supplied with either clamp-type terminals or pot-heads to terminate the incoming-line cables. The low cost of this section makes it ideal when over-current protection is provided elsewhere.

The compartment is suitable for single or loop feed and for either top or bottom cable entrance. A bolted-on end panel gives easy access to the cable fittings.

Potheads can be supplied with special fittings such as wiping sleeves, stuffing boxes, armor clamps, or conduit couplings for any of the common types of cable.

## Air-Interrupter Switches

### Two-position Air-interrupter Switch

This switch consists of a two-position (OPEN/CLOSED), three-pole mechanism. All three poles are operated simultaneously by a removable handle on the front on the switch compartment. A mechanical position indicator is included.

### Air-interrupter Selector Switch

Where there are two separate incoming lines, the interrupter selector switch gives

three positions (LINE 1/OPEN/LINE 2). This gives continuity of service by allowing the operator to switch from one incoming line to the other in case primary feed fails, or to the OPEN position for planned maintenance.

The unit consists of a two-position (OPEN/CLOSED) air-interrupter switch in series with a two-position (LINE 1/LINE 2) selector switch. The selector switch is a dead-break device and is mechanically interlocked so it cannot be operated unless the interrupter switch is open.

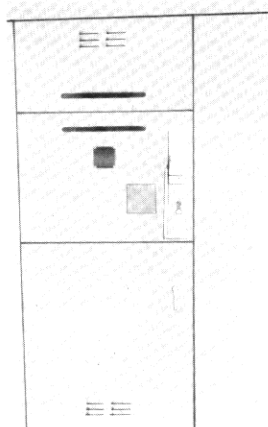


Fig. 22

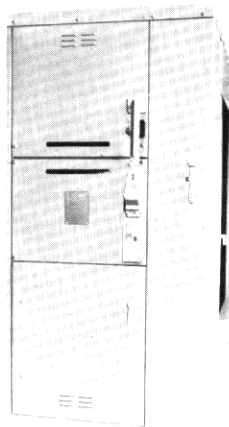
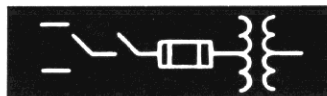


Fig. 23

## AKD-8 Low-Voltage Switchgear

### Load Center Unit Substations Incoming Line Equipment

### Double Air-interrupter Switch

This three-position (LINE 1/OPEN/LINE 2) switch is also used where there are two separate incoming lines, and allows the operator to switch from one line to the other, or to OPEN for planned maintenance.

The double switch has the advantage of isolating the two lines, permitting maintenance of one line while the other line is energized and reducing the probability of fault transfer from one cable to the other. This is accomplished by using two two-position (OPEN/CLOSED) air-interrupter switches, key-interlocked so both incoming line switches cannot be closed at the same time.

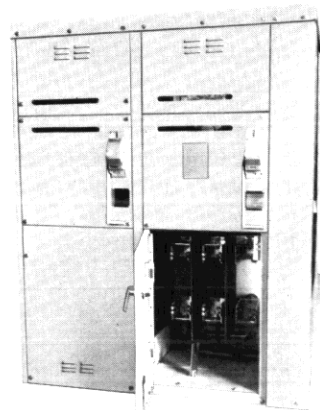
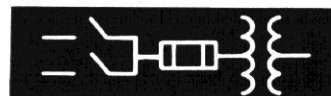


Fig. 24

## VaporTran

The VaporTran transformer is the answer to the need for a truly non-flammable, yet economical transformer.

The VaporTran transformer uses the pool-boiling technique which allows the core and coil to always be totally immersed in dielectric fluid similar to a conventional liquid unit. This compatibility enables the VaporTran transformer to incorporate General Electric's proven core and coil technology.

The insulating fluid is a fully halogenated halocarbon with the chemical name, trichlorotrifluoroethane, familiarly known as R-113. It is currently used industrially in a variety of applications—most notably as a cleaning agent and refrigerant.

R-113 is non-flammable, therefore meeting the fire safety requirements in paragraph 450-23 of the National Electric Code and OSHA Directive 100-54. It is considered superior to the liquids currently offered for non-flammable transformer applications because those liquids all have definite fire and flash points, usually in excess of 300 C.

R-113 is processed to meet General Electric's dielectric specifications after it arrives at the plant in Rome. It has been thoroughly tested and has proven compatibility with standard insulation materials.

## Core-and-Coil Construction Features

All General Electric transformers are built with rectangular windings and core. The rectangular core-and-coil construction reduces the size which results in savings in weight and floor space.

First, the low-voltage coils are wound on a rectangular form which simulates the rectangular core leg and serves as the main support for all the windings. These coils are of sheet winding construction using strip conductors. An

adhesive-coated electrical-grade paper is used as the insulation between each low-voltage turn.

The high-voltage coils are wound, under tension, over the low-voltage coils and are of layer-wound construction using film-insulated wire. Film-insulated wire is used because it is less bulky than paper, has higher dielectric strength on a volts-per-mil basis, and does not tend to split or crack when small radius bends are made. To provide insulation between each layer in the high-voltage windings, an electrical-grade adhesive-coated paper is used.

After completing the winding process the high- and low-voltage coils are clamped to the desired dimensions. They are then oven baked at a temperature which causes the adhesive coating on the paper to bond the adjacent conductors and wires together. The result is a winding structure which has short-circuit strength and high electrical stress withstand capability.

## Liquid-Filled

Liquid-filled transformers are available with two types of dielectric fluid, 10-C® or 10CA™ oil, and silicone-liquid. Both types are enclosed in sealed tanks to keep the internal elements free from dirt, moisture, and corrosive atmospheres.

## Silicone-Filled

The silicone fluid selected for use in General Electric transformers is a clear, water-white liquid silicone polymer (polydimethylsiloxane) that has been specially processed to meet exacting dielectric specifications. To obtain an optimum combination of heat transfer and fire resistant properties, the transformer silicone fluid has a viscosity of 50 centistokes at 25 C. This fluid has a minimum fire point of 300 C and oxygen index of 21.

The silicone fluid that we

are using meets paragraph 450-23 (High Fire Point—Insulated Transformers) of the 1978 National Electric Code. OSHA by its Program Directive 100-68 permits the use of silicone transformers as equivalent to askarel transformers in its enforcement of the National Electric Code.

Transformer silicone fluid has suitable dielectric characteristics, is compatible with other materials used in construction of transformers, and has shown good thermal stability in accelerated aging tests with transformer materials.

## Oil-Filled

The oil-filled unit is the least expensive transformer, and is suitable for mounting outdoors or indoors enclosed in a vault.

The 10-C oil used in General Electric transformers has high dielectric strength, is free from impurities, is durable and has a high flash point. These features make it an excellent insulating liquid. 10-C oil is described in detail in bulletin GEA-4937F.

## AKD-8 Low-Voltage Switchgear

## Load Center Unit Substations Transformers

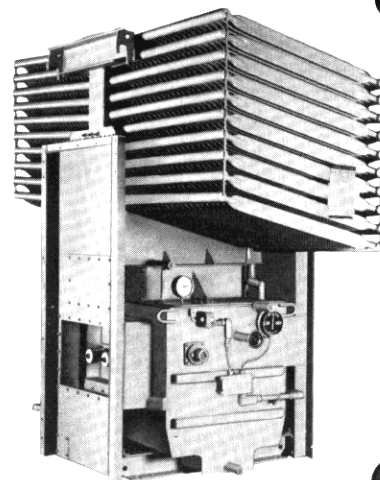


Fig. 25  
Vapor Tran® Transformer

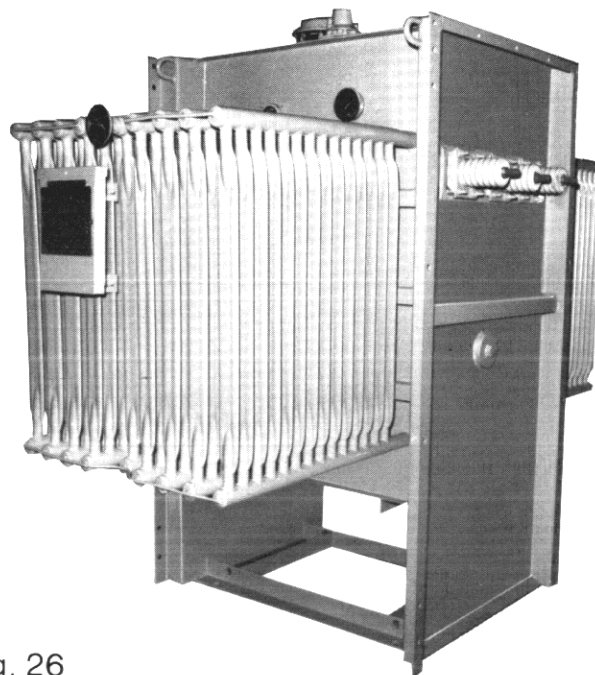


Fig. 26  
Liquid-Filled Transformer

## How to Use

The guide form specifications on these pages may be used to prepare bid specifications for AKD-8 load center unit substations or for free-standing draw out switchgear only. When optional ratings and features are available the choice can be made by crossing out appropriate words in brackets or italics, filling in quantities and ratings, and selecting appropriate paragraphs.

## General

Each [load center unit substation] [low-voltage switchgear equipment] shall be designed, tested, and assembled in accordance with the applicable standards of ANSI and NEMA and shall be complete from the incoming line termination to the out-going feeder terminals. The control side of the switchgear [and the nameplate side of the transformer] shall be the front of the substation.

## General Arrangement

These specifications cover a complete [indoor] [outdoor] [load-center unit substation] [low-voltage switchgear equipment.] The unit shall be arranged as indicated on [drawing] [sketch] number [ ] and shall consist of

Select as Required  
Incoming line section with [ ] primary circuits  
Transforming section with [ ] transformer sections  
Low-voltage section with [ ] switchgear sections

## Incoming Line Section

### • Air Terminal Compartment

1—Air-filled terminal compartment mounted integral

with the transformers with (pothead) (set of clamp-type terminals) for a quantity of . . . (single-conductor) (three-conductor) (lead) (rubber covered) cable(s) . . . size (MCM) (AWG) entering from (below) (above).

3—(Station) (Intermediate) (Distribution) class, . . . kV surge arresters mounted inside terminal compartment.

### • Air-interrupter Switch

1—Two-position: open-close, three-pole, gang-operated, air-interrupter switch with stored-energy operating mechanism rated (5) (15) kV, (600 amps continuous, 40,000 amps asymmetrical momentary) (1200 amps continuous, 60,000 amps asymmetrical momentary), 600 amps load interrupting. (Key interlocking with low-voltage main breaker is required.)

3—Power fuses (GE Type EJ) (S&C Type SM4S) (S&C Type SM5S) are to be mounted in separate compartment within the switch unit accessible through a hinged door mechanically interlocked with interrupter switch. Fuses shall be rated . . . amperes and applied on circuit having short-circuit capacity of . . . kVA (symmetrical) at . . . volts. (Pothead) (Set of clamp-type terminals) for a quantity of . . . (single) (three) conductor lead) (rubber-covered) cable(s) . . . size (MCM) (AWG) entering from (below) (above).

3—(Station) (Intermediate) (Distribution) class, . . . kV surge arresters are to be mounted inside the incoming-line compartment.

### • Air-interrupter Selector Switch

1—Air-interrupter, three-pole, gang-operated, selector switch rated (5) (15) kV, 600 amps continuous and load interrupting rating 40,000 amps

asymmetrical momentary. It will consist of a two-position: open-close air switch with stored-energy mechanism in series with a two-position, line 1—line 2, dead-break switch. The two switches are to be mechanically interlocked so that the open-close interrupter switch must be in the open position before the line 1—line 2, dead-break switch can be operated. (Key interlocking of the interrupter switch with low breakers is required.)

3—Power fuses (GE Type EJ) (S&C Type SM4S) (S&C Type SM5S) are to be mounted in separate compartment within the switch unit accessible through a hinged door mechanically interlocked with interrupter switch. Fuses shall be rated . . . amperes and applied on a circuit having short-circuit capacity of . . . kVA (symmetrical) at . . . volts. (Pothead) (Set of clamp-type terminals) for a quantity of . . . (single-) (three-) conductor (lead) (Rubber covered) cable(s) . . . size (MCM) (AWG) entering from (below) (above).

3—(Station) (Intermediate) (Distribution) class . . . kV surge arresters are to be mounted inside the compartment and are to be connected to the bus between the two switches.

### • Double Air-interrupter Switch

1—Double air-interrupter switch rated (5) (15) kV, (600 amps continuous, 40,000 amps asymmetrical momentary) (1200 amps continuous, 60,000 amps asymmetrical momentary), 600 amperes loading interrupting. The equipment will consist of 2—two-position: open-close, three-pole, gang-operated, air interrupter switches, equipped with stored-energy mechanisms, which are connected to a common load-side

## Guide Form Specifications

bus. The switches will be keyed interlocked so that only one switch can be in the closed position.

3—Power fuses (GE Type EJ) (S&C Type SM4S) (S&C Type SM5S) will be mounted in a separate compartment within the switch unit accessible through a hinged door that is key interlocked so that both switches must be in the open position before the door can be opened. Fuses shall be rated . . . amperes and are to be connected to the load-side switch bus. The incoming circuit has a short-circuit capacity of . . . kVA symmetrical at . . . volts. (Pothead) (set of clamp-type terminals) for a quantity of . . . (single-) (three-) conductor (lead) (rubber-covered) cable(s) . . . size (MCM) (AWG) entering from (below) (above) each switch.

3—(Station) (Intermediate) (Distribution) class . . . kV surge arresters are to be mounted inside the compartment and are to be connected to the common bus between the switches and power fuses.

## VaporTran

The transformer will be insulated with a nonflammable halogenated halocarbon and will be vaporization cooled. Ratings: . . . kVA, three-phase, 60 Hertz, . . . volt delta primary, . . . volt (wye) (delta) secondary.

The high-voltage winding BIL will be (95) (75) (60) (45) kV; the low-voltage winding BIL will be 30 kV. Transformer impedance will be 5.75% (8% is an optional standard at 1000 kVA).

The transformer shall have four approximately 2½% rated kVA taps, two above and two below rated primary voltage. Taps shall be brought to an externally operated manual tap changer for operation only when the transformer is de-energized.

The sound level will be same as those listed in the NEMA Standards for oil-insulated transformers.

(Fans) (provision for the future addition of cooling fans) shall be supplied to provide an additional rating of 150% of the self-cooled rating when operating in a 30 C ambient.

### Standard Accessories

Liquid level gauge (with alarm contacts)  
Pressure-vacuum gage  
Dial-type thermometer  
Pressure relief device  
Pressure switch with contacts  
Tap changer for de-energized operation  
Filling valve  
Drain valve  
Grounding pads  
Lifting lugs for lifting complete unit  
Provision for skidding, rolling, or jacking  
Diagrammatic nameplate

### Optional Accessories

Fans for auxiliary cooling

Overload indicator (with alarm contacts)

## Liquid-Filled Transformers

The transformer section shall be designed and built in accordance with the latest applicable NEMA Standards. It shall be (oil-filled) (silicone-filled), self-cooled (with fans) and rated: OA(/FA)-60- Hertz- . . . kVA (65C) (55/65C)- . . . volts delta primary- . . . volts (wye) (delta) secondary. Impedance, sound level and voltage connections will be in accordance with NEMA Standards.

The transformer shall have four approximately 2½-percent rated kVA taps, two above and two below rated primary voltage. These taps shall be available by means of an externally operated manual tap changer for operation only when transformer is de-energized. Provision for padlocking the tap changer is required.

### Standard Accessories

Diagrammatic nameplate  
Liquid level gauge (with alarm contacts)  
Dial-type thermometer (with alarm contacts)  
Pressure-vacuum gage  
Provision for lifting and jacking  
Base suitable for skidding and rolling in any direction  
Hand hole on cover  
Drain valve and sampling device  
Top filling connection  
Ground pad on low end of tank

### Optional Accessories

Fans for auxiliary cooling mounted on tubes  
Pressure-relief device\*  
Fault-pressure relay  
Winding temperature indicator

## Dry Type

The transformer section shall be designed and built in accordance with the latest applicable NEMA Standards. It shall be ventilated dry type self-cooled (with fans) and rated:

AA (/FA), 60 Hertz, . . . kVA 150C (115C) (80C), . . . volts delta primary, . . . volts (wye) (delta) secondary. Impedance, sound level and voltage connections will be in accordance with NEMA Standards. The transformer shall have four approximately 2½-percent rated kVA taps, two above and two below rated primary voltage. These taps shall be available by means of an internal terminal board located behind a removable plate on the side of the transformer case and are to be changed only when the transformer is de-energized.

### Standard Accessories

Diagrammatic nameplate  
Ventilating louvers  
Removable side sheets  
Vibration-isolating pads  
Provision for lifting  
Provision for jacking  
Base suitable for rolling or skidding  
Ground pad on LV end of enclosure

### Test Requirements

The transformer core and coils shall be designed and built to meet the requirements of "Distribution and Power Transformer Short-circuit Test Code" ANSI C57.12.90a—IEEE 262A-1974. Each bidder shall submit to the engineer for his review and approval a complete listing of all full-size transformers of his manufacture within the rating category covered by these specifications.

## Guide Form Specifications

### Transforming Section

Select one for each primary circuit

Each transformer will receive all standard commercial tests in accordance with ANSI C57.12.90. [In addition, the following special tests will be performed on each transformer in accordance with applicable ANSI Standards—(impulse test on high-voltage winding) (sound level test) (temperature test at the self-cooled rating).]

\*Standard on silicone transformer.



## General

The switchgear shall be rated [ ] volts, 3-phase, [3-wire] [4-wire with 50 percent neutral], [50] [60] Hertz with [aluminum] [copper] main bus rating of [ ] amperes, and braced for [ ] amperes RMS symmetrical.

The low-voltage equipment shall be designed, built, and tested in accordance with ANSI C37.20 and NEMA SG-5 standards and the low-voltage power circuit breaker to ANSI C37.17 and NEMA SG-3. (In addition, the switchgear shall be UL listed and labelled.)

The switchgear shall be arranged for [close coupling to the transformer secondary through a transition compartment] [connection to the supply source by cable] [connection to the supply source by busway].

## Switchgear Sections

Individual vertical sections shall be constructed of bolted steel frames. Each breaker compartment shall be isolated completely from other breaker compartments by grounded steel barriers. For operator safety, breaker compartment doors shall be furnished without ventilation slots and the door shall remain closed when racking the breaker to any of its three positions: disconnected — test — connected.

## Bus bar System

The switchgear bus shall extend to each breaker compartment. The bus system shall be [all-welded aluminum] [bolted copper] with copper to copper connections at the breaker terminals. The bus shall be braced for [ ] amperes RMS symmetrical.

(In addition, the entire bus system shall be phase isolated/insulated to preclude accidental contact with live busbars while working in the outgoing power cable compartment.)

## Low-Voltage Power Circuit Breakers

All circuit breakers shall have stored-energy closing mechanisms, three position closed-door draw out racking mechanism, and a solid-state tripping device, as specified for each breaker.

The breakers shall have self-aligning fingers to engage the line and load primary disconnects. The draw out mechanism shall firmly support the breaker from the fully connected to the fully disconnected positions. Interlocks shall prevent racking the breaker in or out when the breaker contacts are closed. A rejection system shall be provided in each breaker compartment to prevent the insertion of a breaker with inadequate short-circuit rating.

Provisions shall be furnished to padlock the breaker when in the open position to prevent unauthorized closing or racking of the breaker.

Breaker for ac applications will be provided with MicroVersaTrip solid-state trip units. Standard functions will include adjustable current setting, adjustable long-time pick up, adjustable long-time delay, long-time timing light, and adjustable instantaneous.

[For fused breakers add following paragraph:

All fused low-voltage power circuit breakers shall include integrally or separately mounted current limiting fuse units coordinated with over-

current trip devices so as to avoid unnecessary blowing of the fuses. Fused breakers shall include a blown fuse indicator which locks out the circuit breaker until the fuse is replaced and the device reset.]

[For Electrically operated breakers, add the following:

Electrically operated breakers shall have (remote closing) (a close push button on the escutcheon of the breaker).]

## Main Breaker(s)

The quantity, type, and arrangement of the power circuit breakers shall be as follows:

[ ] Main secondary breaker (s) type [AKR- ], [ ] ampere frame size, (manually) (electrically) operated, (fused) (unfused) with MicroVersaTrip solid-state tripping device having (short-time delay) (instantaneous) (high-range instantaneous) elements in the overcurrent trip devices (and integral ground fault protection).

## Tie Breaker (when required)

Tie breaker, type [AKR- ], [ ] ampere frame size, (manually) (electrically) operated, (fused) (unfused) with type MicroVersaTrip solid-state tripping device having (short-time delay) (instantaneous) (high-range instantaneous) elements in the overcurrent trip devices (and integral ground fault protection').

## Tie Breaker Control

Automatic throw-over control equipment with [single-

# Guide Form Specifications

## Low-voltage Switchgear Equipment

phase] [three-phase] under-voltage indication for automatic transfer to the emergency source tie breaker and [manual] [automatic] return to the normal power source.

Control power automatic throw-over equipment to transfer the control bus from one control power source to another when one is de-energized.

### Main Breaker Metering and Control

- ☐ ] Ammeter, indicating type
- ☐ ] Ammeter transfer switch
- ☐ ] Voltmeter, indicating type
- ☐ ] Voltmeter, transfer switch
- ☐ ] Watthour [demand] meter, [2] [2½] [3] element
- ☐ ] Wattmeter, indicating type
- ☐ ] Power factor meter, indicating type
- ☐ ] Current transformers, [     ] ampere
- ☐ ] Potential transformers
- ☐ ] Control power transformer, [     ] kVA
- ☐ ] Current test blocks
- ☐ ] Potential test blocks
- ☐ ] Ground detection lamps with potential transformers
- ☐ ] Solid State Ground Fault Protection
- ☐ ] Monitor Panel

### Feeder Breaker Metering

- ☐ ] Ammeter, indicating type
- ☐ ] Ammeter transfer switch
- ☐ ] Current transformers, [     ] amperes
- ☐ ] Current transformers, [     ] ampere
- ☐ ] Current transformers, [     ] ampere

### Feeder Breakers: (Repeat for each frame size)

- ☐ ] Feeder breaker(s), type [AKR-     ], [     ] ampere frame size, (manually) (electrically) operated, (fused) (unfused) with MicroVersaTrip solid-state tripping device having (short-time delay) (instantaneous) (high-range instantaneous) elements in the over-current trip devices (and integral ground fault protection.)

### Breaker Optional Accessories (specify breakers)

- ☐ ] Shunt trip (standard on electrically operated breaker)
- ☐ ] Instantaneous under voltage device
- ☐ ] Time-delay undervoltage device
- ☐ ] Bell alarm lockout device
- ☐ ] Auxiliary Switch (standard on electrically operated breakers)
- ☐ ] Integral ground fault protection Specify 3W or 4W (includes targets for trip indication).
- ☐ ] Targets for long-time and instantaneous trip indication
- ☐ ] Close-open indicating lights
- ☐ ] Lighted annunciator panel for breaker indication (including close-open)
- ☐ ] Attachment to padlock breaker in test/disconnect positions
- ☐ ] Short-time I<sup>2</sup>t switch—in/out.
- ☐ ] Position Switch (Specify Breakers)

### Equipment Optional Accessories

- ☐ ] Shutters to cover line/load primary disconnects (standard on tie breakers)
- ☐ ] Complete insulated/isolated bus bar system
- ☐ ] Compression lugs
- ☐ ] Breaker lifting device (standard on outdoor equipment)
- ☐ ] Space heaters (standard on outdoor equipment)
- ☐ ] Breaker compartment door interlock for connect/test positions
- ☐ ] Breaker compartment door handle lock
- ☐ ] Kirk-key lock (specify breakers and arrangement)
- ☐ ] Barriers between sections in cable compartment.

## Guide Form Specifications

### Metering

**Busway**

Type DNSP Service Entrance	GEA-10257
Types FVK-FVA 225-1000A.	GEA-6470
Armor Clad * 225-5000A.	GEA-7946
Type CL Current Limiting	GEA-10257

**Panelboards**

Types NLQ/NLAB	GEA-6737
Types NAB/NHB	GEA-6738
Type CCB	GEA-6739
Type QMR	GEA-6740

**Switchboards**

AV-LINE *	GEA-7931
Automatic Throwover Equipment	GEA-10261
AV-Line * Installation Instructions	GEH-2621
Power Break *	GEA-10258
Power Break Installation Instructions	GEH-2638
Power Break Draw out Assembly 3000-4000A.	GEH-2639

**Transformers**

Vapor Tran	GEA-10495
Liquid-Filled	GEA-9878
Ventilated Dry	GEA-10423

**Molded-Case Circuit Breakers**

Application and Selection	GET-2779
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**AKR Power Circuit Breakers**

Application and Selection	GEA-10265
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**High Pressure Contact Switches**

Application and Selection	GET-6205
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**Ground Break\***

Application and Selection	GET-2964
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