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**ELECTRICAL  
SPECIFICATIONS  
GUIDE**

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FOR THE  
NEW YORK  
WORLD'S FAIR  
1964-1965

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GENERAL  ELECTRIC



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FAIR 1964-1965 CORPORATION



GENERAL  ELECTRIC

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**ELECTRICAL  
SPECIFICATIONS  
GUIDE**

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NEW YORK WORLD'S FAIR 1964-1965

Prepared by

**Industrial Power Systems**

**Industrial Sales Operation**

**General Electric Co.**

**Schenectady, New York**

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The following trade-marks of the General Electric Company appear throughout these specifications:

Cabinetrol	Inductrol	Thymotrol
CLF	Limitamp	Versatol
Coronol	Pyranol	Versatol Geoprene
Flamenol	Super Coronol	Vulkene
Geoprene	Thrustor	

# Electric Power for the New York World's Fair

The challenge of designing and specifying the electric equipment and distribution system for your building at the New York World's Fair can be shared. The vision of the Consulting Engineer, Architect-Engineer and Building Owner can be enhanced by the use of effective tools. This brochure has been prepared to assist in the planning and design of the required power systems. The Guide Form Specifications included cover the specific apparatus most frequently needed for the 4160-volt service made available by the New York World's Fair Corporation. Also included are tables for load estimation and typical distribution systems depicting possible applications of electrical apparatus.

## Power System Reliability

Because of the short, two-year life span of the fair, there could be a tendency to design the building electrical power systems to contain only the basic, minimum equipment with little emphasis on efficiency, convenience, and reliability. However, in the interests of the comfort, safety, and good will of the public, power outages which disrupt the operation of the building lighting, air conditioning, or transportation systems can not be tolerated. Therefore, the power system should be designed with a high degree of inherent reliability. This can be accomplished through the use of high-quality, fully-rated, components, good system design, and proper coordination of the power system protective devices.

## Primary Service

The New York World's Fair Corporation will supply three-phase, four-wire, 4160-volt power to the nearest manhole to the exhibit area via underground cables. A normal service and an alternate service circuit will be provided. The available short-circuit duty on the 4160-volt system is 250 mva.

## Metering

Revenue metering will be accomplished in accordance with Section C-6b of "Rules and Regulations for Exhibitors, Concessionaires, and other Participants," published by the New York World's Fair Corporation.

## Load Estimation

It is important that adequate transformer capacity is installed in the exhibit pavilions to accommodate all presently planned electrical loads in addition to those which may be unavoidably required after the electric equipment is purchased. Table I is useful for estimating exhibit building kva requirements based on exhibit area in square feet and estimated load density. It is anticipated that many exhibits will require sufficient transformer capacity to provide a load density of 20 to 25 volt-amperes per square foot.

## Design of the Secondary Power Distribution System

Since most of the electrical loads in the exhibit pavilions will require voltages of 600 volts and less, it will be necessary to provide a voltage transformation. This can be most satisfactorily accomplished by utilizing one or more secondary unit substations with secondary voltages of either 480Y/277 volts or 208Y/120 volts. It is anticipated that the 480Y/277-volt secondary distribution voltage will prove to be the most economical for most installations; however, certain utilization requirements might dictate the use of 208Y/120 volts.

Possible system arrangements for small, medium, and large exhibit areas are shown in Figs. 1, 2 and 3. The radial system (Fig. 1) is suitable for smaller systems up to 1000 kva. Above 1000 kva, the secondary selective arrangement (Fig. 2) with separate 4160-volt services should be considered. This arrangement features added reliability because the load can be carried by one transformer for emergency shutdowns of

the other incoming line or transformer. Larger exhibit areas (above 2000 kva) might best be served by primary 4160-volt power distribution as shown in Fig. 3. Here, the added reliability of the secondary selective unit substation arrangement is maintained.

All of the above system arrangements incorporate the "load-center principle" of power distribution which locates unit substations close to their served loads. Economic studies have shown that systems designed with the load-center approach incorporating 750-kva or 1000-kva substations realize over-all economies. In addition, low-voltage drop, and moderate levels of secondary short-circuit current are realized.

After the unit-substation kva is established, the maximum available short-circuit currents on the secondary of the transformer can be determined from Table II. Low-voltage protective devices and other secondary power distribution equipment must have adequate interrupting capacities and short-circuit capabilities to match this short-circuit duty. Section I of this publication lists the ratings of power system protective devices and equipment.

Guide Form Specifications for power distribution equipment, power utilization equipment and outdoor lighting equipment are included in Sections II and III to aid in the preparation of electric equipment specifications.

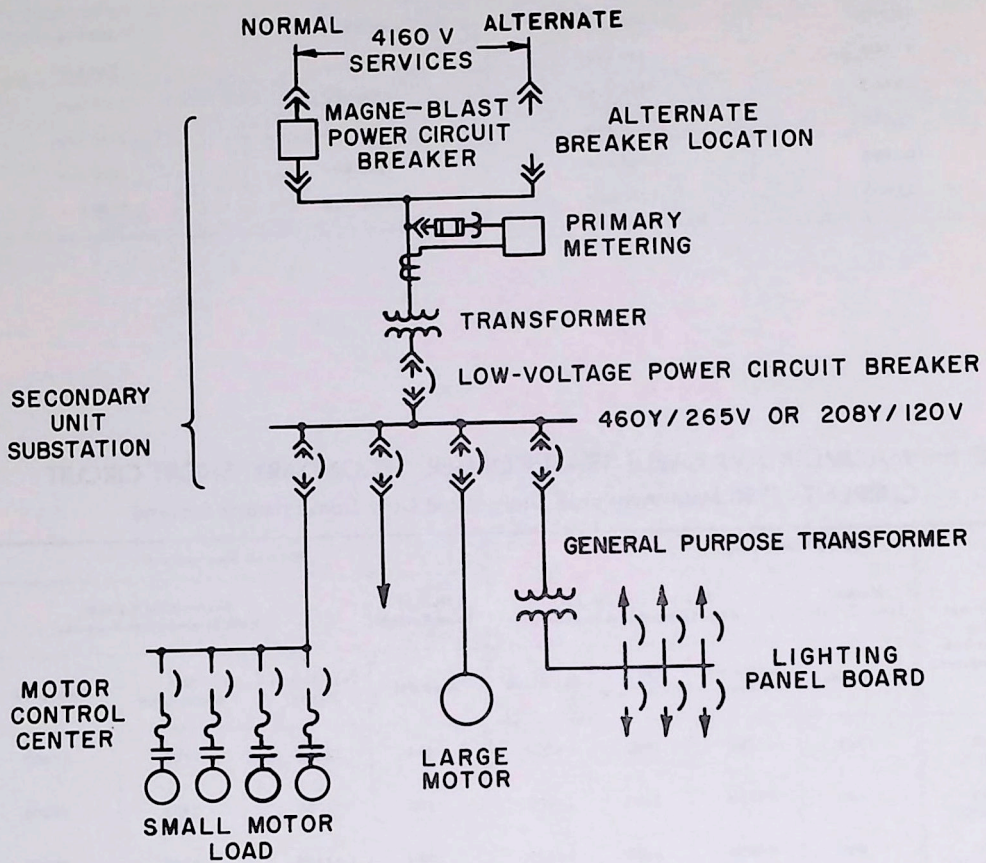
TABLE I

DATA FOR ESTIMATING EXHIBIT BUILDING KVA REQUIREMENTS

Exhibit Building Area Square Feet	Estimated Load Density		
	10 va /FT <sup>2</sup>	20 va /FT <sup>2</sup>	30 va /FT <sup>2</sup>
	Total kva Requirements		
10,000	100 kva	200 kva	300 kva
25,000	250 kva	500 kva	750 kva
50,000	500 kva	1000 kva	1500 kva
75,000	750 kva	1500 kva	2250 kva
100,000	1000 kva	2000 kva	3000 kva
125,000	1250 kva	2500 kva	3750 kva

TABLE II—MAXIMUM AVAILABLE TRANSFORMER SECONDARY SHORT-CIRCUIT CURRENT (250 MVA Available Short-circuit Duty from Primary System)

Transformer Rating 3-Phase kva (% Impedance)	480-volt Secondary				208-volt Secondary			
	Normal Load Current	Short-circuit Current RMS Symmetrical Amperes			Normal Load Current	Short-circuit Current RMS Symmetrical Amperes		
	Amperes	Transformer Alone	100% Motor Load	Combined	Amperes	Transformer Alone	50% Motor Load	Combined
300 (5.0%)	361	7100	1400	8500	834	16200	1700	17900
500 (5.0%)	601	11600	2400	14000	1388	26700	2800	29500
750 (5.75%)	902	14900	3600	18500	2080	34400	4200	38600
1000 (5.75%)	1203	19600	4800	24400	2780	45100	5600	50700
1000 (8%)	1203	14400	4800	19200	.....	.....	.....	.....
1500 (5.75%)	1804	28400	7200	35600	4160	65600	8300	73900
2000 (5.75%)	2406	36700	9600	46300	.....	.....	.....	.....

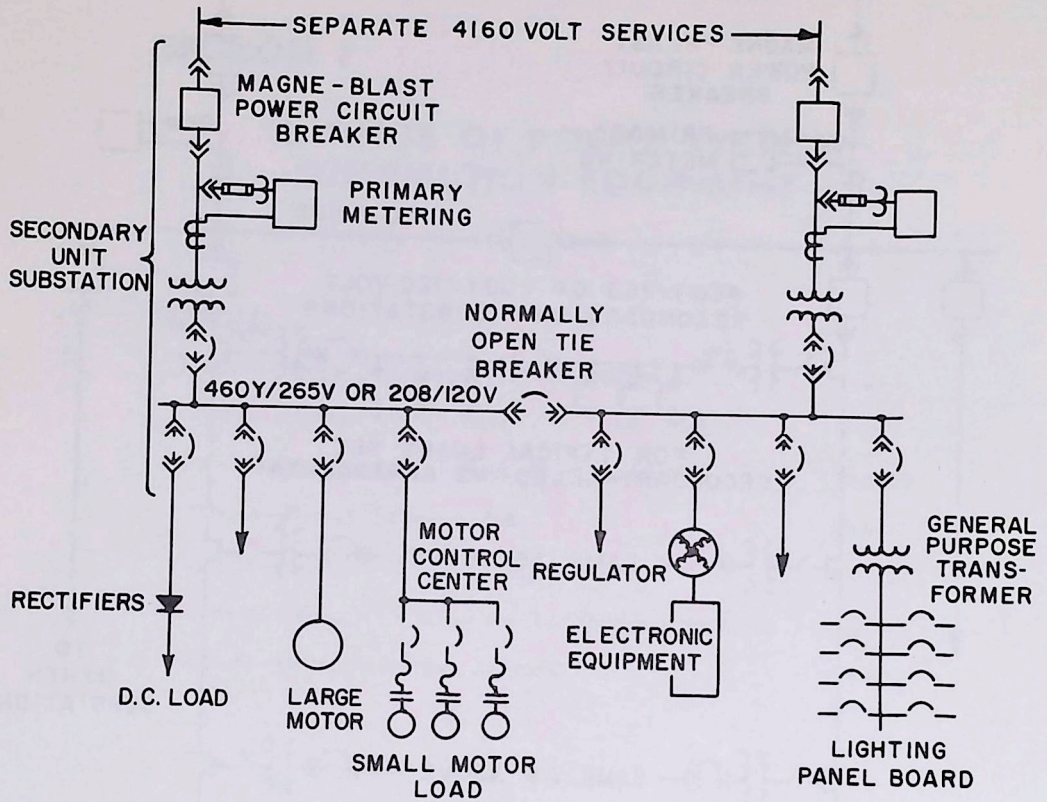


ADVANTAGES OF THE RADIAL SYSTEM

1. LOWEST INITIAL COST
2. EASIEST TO INSTALL
3. SIMPLE TO OPERATE
4. FLEXIBLE AND EXPANDIBLE

RADIAL SYSTEM ARRANGEMENT FOR SMALL SIZE EXHIBITS  
(1000 KVA AND BELOW)

FIG. 1



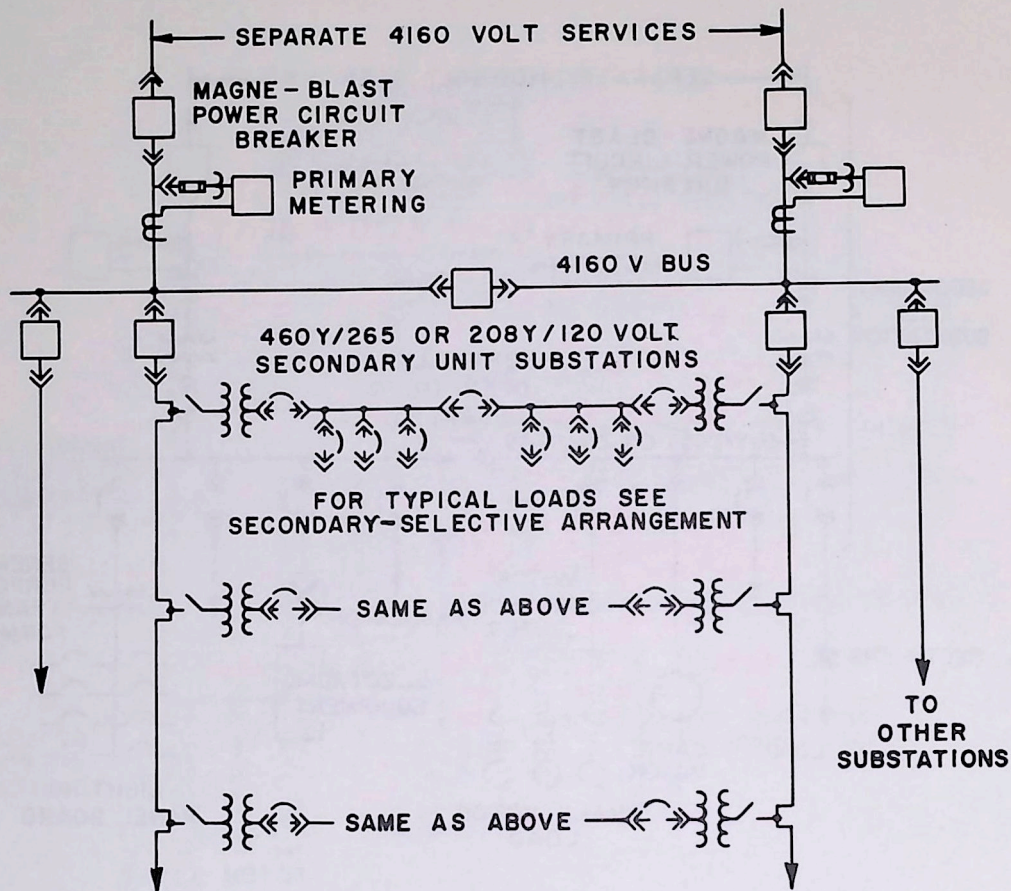
**ADVANTAGES OF THE SECONDARY-SELECTIVE SYSTEM**

1. ADDED RELIABILITY OVER RADIAL SYSTEM
2. INCREASED FLEXIBILITY OF OPERATION
3. RESERVE CAPACITY FOR EMERGENCIES
4. COST ONLY SLIGHTLY GREATER THAN RADIAL SYSTEM

**SECONDARY-SELECTIVE ARRANGEMENT FOR MODERATE SIZE EXHIBITS (UP TO 2000 KVA),**

**FIG. 2**





**ADVANTAGES OF THE PRIMARY DISTRIBUTION ARRANGEMENT**

1. USE OF THE ECONOMICAL LOAD-CENTER SYSTEM OF POWER DISTRIBUTION
2. BETTER VOLTAGE REGULATION
3. MOST FLEXIBLE OPERATION
4. SAFETY AND RELIABILITY

**PRIMARY POWER DISTRIBUTION WITH SECONDARY-SELECTIVE ARRANGEMENT  
FOR LARGE EXHIBITS  
(OVER 2000 KVA)**

**FIG. 3**

## **SECTION I**

### **RATINGS OF POWER SYSTEM DISTRIBUTION EQUIPMENT**

This section contains the ratings of power system distribution equipment.

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**Table A — Ratings of Primary 4160-volt Equipment**

Equipment	Interrupting Rating	Continuous Current
<b>POWER CIRCUIT BREAKER METAL-CLAD SWITCHGEAR</b>		
Type AM-4.16-250	250 mva	1200 or 2000 amp
<b>ROLLOUT SWITCH AND FUSE METAL ENCLOSED SWITCHGEAR</b>		
Type SEF—Fused* Type SEF—Unfused	250 mva .....	15 to 250 amp 600 amp
<b>STATIONARY SWITCH AND FUSE METAL ENCLOSED SWITCHGEAR</b>		
Type SES—Fused Type SES—Unfused	250 mva .....	1 to 450 amp 600 amp
<b>FUSED OIL INTERRUPTER SWITCH</b>		
Type F/O*	155 mva with 200E Fuse 270 mva with 150E Fuse and less	6 to 150 amp

\* Using Type EJ-1 Current-limiting fuses only.

**Table B — Ratings of Low-voltage Power Circuit Breakers**

Circuit Breaker Type (Frame Size)	Voltage Rating		Current Rating—Amperes					Standard Trip Coil Ratings—Amperes
	A-c	D-c	Continuous Range	Interrupting Symmetrical †	Interrupting Asymmetrical and D-c	Short-time Close and Latch Symmetrical	Cascade Interrupting Rating Symmetrical	
AK-2-15	600	250	15- 225	14,000	15,000	9,000	25,000	{ 15, 20, 30, 40, 50 70, 90, 100, 125 150, 175, 200, 225
	480	...	20- 225	22,000	25,000	9,000	42,000	
	240	...	30- 225	25,000	30,000	9,000	50,000	
AK-2-25	600	250	40- 600	22,000	25,000	14,000	42,000	{ 40, 50, 70, 90, 100 125, 150, 175, 200 225, 250, 300, 350 400, 500, 600
	480	...	100- 600	30,000	35,000	14,000	60,000	
	240	...	150- 600	42,000	50,000	14,000	85,000	
AK-2-50	600	250	200-1600	42,000	50,000	42,000	85,000	{ 200, 225, 250, 300 350, 400, 500, 600 800, 1000, 1200, 1600
	480	...	400-1600	50,000	60,000	50,000	85,000	
	240	...	600-1600	65,000	75,000	50,000	100,000	
AK-2-75	600	250	2000-3000	65,000	75,000	65,000	85,000	{ 2000, 2500, 3000
	480	...	2000-3000	65,000	75,000	65,000	85,000	
	240	...	2000-3000	85,000	100,000	65,000	130,000	
AK-2-100	600	250	4000	85,000	100,000	85,000	85,000	{ 4000 ‡
	480	...	4000	85,000	100,000	85,000	85,000	
	240	...	4000	130,000	150,000	85,000	130,000	

† Low-voltage power circuit breakers, co-ordinated with CLF current-limiting fuses, are available in drawout construction. This combination has an interrupting rating of 200,000 amperes symmetrical.

‡ For special applications trip coil ratings available down to 2000 amperes.

Table C—Ratings of Molded-case Circuit Breakers

Type (Frame Size)	Voltage Rating		No. of Poles	Current Rating—Amperes				Standard Trip Coil Rating—Amperes
	A-c	D-c *		Continuous Range	Interrupting Symmetrical	Interrupting Asymmetrical	Interrupting D-c	
TR	120	.....	1	15-20	5,000	5,000	.....	15, 20, 30
	120/240	.....	2	15-30	5,000	5,000		
TQ	120	.....	1	10-50	5,000	5,000	.....	10, 15, 20, 30, 40, 50, 70
	120/240	.....	2	15-70	5,000	5,000		
	240	.....	2, 3	15-70	5,000	5,000		
TQL	120	.....	1	10-50	5,000	5,000	.....	10, 15, 20, 30, 40, 50, 70
	120/240	.....	2	15-100	5,000	5,000		
	240	.....	2	15-70	5,000	5,000		
	240	.....	3	15-70	5,000	5,000		
<b>E100 LINE 15-100 AMPERES</b>								
TE	120/240	125	1	15-100	7,500	7,500	5,000	15, 20, 30, 40, 50, 70, 90, 100
	240	125/250	2, 3	15-100	7,500	7,500		
TEF	600 Δ	250	2, 3	15-100	14,000	15,000	10,000	15, 20, 30, 40, 50, 70, 90, 100
	480	250	2, 3	15-100	14,000	15,000		
	277	125	1	15-50	10,000	10,000		
	240	125	2, 3	15-100	18,000	20,000		
THEF	600 Δ	250	2, 3	15-100	18,000	20,000	10,000	15, 20, 30, 40, 50, 70, 90, 100
	480		2, 3	15-100	25,000	30,000		
	240		2, 3	15-100	65,000	75,000		
<b>F225 LINE 70-225 AMPERES</b>								
TFJ	600	250	2, 3	70-225	14,000	15,000	10,000	70, 90, 100, 125, 150, 175, 200, 225
	480		2, 3	70-225	18,000	20,000		
	240		2, 3	70-225	22,000	25,000		
TFK	600	250	2, 3	70-225	22,000	25,000	10,000	70, 90, 100, 125, 150, 175, 200, 225
	480		2, 3	70-225	22,000	25,000		
	240		2, 3	70-225	25,000	30,000		
THFK	600	250	2, 3	70-225	22,000	25,000	20,000	70, 90, 100, 125, 150, 175, 200, 225
	480		2, 3	70-225	25,000	30,000		
	240		2, 3	70-225	42,000	50,000		
<b>J400 LINE 125-400 AMPERES</b>								
TJJ	600	250	2, 3	125-400	22,000	25,000	10,000	125, 150, 175, 200, 225, 300, 350, 400
	480		2, 3	125-400	22,000	25,000		
	240		2, 3	125-400	35,000	40,000		
TJK	600	250	2, 3	125-400	22,000	25,000	20,000	125, 150, 175, 200, 225, 300, 350, 400
	480		2, 3	125-400	30,000	35,000		
	240		2, 3	125-400	42,000	50,000		
THJK	600	250	2, 3	125-400	25,000	30,000	20,000	125, 150, 175, 200, 225, 300, 350, 400
	480		2, 3	125-400	35,000	40,000		
	240		2, 3	125-400	65,000	75,000		
<b>K1000 LINE 125-1000 AMPERES</b>								
TKM	600	250	2, 3	125-1000	22,000	25,000	20,000†	125, 150, 175, 200, 225, 300, 350, 400, 500, 600, 700, 800, 1000 Δ
	480		2, 3	125-1000	30,000	35,000		
	240		2, 3	125-1000	42,000	50,000		
THKM □	600	250	2, 3	125-1000	25,000	30,000	20,000†	125, 150, 175, 200, 225, 300, 350, 400, 500, 600, 700, 800, 1000 Δ
	480		2, 3	125-1000	35,000	40,000		
	240		2, 3	125-1000	65,000	75,000		

\* Two-pole breakers and single-pole TE and TEF breakers.

† D-c rating for 600-ampere maximum.

Δ NEMA Rated.

□ Contact factory for availability 1000-amp rating.

**Table D—Ratings of Fused Interrupters**

Continuous Current Ratings, Amperes	Interrupting Rating, RMS Symmetrical Amp (with CLF Fuses)	Contact Interrupting Rating, Amperes
<b>TYPE LB-1 POWER PROTECTOR</b>		
600, 800, 1000, 1200, 1600, 2000, 2500, 3000, 3500, 4000	*	200,000
<b>TYPE QMR INTERRUPTER (for use in panelboards, switchboards, motor control centers)</b>		
30, 60, 100, 200, 400, 600**	200,000	Consult Factory
800, 1200	45,000†	

\* Full-load capability in enclosure with fuses.

\*\* Full-load capability in enclosure with fuses is 80 percent of values listed.

† Temporary rating until testing program is completed; consult the factory for latest information.

**Enclosed Switches (Safety Switches)**

Continuous Current Rating	Horsepower Ratings (Max. rating listed by UL; check Handbook Section 7610 for actual ratings)									
	Using CLF or NEC Fuses						Using Time-delay Fuses			
	240 Volts 1-phase	240 Volts 3-phase	480 Volts 3-phase	600 Volts 3-phase	250 Volts d-c	600 Volts d-c	240 Volts 1-phase	240 Volts 3-phase	480 Volts 3-phase	600 Volts 3-phase
30	1 1/2	3	5	7 1/2	5	10	3	7 1/2	15	20
60	3	7 1/2	15	15	10	15	10	15	30	50
100	7 1/2	15	25	30	20	25	15	30	50	50
200	15	25	50	50	40	50	15	50	50	50
400	....	50	....	....	....	....	....	50	....	....

**Interrupting Ratings**

Type TH with CLF\* fuses—200,000 amp symmetrical.  
All others—no a-c interrupting rating.

**Continuous Current Loading in Panelboards**

NEMA (Pub 42-82) states that "The load current ratio to the rating of the thermal device determines its operating temperature, and accordingly, the loads of panelboard circuits should never be more than 70% of the rating of the thermal device whether it be circuit breaker or fuse type."

\* CLF is the General Electric Company trademark for its current-limiting (Class J and L) fuses.

NEC (Art 384-16c) states "The overcurrent protective devices of all panelboards installed in industrial or commercial buildings, where loads continue for long periods of time shall have a rating not less than 125% of the circuit loading, as determined by articles 210 and 220."

**Selection of Fuse Size**

NEC (Tables 430-146, 430-152 and 430-153) govern selection of maximum fuse size. For use with NEMA Design B motors which includes G-E Type K, the code specifies a maximum fuse size of approximately 300 percent of motor-starting current, unless insufficient to handle starting current in which case it may be increased up to 400 percent (NEC 430-52).

**Table E—Ratings of Current-limiting Fuses**

Class J	600 volts and less a-c	200,000 amp interrupting	3 to 600 amp continuous
Class L	600 volts and less a-c	200,000 amp interrupting	800 to 4000 amp continuous

Table F—Ratings of Lighting and Distribution Panelboards

TYPE	DESCRIPTION	SERVICE		MAINS		BRANCHES		
		VOLTAGE	CIRCUIT	LUGS	BREAKER OR SWITCH	BREAKER	NO. POLES	INT. RATING (SYM. AMP)
<b>LOAD-CENTER LIGHTING PANEL <math>\Delta</math></b>								
TRP	Circuit Breaker 2-40 Poles	120/240	3W AC	40, 70, 125, 150, 200	—	TR 15-30 TQL 15-100	1, 2 1, 2	5,000 AC
	Circuit Breaker 12-42 Poles	120/240 208Y/120 240	3W AC 4W AC 3W AC	125, 150, 200	—	TR 15-30 TQL 15-70	1, 2 2, 3	5,000 AC
<b>STYLE Q PANELBOARD <math>\phi</math></b>								
NLAB	Circuit Breaker	120/240 240	3W AC 3W AC	600A	TE-100 TEF-100 TFJ-225 TFK-225 TJJ-400 TJK-400	TQ 15-100	1, 2, 3 (Bolt-in Breaker)	5,000 AC
NLTQ DB		208Y/120	4W AC			TQL 15-100	1, 2, 3 (Plug-in Breaker)	5,000 AC
<b>STYLE NCP PANELBOARDS</b>								
NCP ●	Circuit Breaker	125/250 120/240 240	3W DC 3W AC 3W AC	600A	TE-100 TEF-100 TFJ-225 TFK-225  TJJ-400 TJK-400	TE-50	1	5,000 DC 7,500 AC
		208Y/120	4W AC			TE-100	2, 3	
		460 460Y/265	3W AC 4W AC			TEF-50 TEF-100	1 2, 3	10,000 DC 18,000 AC
<b>STYLE CP PANELBOARD</b>								
CCB* ●	Circuit Breaker	125/250 120/240 208Y/120 460Y/265 230-575	3W DC 3W AC 4W AC 4W AC 3W AC	1200A	TE-100 TEF-100 TFJ-225 TFK-225 TJJ-400 TJK-400 TKM-800 TKM-1000(1)	TE-100 TEF-50	1	18,000 AC
						TE-100 TEF-100 TFJ-225 TFK-225 TJJ-400 TJK-400 TKM-1000	2, 3	42,000 amp AC Max#
QMR*	Interrupter Switch			1200A	QMR 1200	QMR Switch 30-1200	2, 3	100,000 Amp Max $\pi$
MSP	Motor Starter			1200A	CCB or QMR Mains	Magnetic Motor Starters Size 0, 1, 2, and 3		

\* Branch circuits may also include magnetic motor starter unit, sizes 0, 1, 2 and 3.

# TJK, TKM at 240 volts.

$\pi$  Only when CLF fuses are used. 800 A and 1200 A—50,000 amp max.

● Incorporates former NAB, NHB, NCB and NHCB panels.

Type NEP and CCB panelboards available with interrupting ratings up to 65,000 amp symmetrical at 240 volts. Check with factory.

(1) 1000A TKM—No UL listing.

$\Delta$  Manufactured by CPDD.

$\phi$  Manufactured by DAD.

Table G—Ratings of Busway and Cable

Function	BUSWAY							CABLE				
	LTG	DH	DE	FVA FVK	LVDP	LVD	CL	Flamenol	Versatol	Varnished Cambric Interlocked Armor	Super Coronol	Vulkene
<b>Voltage</b>												
0-300 Volts	x											
0-600 Volts		x	x	x	x	x	x	x	x	x	x	x
601-15,000 Volts										x	x	To 5 Kv
<b>Approximate Voltage Drop Per 100 ft. (Full load, 80 percent power factor)</b>												
Distributed Loading	1 $\frac{3}{4}$ -2	2 $\frac{1}{4}$	1 $\frac{1}{2}$ -2	1 $\frac{1}{2}$ -2 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$						
Concentrated Loading		4 $\frac{1}{2}$	4	5	3	3	8-20	2-5	3-7	3-8	4-8	3-5
<b>Current Capacity (amperes 3-conductor in air, 40 C ambient)</b>												
Smallest	50	100	225	225	600	600	1000	18	25	30	28	22
Largest	50	100	1000	1000	5000	5000	4000	420	420	420	470	560
<b>Short-circuit Current Rating</b>												
Momentary— Thousand Amps	5	15	50 $\Delta$	25 $\Delta$	40-200	40-200	100					
Maximum Cable Temperature								150 C	200 C	200 C	200 C	250 C
<b>For Installation</b>												
Indoors	x	x	x	x	x	x	x	x	x	x	x	x
Outdoors						x*	x*	x†	x†	x*†	x†	x
<b>How Used</b>												
Few Tap-offs	x	x	x	x	x	x		x	x	x	x	x
Many Tap-offs	x	x	x	x	x.							

\* Outdoor-weatherproof construction is available as a modification.

$\Delta$  Except 225A

## SECTION II

# GUIDE FORM SPECIFICATIONS FOR POWER SYSTEM DISTRIBUTION EQUIPMENT

This section contains guide form specifications for power system distribution equipment.

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Cable . . . . .	Page 47



# Power Circuit Breaker Metal-clad Switchgear

## GUIDE FORM SPECIFICATIONS

**Cross out one.** These specifications describe (*indoor*) (*outdoor*) metal-clad switchgear as proposed for the control of equipment or circuits arranged for operation on (*a grounded*) (*an ungrounded*) system rated . . . . . volts, three-phase, (*three-*) (*four-*) wire, 60 cycles.

**Supply correct information.**

The one-line diagram and space requirements shall be as indicated on drawing(s) No. . . . . which form a part of these specifications.

### APPLICABLE STANDARDS

The switchgear equipment covered by these specifications shall be designed, tested and assembled in accordance with the applicable standards of A.S.A., A.I.E.E. and N.E.M.A.

### DRAWINGS AND INSTRUCTION BOOKS

The following drawings of the switchgear shall be furnished:

- Front View
- Floor Plan
- Section Views
- Elementary Diagram
- Wiring Diagrams

Suitable instruction books shall be shipped with the switchgear.

### BUS RATING

**Cross out one.** Necessary three-phase insulated buses shall be furnished in the switchgear and **Use 1200 for 75 MVA equipment.** shall have a continuous current rating of (*1200*) (*2000*) amperes throughout the gear. Tapered bus shall not be used in the switchgear equipment.

### SWITCHGEAR INDEX AND ARRANGEMENT

**Cross out one.** The units shall consist of the following and shall be arranged from (*left to right*) (*right to left*) when viewed from the Hinged Panel side of the structure, in the order given:

<b>Omit, add to and arrange as required.</b>	Incoming-line Equipment . . . . .	Item M-
	Auxiliary Equipment . . . . .	Item M-
	Synchronous Motor Equipment . . . . .	Item M-
	Feeder Equipment . . . . .	Item M-
	Feeder Equipment . . . . .	Item M-
	Transformer Equipment . . . . .	Item M-
	Bus Entrance Equipment . . . . .	Item M-
	Bus Sectionalizing Equipment . . . . .	Item M-
	Induction Motor Equipment . . . . .	Item M-

### Basic Unit

The basic metal-clad unit shall consist of one metal-clad unit complete including:

- 1-Hinged front panel.
  - 1-Oilless magne-blast power circuit breaker, three-pole, single-throw, rated 4160 volts, with 250 mva interrupting rating. The circuit breaker shall be electrically operated by (*230-volt a-c rectifier solenoid*) (*125-volt d-c solenoid*) (*250-volt d-c solenoid*) (*230-volt a-c stored energy*) (*48-volt d-c stored energy*) (*125-volt d-c stored energy*) (*230-volt a-c*) potential trip coil.
  - It shall be electrically and mechanically trip free with (*24-volt a-c*) (*48-volt d-c*) (*125-volt d-c*) (*250-volt d-c*) (*230-volt a-c*) potential trip coil.
  - 1-Circuit breaker position-changing mechanism for vertical lift breaker unit.
  - 1-Set of primary disconnecting devices.
  - 1-Set of secondary disconnecting contact devices.
  - 1-Control switch, with indicating lamps No. 1.
- Refer to breaker ratings, Table A**
- Cross out six.**
- Cross out four.**

# Power Circuit Breaker Metal-clad Switchgear

1-Set of three-phase insulated connections, current-carrying capacity equal to that of power circuit breaker.

1-Set of necessary terminal blocks, small wiring, ground bus and control buses.  
1-Set of automatic shutters.

Omit if potheads are used. | 1-Set of solderless clamp-type terminals for terminating cables.

## Auxiliary Sections

Auxiliary sections shall be included, as required.

## Detail Specification

(Note: Numbers are device function numbers)

### 1. Incoming-line Equipment

Fill in number. | Item M-..... Incoming-line metal-clad equipment(s).

Refer to breaker ratings, Table A. | Each power circuit breaker removable element shall be type..... rated  
Fill in type. Cross out two. | (1200) (2000) (3000) amperes..... No. 52

Each equipment shall consist of:

1-Metal-clad basic unit.

1-Ammeter, a-c indicating with three-phase transfer switch.

2-Relays, time overcurrent..... No. 51

1-Relay, time overcurrent, ground..... No. 51N

Supply rating. | 3-Current transformers, single secondary..... /5 amperes

#### Optional equipment

Add if 3 phase and 1 ground relays desired. | 1-Relay, time overcurrent..... No. 51

Use only one. | Cross out one. | (1-Three-conductor) (3-Single-conductor) pothead(s).

Cross out one. | (2-Three-conductor) (6-Single-conductor) pothead(s).

Add one as required. | Use for ungrounded system. | 3-Relays, directional overcurrent time..... No. 67

Use for grounded system. | 2-Relays, directional overcurrent time..... No. 67

1-Relay, directional overcurrent time ground..... No. 67N

1-Set of 3 auxiliary potential transformers connected wye-broken delta, for use with No. 67N (Potential Polarizing).

*Note: Phase relays No. 67 require three-phase line-to-line potential. Ground relay No. 67N requires "broken-delta" potential. For ungrounded system, two potential transformers are required, connected "open delta" (L/L). For grounded system, three potential transformers are required, connected "wye-wye" (L/N). Potential transformers may be connected to either "line" or "bus" side of breaker.*

### 2. Auxiliary Apparatus Equipment

Fill in number. | Item M-..... Auxiliary Apparatus Equipment(s)

#### Optional equipment

Each equipment shall consist of:

Fill in kva value if also required for external load. | 1-Control power transformer (suitable) (....), kva, single-phase with primary current-limiting fuses and transformer secondary circuit breaker with key interlocks..... No. 11

# Power Circuit Breaker Metal-clad Switchgear

**Cross out one and fill in rating.** (2) (3) bus current transformers, single secondary, ...../5 amperes

**Fill in quantity and rating and cross out data that does not apply.** .....Potential transformer(s), type ...../120 volts, for (metering) (relaying) (ground detection) (ground relaying) (Specify others as required) and for (L/L) (L/N) connection.

**Use for outdoor equipment only.** **Cross out one.** 1-Tripping battery (48) (24) volts, sealed-in transparent jar, pasted plate type with suitable accessories.  
1-Static type battery charger, complete with voltmeter, ammeter and charging rheostat.

## 3. Bus Entrance and Auxiliary Apparatus Equipment

**Fill in number.** Item M- ..... Bus entrance and auxiliary equipment(s)

Each equipment shall consist of:  
1-Set of three-phase copper connections for connection of incoming circuit to bus.

**Omit if potheads or bus duct connections are used.** 1-Set of solderless clamp-type terminals for rubber-insulated cables.

**Optional items**

**Cross out one. Fill in rating.** (2) (3) Current transformers, single secondary mounted in bus entrance copper connections ...../5 amperes

**Use for bus duct connection. Cross out two.** Provision for terminating (1200) (2000) (3000) ampere bus duct.

**Use only one.** **Cross out one.** (1-Three-conductor) (3-Single-conductor) pothead(s).  
**Cross out one.** (2-Three-conductor) (6-Single-conductor) pothead(s).

**Fill in quantity and rating, and cross out data that does not apply.** .....Potential transformer(s), ...../120 volts for (metering) (relaying) (ground detection) (ground relaying) (specify others as required) and for (L/L) (L/N) connection.

**Use for outdoor equipt. only.** **Cross out one.** 1-Tripping battery (48) (24) volts, sealed-in transparent jar, pasted-plate type with suitable accessories.  
1-Static type battery charger, complete with voltmeter, ammeter and charging rheostat.

## 4. Bus Sectionalizing Equipment

**Fill in number.** Item M- ..... Bus sectionalizing metal-clad equipment(s).

**Refer to breaker ratings, Table A. Fill in type. Cross out two.** Each power circuit breaker removable element shall be type....., rated (1200) (2000) (3000) amperes. ....No. 24

Each equipment shall consist of:  
1-Metal-clad basic unit.

**Optional equipment**

**Cross out one each. Supply rating.** (2) (3) Current transformers, (single) (double) secondary, ...../5 amperes.

# Power Circuit Breaker Metal-clad Switchgear

## 5. Feeder Equipment

- Fill in number. | Item M-..... Feeder metal-clad equipment(s)
- Refer to breaker ratings, Table A | Each metal-clad power circuit breaker removable element shall be type.....  
 Fill in type. Cross out two. | ....., rated (1200) (2000) (3000) ampere..... No. 52
- Each equipment shall consist of:  
 1-Metal-clad basic unit.  
 1-Ammeter, a-c indicating with three-phase transfer switch.
- Cross out instantaneous if not required. | 2-Relays (*instantaneous and*) time overcurrent..... No. 50/51  
 1-Relay, time overcurrent ground..... No. 51N
- Supply Rating. | 3-Current transformers, single secondary,..... /5 amperes

### Optional equipment

- Add if 3 phase and 1 ground relays desired. | 1-Relay (*instantaneous and*) time overcurrent..... No. 50/51
- Use only one. | Cross out one. | (1-Three-conductor) (3-Single-conductor) pothead(s).  
 Cross out one. | (2-Three-conductor) (6-Single-conductor) pothead(s).

## 6. Transformer Equipment

- Fill in number. | Item M-..... Transformer metal-clad equipment(s).
- Refer to breaker ratings, Table A. Fill in type. | Each power circuit breaker removable element shall be type.....  
 Cross out two. | rated (1200) (2000) (3000) amperes..... No. 52
- Each equipment shall consist of:  
 1-Metal-clad basic unit.  
 1-Ammeter, a-c indicating with three-phase, transfer switch.
- Cross out instantaneous, if not required. | 2-Relays (*instantaneous and*) time overcurrent..... No. 50/51  
 1-Relay, time overcurrent ground..... No. 51N
- Supply rating. | 3-Current transformers, single secondary..... /5 amperes

### Optional equipment

- Add if 3 phase and 1 ground relays desired. | 1-Relay (*instantaneous and*) time overcurrent..... No. 50/51
- Use only one. | Cross out one. | (1-Three-conductor) (3-Single-conductor) pothead(s).  
 Cross out one. | (2-Three-conductor) (6-Single-conductor) pothead(s).

## Metering and Auxiliary Apparatus Compartment

- Fill in number | Item M.....
- Fill in quantity. Cross out one. | ..... (*Incoming Line*) (*Bus*) Metering and Auxiliary Apparatus Equipment(s). Each equipment consisting of:  
 1-Auxiliary compartment of the same height and depth as the rest of the switchgear.

**References:** GEA-5664 Metal-clad Switchgear

# Rollout Switch and Fuse Metal-enclosed Switchgear — For Rating of Equipment Refer to Table A

## GUIDE FORM SPECIFICATIONS

**Cross out data that does not apply. Fill in system ratings.**

**Supply correct information.**

These specifications describe (*indoor*) (*outdoor*) rollout switch and fuse equipment as proposed for the control of equipment or circuits arranged for operation on (*a grounded*) (*an ungrounded*) system rated . . . . . volts, three-phase, three-wire, (*50*) (*60*) cycles, and an available short-circuit capacity of . . . . . MVA. The one-line diagram and space requirements will be indicated on drawing(s) No. . . . . which form a part of these specifications.

### APPLICABLE STANDARDS

The switchgear equipment covered by these specifications will be designed, tested and assembled in accordance with the American Standards on Insulation requirements.

### DRAWINGS AND INSTRUCTION BOOKS

The following drawings of the switchgear will be furnished:

- Front View
- Floor Plan
- Necessary Side Views
- Wiring Diagrams (*when required*)

Suitable instruction books will be shipped with the switchgear.

### BUS RATING

The three-phase buses furnished in this switchgear will be bare bus and will have a continuous current rating of 1200 amperes throughout the gear. Tapered bus will not be used in this switchgear equipment.

### Basic Unit

The basic switch and fuse unit shall consist of one metal-enclosed unit complete, including:

- 1-Front instrument panel.
- 1-Switch and fuse removable element, three-pole, single-throw, manually operated.
- 1-Removable element manual position-changing mechanism.
- 1-Set of primary disconnecting devices.
- Omit for single unit.** 1-Set of three-phase bare buses, rated 1200 amperes.
- 1-Set of three-phase connections, current-carrying capacity at least equal to that of the switch and fuse element.
- 1-Ground bus.
- 1-Set of automatic shutters.
- Omit if potheads are used.** 1-Set of solderless lugs and splitwood block support for rubber-insulated cables.

### WEATHERPROOFING

The switch and fuse equipment will be thoroughly weatherproofed and suitable for outdoor use. Each of the following items shall be located within each compartment:

- Omit for indoor gear.** Weatherproof door on the front with provisions for padlocking.
- Necessary screened protective openings for ventilation.
- Fused combination lighting and convenience receptacle.
- Fused strip heaters.

### Metering and Auxiliary Apparatus Compartment

- Fill in number.** Item M. . . . .
- Fill in quantity. Cross out one.** . . . . . (*Incoming Line*) (*Bus*) Metering and Auxiliary Apparatus Equipment(s). Each equipment consisting of:
  - 1-Auxiliary compartment of the same height and depth as the rest of the switchgear.

# Rollout Switch and Fuse Metal-enclosed Switchgear

## Optional equipment

- Omit transfer switches if not required. | 1-Ammeter, a-c indicating (*with three-phase transfer switch*).  
 | 1-Voltmeter, a-c indicating (*with three-phase transfer switch*).
- Omit demand register if not required. | 1-Watthour meter, switchboard drawout, two-element [*with (15) (30) (60) minute Type M-30 indicating demand register*].
- Cross out two and supply ratio as required. | (1) (2) (3) Current transformers ratio...../5 amperes.  
 | 1-Control power transformer of suitable kva, single-phase pyranol, with primary fuses and transformer secondary circuit breaker with key interlocks.....No. 11
- Cross out one and supply ratio as required. | (1-) (2-) Potential transformer(s) with primary fuses ratio...../120 volts.

## Incoming-line Equipment

- Fill in number. | Item M.....Incoming-line switch and fuse equipment(s).
- Cross out one. | The incoming-line removable element(s) will be supplied (*without fuses*) (*with fuses rated.....*).
- Each equipment will consist of:  
 1-Switch and fuse basic unit.

## Optional equipment

- Use only one. | Cross out one. | (1-Three-conductor) (3-Single-conductor) 5 kv pothead(s).  
 | Cross out one. | (2-Three-conductor) (6-Single-conductor) 5 kv pothead(s).
- Cross out one and supply ratio as required. | (2) (3) Current transformers, single secondary, with...../5 ratio.
- Omit transfer switch if not required. | 1-Ammeter, a-c indicating (*with three-phase transfer switch*).

## Feeder Equipment

- Fill in number. | Item M.....Feeder switch and fuse equipment(s).
- Fill in rating. | The feeder switch and fuse removable element(s) will be supplied with fuses rated.....
- Each equipment will consist of:  
 1-Switch and fuse basic unit.
- Optional equipment
- Use only one. | Cross out one. | (1-Three-conductor) (3-Single-conductor), 5 kv pothead(s).  
 | Cross out one. | (2-Three-conductor) (6-Single-conductor), 5 kv pothead(s).
- (2) (3) Current transformers, single secondary with...../5 ratio.
- Omit transfer switch if not required. | 1-Ammeter, a-c indicating (*with three-phase transfer switch*).

## Bus Sectionalizing Equipment

- Fill in number. | Item M.....Bus sectionalizing switch equipment(s).
- The bus-tie removable element(s) will be rated 600 amperes and furnished without fuses.
- Each equipment will consist of:  
 1-Switch, basic unit, without fuses.

**References:** GEA-6623 Rollout Switch and Fuse Equipment

# Stationary Switch and Fuse Metal-enclosed Switchgear — For Rating of Equipment Refer to Table A

## GUIDE FORM SPECIFICATIONS

**Cross out data that does not apply. Fill in system ratings.** These specifications describe (*indoor*) (*outdoor*) stationary switch and fuse equipment as proposed for the control of equipment or circuits arranged for operation on (*a grounded*) (*an ungrounded*) system rated ..... volts, three-phase, three-wire, 60 cycles, and an available short-circuit capacity of ..... mva. The one-line diagram and space requirements will be indicated on drawing(s) No. .... which form a part of these specifications.

**Supply correct information.**

### APPLICABLE STANDARDS

The switchgear equipment covered by these specifications will be designed, tested and assembled in accordance with the American Standards on Insulation requirements.

### DRAWINGS AND INSTRUCTION BOOKS

The following drawings of the switchgear will be furnished:

- Front View
- Floor Plan
- Necessary Side Views
- Wiring Diagrams (*when required*)

Suitable instruction books will be shipped with the switchgear.

### Basic Unit

The basic switch and fuse unit shall consist of one metal-enclosed unit complete including:

- 1-Switch and fuse element, three-pole, single-throw, manually operated.

**Omit for single unit.** 1-Set of three-phase bare buses, rated 1200 amperes.  
1-Set of three-phase connections, current-carrying capacity at least equal to that of the switch and fuse element.  
1-Ground bus.

**Omit if potheads are used.** 1-Set of solderless lugs and splitwood block support for rubber-insulated cables.

### WEATHERPROOFING

The switch and fuse equipment will be thoroughly weatherproofed and suitable for outdoor use. Each of the following items shall be located within each compartment:

- Omit for indoor gear.**
- Weatherproof door on the front with provisions for padlocking.
  - Necessary screened protective openings for ventilation.
  - Fused strip heaters.

### Metering and Auxiliary Apparatus Compartment

**Fill in number.** Item M. ....  
**Fill in quantity. Cross out one.** ..... (*Incoming Line*) (*Bus*) Metering and Auxiliary Apparatus Equipment(s). Each equipment consisting of:  
1-Auxiliary compartment of the same height and depth as the rest of the switchgear.  
1-Bare bus, 3-phase, 3-wire, 1200 amp when required  
1-Set of clamp type terminals  
X-Space for control power transformer or instrument potential transformers

# Stationary Switch and Fuse Metal-enclosed Switchgear

## Optional equipment

- Omit transfer switches if not required. | 1-Ammeter, a-c indicating (*with three-phase transfer switch*).  
 | 1-Voltmeter, a-c indicating (*with three-phase transfer switch*).
- Omit demand register if not required. | 1-Watthour meter, switchboard drawout, two-element [*with (15) (30) (60) minute Type M-30 indicating demand register*].
- Cross out two and supply ratio as required. | (1) (2) (3) Current transformers ratio ...../5 amperes.  
 | 1-Control power transformer of suitable kva, single-phase pyranol, with primary fuses and transformer secondary circuit breaker with key interlocks. ....No. 11
- Cross out one and supply ratio as required. | (1-) (2-) Potential transformer(s) with primary fuses ratio ...../120 volts.

## Incoming-line Equipment

- Fill in number. | Item M-.....Incoming-line switch and fuse equipment(s).
- Cross out one. | The incoming-line removable element(s) will be supplied (*without fuses*) (*with fuses rated* .....).
- Each equipment will consist of:  
 1-Switch and fuse basic unit.

## Optional equipment

- Use only one. | Cross out one. | (1-Three-conductor) (3-Single-conductor) (5 kv pothead(s)).  
 | Cross out one. | (2-Three-conductor) (6-Single-conductor) (5 kv pothead(s)).
- Cross out one and supply ratio as required. | (2) (3) Current transformers, single secondary, with ...../5 ratio.
- Omit transfer switch if not required. | 1-Ammeter, a-c indicating (*with three-phase transfer switch*).

## Feeder Equipment

- Fill in number. | Item M-.....Feeder switch and fuse equipment(s).
- Fill in rating. | The feeder switch and fuse element(s) will be supplied with fuses rated.....
- Each equipment will consist of:  
 1-Switch and fuse basic unit.

## Optional equipment

- Use only one. | Cross out one. | (1-Three-conductor) (3-Single-conductor), (5 kv pothead(s)).  
 | Cross out one. | (2-Three-conductor) (6-Single-conductor), (5 kv pothead(s)).
- Cross out one and supply ratio as required. | (2) (3) Current transformers, single secondary with ...../5 ratio.  
 | 1-Ammeter, a-c indicating (*with three-phase transfer switch*).

**References:** GEA-7186 New Housed Switch and Fuse Equipment



## Fused Oil Interrupter Switch — For Rating of Equipment Refer to Table A

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One fused oil interrupter switch ..... amperes, 3-pole, 4160-volt, stationary mounted for (*indoor*) (*outdoor*) application.  
Does not include power fuses. Type E-J-1 fuses must be ordered separately.

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**References:** GEC-1727 Fused Oil Switch Buyers Guide  
GEA-7191 Vented and Sealed Oil Cutouts

# Secondary Unit Substations

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## General

Unit-substations provide a convenient, compact, economical means of stepping down primary system voltages (2400 to 13,800 volts) to secondary voltages of less than 600 volts and also incorporate control and protection of the low-voltage feeder circuits. The unit substation consists of three components; an incoming line section, a transforming section, and a low-voltage switchgear section.

## Incoming-line Section

Several types of incoming line sections are available for the primary voltage side of the secondary unit substation.

## Transforming Section

There are three types of transformers available for the transforming section; liquid-filled (oil-filled for outdoor installation, Pyranol filled for indoor installation), open dry-type for indoor installation, and sealed dry-type for indoor or outdoor installation.

## Low-voltage Switchgear Section

Two types of low-voltage switchgear sections are available: Drawout Switchgear type and Stationary Switchboard type. The Drawout Switchgear type contains drawout low-voltage power circuit breakers and provides maximum safety and ease of maintenance. Low-voltage power circuit breakers have adjustable tripping characteristics which can be co-ordinated to provide maximum system selectivity and service reliability. In addition, low-voltage power circuit breakers can be used for motor starting applications where motors are started infrequently.

The Stationary Switchboard type can accommodate many low-voltage protective devices including low-voltage power circuit breakers, molded-case circuit breakers, and fused interrupter switches which are stationary mounted in the switchboard.

Both of these low-voltage sections are available as separate free-standing equipments without the transforming or primary incoming line section.

## GUIDE FORM SPECIFICATIONS

..... KVA (INDOOR) (OUTDOOR) SECONDARY UNIT SUBSTATION(S)

### General Arrangements

Each secondary unit substation covered by these specifications will be designed, tested and assembled in accordance with applicable standards of NEMA, AIEE and ASA, and will be complete from the incoming line termination to the outgoing feeder terminals. The control side of the switchgear and the nameplate side of the transformer will be the front of the substation.

Refer to Sketch ..... for arrangement.

### Rating

The rating(s) of the substation(s) shall be:

Self-cooled rating .....kva  
Frequency ..... 60 Cycles  
Number of phases ..... three  
Incoming 3-wire circuits .....volts  
Outgoing (3-wire) (4-wire) circuits .....volts

The unit substation shall consist of the following components:

### Sections

Each substation will consist of the following sections which are designed for connection in the field:

- Incoming-line Section(s)
- Transforming Section(s)
- Low Voltage Switchgear Section

## Secondary Unit Substations — Incoming Line Section

---

### .....Incoming-line Section(s)

Each incoming-line section shall be designed in accordance with industry standards and shall include one of the following items:

For incoming-line section consisting of power circuit breaker metal-clad switchgear, see guide form specifications in Section II.

Include:

1—Transition compartment for connection to transformer.

Air interrupter switch(es), with stored-energy operating mechanism, (2-position, open-close) (and line selector switch, 3-position, close-open-close) (5 kv), 600 amperes continuous and interrupting rating (key interlocked with low voltage breakers).

—Set of three power fuses.

—Necessary (potheads) (clamp-type terminals) for (loop) (single) feed.

—Set of compartment heaters.

—(Oil) (Pyranol) filled interrupter switch, 2-position, open-close, rated 400 amperes (5 kv), (key interlocked with the low voltage breakers), with compound-filled terminal chamber for (single) (loop) feed.

—Air insulated terminal chamber.

—Necessary (potheads) (clamp-type terminals) for (loop) (single) feed.

—Set (fused) oil-filled cutouts, group-operated, 2-position, open-close, rated 200 amperes, (5 kv) (mechanically interlocked with the low voltage breakers).

—Necessary (potheads) (clamp-type terminals) for (loop) (single) feed.

—Set of three power fuses.

## Metering Requirements Where Primary Metering Is Required

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1—Metering compartment consisting of:

2—Potential transformers, 4160/120 volts, with current limiting fuses.

1—Provision for mounting metering current transformers and watt-hour meter (to be rented from the New York World's Fair Agent).

## Secondary Unit Substations—Transforming Section

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### .....(Pyranol) (Oil) Transforming Section(s)

The transforming section shall be designed in accordance with the following:

a. Ratings:

The rating(s) of the transforming section(s) shall be:

Self-cooled rating .....	kva
Temperature rise .....	65 C
Frequency .....	60 cycles
Number of phases .....	three
High-voltage rating for delta connection .....	volts
Low-voltage rating for ( <i>wye</i> ) ( <i>della</i> ) connection .....	volts

b. Type of Transformer:

The transformer shall be of the liquid-immersed type, (*Pyranol*) (*oil*) filled.

c. Manual Tap Changers:

The transformer shall be provided with four approximately 2½ percent rated kva taps in the high-voltage winding, two above and two below rated primary voltage. The external manually operated tap changer shall be suitable for operation when the transformer is de-energized only.

d. Liquid Preservation:

Transformers shall have a sealed tank with welded-on cover for preservation of the transformer liquid.

e. Neutral Bushing:

A low-voltage neutral bushing shall be included.

f. Maintenance Devices:

The following maintenance devices shall be provided as a part of the transformer.

1. Drain and sampling valves.
2. Filter-press connections.
3. Liquid-level gage without alarm contacts.
4. Ground pad.
5. Nameplate.
6. Provision for lifting and jacking.
7. Top liquid dial-type thermometer without alarm contacts.
8. Pressure-vacuum gage.
9. Pressure relief device.
10. Handhole

Pyranol. |  
Oil. |

The transformer base construction shall be of the fabricated type and suitable for using rollers or skidding in any direction.

The low-voltage terminals and transition flange shall be properly co-ordinated for field connection to the outgoing section.

The high-voltage terminals and transition flange shall be properly co-ordinated for field connection to the incoming-line section.

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**References:** GEA-6832 Distribution Equipment Transformers

## Secondary Unit Substations—Transforming Section

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### .....Open Dry-type Transforming Section(s)

The transforming section shall be designed in accordance with the following:

a. Ratings:

The ratings of the transforming section(s) shall be:

Self-cooled rating .....	kva
Temperature rise .....	150 C
Frequency .....	60 cycles
Number of phases .....	three
High-voltage rating for delta connection .....	volts
Low-voltage rating for ( <i>wye</i> ) ( <i>delta</i> ) connection .....	volts

b. Type of Transformer:

Transformer shall be of the open-dry-type.

c. Taps:

The transformer shall be provided with (*four approximately 2½-percent rated kva taps in the high-voltage winding, two above and two below*) rated primary voltage brought out to an internal terminal linkage accessible through a removable section. Taps will be changed only when the transformer is de-energized.

d. Neutral Bus Bar:

A low-voltage neutral bus bar shall be included.

e. Maintenance Devices:

1. Removable side sheets.
2. Ground pad.
3. Nameplate.
4. Provision for lifting and jacking.

The transformer base construction shall be of the fabricated type and suitable for using rollers or skidding in any direction.

The low-voltage terminals and transition flange shall be properly co-ordinated for field connection to the outgoing section.

The high-voltage terminals and transition flange shall be properly co-ordinated for field connection to the incoming-line section.

---

**Reference:** GEA-6668 Open Dry-type Transformers

## Secondary Unit Substations—Transforming Section

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### ... Sealed Dry-type Transforming Section(s)

The transforming section shall be designed in accordance with the following:

a. Ratings:

The rating of the transforming section(s) shall be:

Self-cooled rating .....	kva
Temperature rise .....	150 C
Frequency .....	60 cycles
Number of phases .....	three
High-voltage ratings for delta connection .....	volts
Low-voltage rating for ( <i>wye</i> ) ( <i>delta</i> ) connection .....	volts

b. Type of Transformer:

The transformer shall be of the self-cooled sealed dry-type with sealed tank.

c. Taps:

The transformer shall be provided with (*four approximately 2½-percent rated kva taps in the high-voltage winding, two above and two below*) rated primary voltage brought out to an internal terminal linkage accessible through a removable section. Taps will be changed only when the transformer is de-energized.

d. Neutral Bushings:

A low-voltage neutral bushing shall be included.

e. Maintenance Devices:

The following maintenance devices shall be provided as a part of the transformer:

1. Pressure test fitting.
2. Gas purging valves—top and bottom.
3. Ground pad.
4. Nameplate.
5. Provision for lifting and jacking.
6. Pressure vacuum gage.

The transformer base construction shall be of the fabricated type and suitable for using rollers or skidding in any direction.

The low-voltage terminals and transition flange shall be properly co-ordinated for field connection to the outgoing section.

The high-voltage terminals and transition flange shall be properly co-ordinated for field connection to the incoming-line section.

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**Reference:** GEA-6790 Sealed Dry-type Transformers

## Secondary Unit Substations—Low-voltage Switchgear Section

### Low-voltage Switchgear Section—Drawout Switchgear Type, Metal-enclosed, Dead-front (Indoor) (Outdoor)

#### General

The low-voltage drawout-type power air-circuit-breaker switchgear described by these specifications shall contain removable power circuit breaker elements, stationary structure, bus and connections, and associated equipment such as current and potential transformers, instruments, relays, switches, etc., as indicated in the detail portion of these specifications.

The low-voltage power circuit breakers shall be triple-pole, single-throw, drawout-type. They shall have manually or electrically operated spring charge closing mechanisms and three dual-magnetic (*long-time-delay and instantaneous*) overcurrent trip devices unless specified otherwise (*such as short-time-delay trip for selective tripping*). Electrically operated breakers shall have either a control switch with indicating lamps or a push button on the escutcheon of the breaker, and when required a shunt-trip device and auxiliary switch. Manually operated breakers shall not have a shunt trip and auxiliary switch unless specified. Equipped compartments shall be complete except for breaker element.

The electrical arrangement of the circuit breakers shall be (*selectively coordinated*) (*fully rated*) or (*cascaded*).

For a selectively coordinated substation, curves shall be furnished which demonstrate coordination of the main breaker with the feeder breakers.

—(*Busway indoor/outdoor*) (*transition compartment*) for connection to transformer.

—Incoming line breaker(s) Type AK....., ..... amperes frame size (*manually*) (*electrically*) operated with long-time delay, (*short-time delay*) (*instantaneous*) elements in the overcurrent trip devices, (*and*\*)

—Bus tie breaker(s), Type AK....., ..... amperes frame size normally (*open*) (*closed*), (*manually*) (*electrically*) operated, with long-time delay, (*short-time delay*) (*instantaneous*) elements in the overcurrent trips (*and*\*)

NOTE: In double-ended substations, if the tie breaker is normally closed, or if there is no tie breaker, check the interrupting rating of all breakers. Also a directional fault detection relay, selective with main and tie breakers may have to be included for primary fault protection.

Refer to Table B for ratings

—Feeder breaker(s), Type AK....., ..... amperes frame size (*manually*) (*electrically*) operated, with long-time delay (*short-time delay*) (*instantaneous*) elements in the overcurrent trips (*and*\*)

—Feeder breaker(s), Type AK....., ..... amperes frame size (*manually*) (*electrically*) operated, with long-time delay (*short-time delay*) (*instantaneous*) elements in the overcurrent trips (*and*\*)

—Feeder breaker(s), Type AK....., ..... amperes frame size (*manually*) (*electrically*) operated, with long-time delay (*short-time delay*) (*instantaneous*) elements in the overcurrent trips (*and*\*)

—Compartment(s) equipped for future breaker, Type AK....., ..... amperes frame size (*manually*) (*electrically*) operated.

\* Add the following to each breaker item as required:

Undervoltage device (*time-delay*) (*instantaneous*).

Shunt tripping device (*for manual breakers*).

Auxiliary switch (*for manual breakers*).

Position switch.

Key interlock.

Feeder Cable and Busway Termination

—Set of clamp type connectors\* for each breaker, as required.

—Set(s) vertical conductors (*and flange*) for connecting to (*busway*) termination.

Transformer Secondary Metering and Control

—Current transformer(s).

—Ammeter(s) and transfer switch(es).

—Control power transformer(s).

—Potential transformer(s).

—Voltmeter(s) and transfer switch(es).

—Watt-hour (*demand*) meter (2) (2½) (3)-element.

Feeder Metering and Control

—Ammeter(s) and transfer switch(es).

—Current transformers.

**References:** GEA-3592 Load Center Unit Substations

# Low-voltage Switchgear Section—Stationary Switchboard Type, Metal-enclosed, Dead-front (Indoor) (Outdoor)

## Construction

Switchboard shall consist of one or more vertical structures bolted together to form one sheet-metal enclosure. It shall be provided with front and rear channels. The ends, top, and rear shall be covered with removable screw-on steel plates. Switchboard shall include all protective devices and equipment as listed with necessary interconnections, instrumentation and control wiring, terminal blocks, and mechanical-type solderless connectors for terminals.

Protective devices shall have individual front plates and necessary bus connection straps. Devices shall be modular-sized and so arranged as to be individually removable and readily interchangeable. Each device shall be provided with cardholder and card for identification.

## Ratings

The distribution switchboard(s) shall be arranged for operation on circuits rated as follows:

- Cross out one. | Voltage—(208Y/120) (480Y/277) volts.
- | Frequency—(60) cycles.
- | Phases—(3).
- Cross out one. | Circuit—(3) (4) wire.
- Cross out two. | Neutral—(none) (half capacity) (full capacity).
- Cross out one. | Bus bar structure to be braced for [(40,000) (85,000) RMS symmetrical amperes] short-circuit faults.

The switchboard will consist of the following:

For ratings refer to table	(Busway indoor/outdoor) (transition compartment) for connection to transformer																				
B	—Incoming line circuit breaker, Type AK-..... amperes (manually) (electrically) operated, (rigid) (drawout) mounted, ..... symmetrical ampere interrupting rating.																				
D	—Incoming power protectors, Type LB-1, ..... ampere (manually) (electrically) operated, 200,000 amperes RMS symmetrical interrupting rating with one current-limiting fuse per pole.																				
C	—Incoming molded-case circuit-breaker, Type T ..... amperes, ..... Sym. ampere interrupting rating.																				
B	—Bus-tie circuit-breaker, Type AK-....., ..... amperes, (manually) (electrically) operated, (rigid) (drawout) mounted, ..... symmetrical ampere interrupting rating.																				
	—Feeder Power Circuit-Breaker, Type AK, (manually) (electrically) operated.																				
	<table border="0" style="width: 100%;"> <thead> <tr> <th style="width: 15%;">No.</th> <th style="width: 15%;">AK-</th> <th style="width: 15%;">Amperes</th> <th style="width: 55%;">Interrupting Rating Sym. Amperes</th> </tr> </thead> <tbody> <tr> <td>.....</td> <td>.....</td> <td>.....</td> <td>.....</td> </tr> <tr> <td>.....</td> <td>.....</td> <td>.....</td> <td>.....</td> </tr> <tr> <td>.....</td> <td>.....</td> <td>.....</td> <td>.....</td> </tr> <tr> <td>.....</td> <td>.....</td> <td>.....</td> <td>.....</td> </tr> </tbody> </table>	No.	AK-	Amperes	Interrupting Rating Sym. Amperes	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
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# Low-voltage Switchgear Section—Stationary Switchboard Type, Metal-enclosed, Dead-front (Indoor) (Outdoor)

For ratings refer to table

		—Feeder Molded-Case Circuit-Breaker ( <i>Types E-100, F-225, J-400, K-1000</i> )			
	No.	Type	Amperes	Interrupting Rating Sym. Amperes	
C	.....	.....	.....	.....	
	.....	.....	.....	.....	
	.....	.....	.....	.....	
	.....	.....	.....	.....	
		—Feeder Fused-Interrupter Switch ( <i>Type QMR</i> ) Equipped with Rejection-Type Fuse Clips for Current Limiting Fuses. ( <i>Fuses to be furnished by others.</i> )			
	No.	Amperes			
D	.....	.....			
	.....	.....			
		—Feeder Current-Limiting Molded-Case Circuit-Breakers with Interrupting Rating of 80,000 Symmetrical Amperes.			
	No.	Amperes			
C	.....	.....			
	.....	.....			
	.....	.....			

Include necessary metering as required.

**References:** GEA-7222 Integral Distribution Centers (Rome)  
GEA-6928 Integral Distribution Centers (Ft. Wayne)

# Low-voltage Power Circuit Breakers —

## For Rating of Equipment Refer to Table B

### GUIDE FORM SPECIFICATIONS

#### General Specifications

- Cross out one.** | The individually mounted low-voltage power circuit breaker shall consist of an electrically and mechanically trip-free circuit-breaker element (*and a suitable mounting enclosure*) (*nonenclosed for dead-front mounting*). The circuit-breaker element shall be equipped with direct-acting dual-magnetic overcurrent tripping devices each pole, a manual or electrical operating mechanism and multiple finger-type contact structure provided with arc quenchers. It shall include interpole barriers, mechanical push-button trip, position indicator and provisions for up to three padlocks to lock the breaker in a trip-free position. The manual or electrical closing mechanism shall be the stored-energy type to provide "quick-make, quick-break" operation.
- Include for enclosed unit only.** | **Cross out one. Cast-iron for explosion-proof only.** | The circuit-breaker enclosure shall be (*code-gage steel*) (*cast iron*) and shall be phosphate coated, primed and finished with high-grade lacquer. Enclosures shall be of the NEMA type specified below and shall not require pull boxes for making connections. Circuit-breaker elements shall be the easily removable type.

#### Detailed Specifications

- Fill in number.** | This specification covers.....low-voltage power circuit breakers rated:  
 ..... Amperes maximum frame size  
 ..... Amperes RMS symmetrical interrupting capacity
- Fill in rating.** | **Select one.** | ..... Volts (A-c..... Cycles) (D-c)  
 ..... Amperes trip coil rating
- Select as required.** | Dual-magnetic overcurrent trips to provide (*long time-delay*) (*selective*) (*instantaneous*) characteristic.
- Cross out one.** | (*Manual*) (*electrical*) stored-energy operating mechanism.
- Cross out accessories not required.** | Breaker accessories: (*shunt trip*) (*undervoltage trip, instantaneous*) (*undervoltage trip, time delay*) (*overcurrent bell alarm*) (*overcurrent lockout*) (*auxiliary switch*).
- Cross out six.** | Enclosure to be (*dead-front switchboard*) (*skeleton drawout*) (*general-purpose NEMA Type 1*) (*semidust-tight, NEMA Type 1A*) (*weatherproof, NEMA Type 3*) (*dust-tight, watertight, NEMA Types 4 and 5*) (*explosion-proof, NEMA Type 7*)
- Cross out one.** | The breaker shall be suitable for three-phase, (*three-wire*) (*four-wire*) service.
- Cross out if not required.** | Means shall be provided for connecting to a bus-way stub.
- Fill in number and size of cables.** | Cable lugs are to be supplied for.....No.....cables per phase.

**Reference:** GEA-5915 Low-voltage Power Circuit Breakers  
 GET-1113 Selection and Application of Low-voltage Power Circuit Breakers

# Molded-case Circuit Breakers —

For Rating of Equipment Refer to Table C

---

## GUIDE FORM SPECIFICATIONS

The molded case circuit breaker shall be a circuit interrupting device which will operate both manually for normal switching functions and automatically under overload and short-circuit conditions. It will provide circuit and self-protection when applied within its rating. Control and signaling functions may be incorporated by the use of accessories

The operating mechanism shall be entirely trip-free so that the contacts cannot be held closed against a short circuit. The operating handle of the circuit breaker shall open and close all poles of a multipole breaker simultaneously. These breakers shall meet NEMA, AB1-1959 and Underwriters' Laboratories, Inc. specifications. Each circuit breaker shall have a thermal magnetic trip unit. The thermal magnetic trip unit for each pole shall consist of a thermal bimetal element for inverse time-delayed overload protection and an instantaneous magnetic element for short-circuit protection. The trip elements shall operate a common trip bar which will open all poles in case of an overload or short-circuit current through any one pole.

The circuit breakers to be used in (panelboards), (power panels), (motor control centers), (switchboards), with up to \_\_\_\_\_ amperes, \_\_\_\_\_ system volts, \_\_\_\_\_ short-circuit amperes (symmetrical) (asymmetrical) available, should be a (one), (two), (three) pole, (TQ), (TQL), (E 100), (F 225), (J 400), (K 1000) line, General Electric Type T\_\_\_\_\_.

---

**Reference:** GEA-7410 Molded Case Breakers  
GET-2779 Application and Selection  
Molded Case Circuit Breakers

# Power Protector —

For Rating of Equipment Refer to Table D

## GUIDE FORM SPECIFICATIONS

### Power Protector Type LB-1

#### General

**Fill in number.** This specification covers ..... (service-entrance switch(es), (heavy-duty feeder switch(es)).  
**Cross out one.**

This switch shall be a combination device, consisting of switch mechanism and high-interrupting-capacity current-limiting fuses. The combination device shall be capable of closing against, remaining closed and interrupting short-circuit currents up to 200,000 ampere rms symmetrical with no derating. The switch mechanism shall have a load-interrupting capacity of twelve (12) times the continuous-current rating of the combination device. The switch mechanism shall be a quick-make, quick-break type with the speed of operation in both closing and opening independent of the operator. The allowable temperature rise, for carrying rated load current, of the combined three-phase switch and fuses mounted in an enclosure for which it is designed to be used, shall be 55 C rise over 40 C ambient at the connecting terminal. This device shall be tested in combination by one manufacturer. Device shall be equipped with blown fuse indicators and single-phase protection.

#### Rating

**Fill in rating.** Continuous current ..... amp  
Interrupting rating ..... 200,000 amp rms symmetrical  
**Fill in rating.** System voltage ..... volts  
Phases ..... 3-phase  
Frequency ..... 60 cycles

#### Enclosures

**Cross out one.** The switch shall be (mounted in a free-standing general-purpose enclosure) (for dead-front switchboard mounting). The enclosure shall be of suitable metal and design for surrounding conditions.

#### Connections

**Cross out one.** The switch shall be suitable for 3-phase (3-wire) (4-wire) service. (The full-capacity neutral will only be provided with the free-standing enclosure.)  
**Cross out if not required.** Means shall be provided for connecting a busway stub to the free-standing enclosure.

#### Operation

**Cross out one.** The switch shall be suitable for (manual) (electrical) operation.  
An operating handle shall be provided for manual operation only.  
A mechanical push button for opening the switch and a position indication shall be provided on the front of the switch.  
The free-standing enclosure door shall be interlocked to prevent opening the door while the switch is in the closed position.  
There shall be provision for locking the switch in the open position.  
**Cross out if not required.** A shunt trip device shall be provided for remote tripping. An undervoltage device (instantaneous) (time delay) shall be provided to trip the switch in case of sustained undervoltage conditions.

**Reference:** GEA-6527 LB-1 Power Protector

# Lighting and Power Panelboards —

For Rating of Equipment Refer to Table F

## GUIDE FORM SPECIFICATIONS

### Lighting Panelboards

Types NLAB and NLTQ

### Power Panelboards

Types NCP and CCB Circuit Breaker Panelboards

Type QMR Fusible-switch Panelboards

#### General

Use for  
circuit-breaker  
panelboards  
only.

Use for  
fusible-switch  
panelboards  
(Type QMR)  
only.

- Cross out one.** | The (*lighting*) (*power*) panelboard shall consist of automatic short-circuit and overcurrent protective devices of the circuit-breaker type, assembled into a single interior unit which shall be mounted in a sheet-steel enclosure, consisting of a box and front designed (*to be placed in or against a wall or partition*) (*for mounting between the flanges of an "H" column*).

The panelboards shall consist of individual quick-make, quick-break fusible interrupter switch units assembled into a single interior unit mounted in a sheet-steel enclosure, consisting of a box and front, designed to be placed in or against a wall or partition.

The panelboards shall be of the dead-front type and shall be in accordance with Underwriters' Laboratories, Inc., standard for panelboards and enclosing cabinets, and so labeled.

- Cross out seven.** | The panelboard shall be designed for connection to a (*three-wire, single-phase, 120/240-volt a-c, solid-neutral*) (*three-wire, three-phase, 240-volt a-c*) (*three-wire, three-phase, 480-volt a-c*) (*three-wire, three-phase, 600-volt a-c*) (*four-wire, three-phase, 208Y/120-volt a-c, solid-neutral*) (*four-wire, three-phase, 480Y/277-volt, a-c, solid-neutral*) (*two-wire, 250-volt d-c*) (*three-wire, 125/250-volt d-c, solid-neutral*) source.

Use for  
circuit-breaker  
panelboards  
only.

Use for  
fusible-switch  
panelboards  
(Type QMR)  
only.

- Cross out one.** | The mains of the panelboard shall be provided with (*main lugs only*) (*a main circuit breaker*) and with solderless lugs.
- Cross out one.** | The mains of the panelboard shall be provided with (*main lugs only*) (*main fusible switch*) and with solderless lugs.
- Cross out one.** | The service connection to the panelboard shall be made at the (*top*) (*bottom*).

# Lighting and Power Panelboards

---

Include for wall-mounted panelboards only.

Include for column-type panelboards only.

The neutral bar shall be mounted at the opposite end of the structure from the mains and shall have numbered terminals for connection of neutral wires.

The neutral bar shall be mounted in the pullbox.

## Box

The panelboard box shall be fabricated from galvanized sheet steel. A turned edge shall be provided around the front of the box for rigidity and attachment of the front. Wiring gutters shall be in accordance with the National Electrical Code.

Include for column-type panelboards when required.

An extension trough and pullbox shall be provided.

## Fronts

The panelboard front shall consist of a flat piece of sheet steel, with an opening to which the panelboard door is attached by means of semi-concealed steel hinges. The door shall have a cylinder tumbler-type lock. On doors more than 48 inches high, a combination three-point catch and lock shall be provided. A circuit directory shall be provided on the inside of the door.

Use for all except Type QMR. Optional for Type QMR.

Fronts shall be finished in grey enamel over a rust inhibitor. The front shall be designed for *(flush) (surface)* mounting.

## Interiors

Interior shall be of the unit type, mounted on a back plate or frame, properly reinforced by flanging providing a rigid assembly to protect against damage during handling or installation.

Structure shall be so designed that units may be easily removed without disturbing adjacent units, bus structure or insulation. A removable dead-front shield shall be provided for easy access to the wiring. Panel busing shall be arranged to maintain sequence phasing throughout, that is, adjacent poles shall be of unlike polarity and rotated in sequence.

## Branch Circuits—Circuit Breakers

Branch circuit-protective devices shall be of the molded-case circuit-breaker type consisting of the number of poles, ampere rating, and interrupting rating as listed on the drawings.

Use for circuit breaker panelboards only.

# Lighting and Power Panelboards

Use for  
circuit  
breaker  
panelboards  
only.

Include when two-  
pole circuit breakers  
are required.  
Cross out one.

The breakers shall have quick-make and quick-break toggle mechanism, inverse-time trip characteristics, and shall be trip-free on overload or short circuit. Automatic release is to be secured by a bimetallic thermal element releasing the mechanism latch. In addition, a magnetic armature shall be provided to trip the breaker instantaneously for short-circuit currents above the overload range. Automatic tripping shall be indicated by a handle position between the manual OFF and ON positions.

The individual breakers shall be calibrated and sealed to eliminate tampering or unauthorized changes in calibration. Breakers shall be interchangeable and capable of being operated in any position.

Two-pole branch circuit breakers shall be (*common-trip type*) (*provided by means of handle extensions on two single-pole breakers, thereby obtaining common manual operation, but independent tripping*).

## Branch Circuits—Fusible Devices

Branch circuit-protective devices shall be interrupter switches of the quick-make, quick-break type and shall have sufficient load-break capacity to properly co-ordinate with the time-current characteristics of Class J current-limiting fuses, to provide an integrated switch and fuse device. The interrupter switches shall be horsepower rated for standard and time-delay fuses in accordance with NEMA standards. The number of poles and ampere ratings of the switches to be included shall be as listed on the drawings. The short-circuit interrupting rating of the branch circuit switch-fuse combination shall be 100,000 RMS asymmetrical amperes.

Each unit shall be housed in a painted steel enclosure and shall be front operable by means of a cast-metal handle. The enclosure shall have a hinged cover which shall provide access to the fuses and wiring terminals only. Each hinged cover shall engage a spring latch with provision for padlocking and shall have markings to coincide with the ON and OFF positions of the switch handle. Means shall be provided for padlocking the operating handle in the (*OFF*) (*ON or OFF*) position.

Cross out one.

The hinged cover shall be so interlocked that it may not be opened when the switch is in the ON position, except that the interlock shall be tool-releasable by a qualified person.

Switching contacts shall be visible when the switch is in the OFF position and the unit cover is open.

Units of all sizes shall be interchangeable and shall be convertible to lower current fuse capacities.

Use for  
fusible switch  
panelboards  
(Type QMR)  
only.

Optional  
feature.  
Include  
when  
required.

## Switch Construction

Each pole unit of a switch shall have a quick-make, quick-break mechanism with grid plate arc quenchers.

Each pole unit of a switch shall have silver-alloy contact tips and silver-plated copper parts for low-temperature-rise operation. The movable contact arm shall be spring-reinforced to provide constant contact pressure and long operating life. The entire switch mechanism shall be supported by mechanically strong, insulating bases.

Fuse clips shall be provided which will reject conventional National Electrical Code fuses but will accept Class J current-limiting fuses. (A panelboard so equipped will not be Underwriters' Laboratories, Inc., labeled.)

- References:** GEA-6737 Lighting and Distribution Panelboards Style Q.  
GEA-6738 Lighting and Distribution Panelboards Style NCP  
GEA-6739 Lighting and Distribution Panelboards Type CCB  
GEC-1100 Buy Log of Low-voltage Equipment

# Safety Switches —

For Rating of Equipment Refer to Table D

## GUIDE FORM SPECIFICATIONS

### General Specifications

The safety switches shall conform to governing industry NEMA standards. They shall be listed by Underwriters' Laboratories, Inc., where applicable.

The switch enclosure shall be of phosphate-coated or equivalent code-gage steel with baked enamel finish for NEMA Types 1, 1A and 12. NEMA Type 3R enclosures shall be of galvanized steel or equivalent, phosphate-coated and finished with baked enamel.

### Detailed Specifications\*

#### Premium Heavy-duty Safety Switch Specification, Style A

- Fill in number. | This specification is for .....heavy-duty safety switches rated
- Fill in rating. | .....amperes .....volts
- Cross out one. | (2) (3) pole, (single throw)(double throw)
- Cross out one. | (With) (Without) insulated neutral
- Cross out one. | (Non-fusible) (Fusible)
- Cross out one if fuses are required. | (Standard) (Rejection) clips
- Cross out if not required. | Dummy fuse required for switching neutral
- Cross out four. | Enclosure to be (general-purpose, NEMA Type 1) (semi-dust-tight, NEMA Type 1A) (watertight, NEMA Type 4) (dust-tight, NEMA Type 5) (oil- and dust-resistant, NEMA Type 12)
- Cross out if required lugs are standard—fill in if they are not. | Cable lugs are to be supplied for wire size.....

#### Heavy-duty Safety Switch Specification Type TH

- Fill in number. | This specification is for ..... heavy-duty safety switches rated
- Fill in rating. | .....amperes .....volts
- Cross out two. | (2) (3) (4) pole, single throw
- Cross out one. | (With) (Without) insulated neutral
- Cross out one. | (Non-fusible) (Fusible)
- Cross out one if fuses are required. | (Standard) (Rejection) Clips
- Cross out if not required. | Dummy fuse required for switching neutral
- Cross out one. | Enclosure to be (general-purpose, NEMA Type 1) (raintight, NEMA Type 3R)
- Cross out one when specifying raintight switches. | Switch (shall) (shall not) be equipped with non-releasable cover interlock.

#### Light-duty Safety Switch Specification Type TG

- Fill in number. | This specification is for .....light-duty safety
- Fill in rating. | switches rated .....amperes .....volts
- Cross out one. | (2) (3) pole, single throw
- Cross out one. | (With) (Without) insulated neutral
- Cross out one. | (Non-fusible) (Fusible)
- Cross out if not required. | Dummy fuse required for switching neutral
- Cross out one. | Enclosure to be (general-purpose, NEMA Type 1) (raintight, NEMA Type 3R)

\* One detailed specification form should be used for each lot of identical switches. The total specification can contain as many of the form paragraphs as required.

- 
- References:** GEA-6751 Disconnect Switches  
GEA-6756 Safety Switches  
GEC-1100 Buy Log of Low-voltage Equipment



# General-purpose Transformers Current Limiting Fuses

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## GUIDE FORM SPECIFICATIONS

Fill in quantity. | Transformers shall be furnished in accordance with the following specification:

### Rating

- Fill in rating. | Capacity ..... kva  
Frequency ..... (60) ..... cycles
- Cross out two. | Number of phases ... (one) (two) (three)
- Cross out one. | Type of transformer . (insulated) (auto-transformer)
- Cross out one. | Location . . . . . (indoors) (outdoors)

### Primary Winding

- Fill in ratings. | The primary winding shall be rated for ..... volts for use on  
Cross out one for three-phase. | ..... phase, .....-wire circuit and, (connected delta) (con-  
Omit for single-phase. | nected wye or tee), furnished with rated kva taps as follows: (none)  
Cross out four. | (two 5 percent below rated voltage) (four 2½ percent below rated  
voltage) (two each 2½ percent above and below rated voltage) (six 2½  
percent, 2 above and 4 below rated voltage).

### Secondary Winding

- Fill in ratings. | The secondary winding shall be rated for ..... volts, .....  
for use on ..... wire, ..... phase circuit.

### Special Requirements

- Specify as required. | In addition the transformer shall have to meet the following require-  
ments:  
*(Describe such special requirements as special enclosures, environ-  
mental conditions, accessories, special connections and operating  
conditions.)*

---

**References:** GEC-1070 Dry-type Transformers

## Current Limiting Fuses —For Rating of Equipment Refer to Table E

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This specification covers a quantity of high-interrupting-capacity current-limiting fuses with ratings as listed below. The fuses shall have a maximum interrupting capacity of 200,000 amperes RMS symmetrical, and under fault conditions of this magnitude shall limit the amount of energy let through the fuse. The fusible element shall be of pure silver, imbedded in a high-grade granular quartz filler. The cartridge shall consist of a strong, resilient insulating barrel with silver-plated copper ferrules, knife blades, or tangs at each end. Ratings 600 amp and below shall be provided with rejection features to prevent substituting fuses having inadequate interrupting capacity. Ratings above 600 amp shall be provided with universal tangs to permit mounting interchangeably on "Pringle" or "NEC" drillings.

---

**References:** GEA-6319D Current Limiting Fuses

# Inductrol Voltage Regulators

## GUIDE FORM SPECIFICATIONS

Fill in quantity. Cross out one. | ..... (Single-phase) (Three-phase) dry-type induction-voltage regulator(s) shall be furnished in accordance with this specification.  
Cross out two. | The regulator(s) shall be natural-draft air-cooled (*hand-operated*) (*motor-operated, manually controlled*) (*automatic*) for indoor service.  
Fill in rating; cross out one. | Rating shall be .....kva; (*one-hour*) (*continuous*) ..... volts, .....amperes (load). To provide voltage regulation of .....per cent raise and .....percent lower.  
Fill in required regulation.

For hand-operated only.

For motor-operated, manual or automatic control.

For automatic regulators only.

Cross out for automatic control regulators.

The regulator(s) to be furnished complete with:

Counterbalanced hand-crank.

Enclosed worm-gear.

Position indicator.

Ball-bearing, capacitor-type motor.

Double-worm gear reduction and limit switch.

Motor power supply to be provided by others.

(Single-phase, 60 cycles, 120 volts)

Control devices, assembled on steel panel,

Voltage-regulating relay.

Motor-control relay.

Automatic-Manual selector switch.

Manual raise and lower switches.

Motor power switch.

Potential supply switch.

Potential-test terminals (output voltage).

Self-contained motor power and potential supply.

\* The regulator nameplate kva rating is much less than the circuit rating because the regulator rating is a measure of the physical capacity of the parts used in the construction. Its rating is the voltage (either raise or lower) times the load current going through the series winding.

**References:** GEC-1450 Inductrol Voltage Regulators

# Voltage-stabilizing Transformers

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## GUIDE FORM SPECIFICATIONS

**Fill in quantity.** | ..... Dry-type voltage-stabilizing transformer(s) shall be furnished in accordance with this specification.

### Rating

**Fill in rating.** | The stabilizing transformer(s) shall be rated ..... volt-amperes, for operation indoors on ..... volts nominal line-voltage and .....

**Fill in expected voltage variation.** | ..... cycles nominal frequency. The line-voltage variation shall be within ..... maximum and ..... minimum and the frequency variation shall be

**Omit on normal utility-system applications** | within ..... maximum and ..... minimum cycles.

### Load

**Specify type of load.** | The stabilizing transformer(s) shall be used to supply a ..... load at

**Specify load voltage.** | a nominal voltage of ..... volts. The permissible voltage variation at the load shall be  $\pm 1$  percent at rated load. The load power-factor will be

**Specify load power-factor.** | (*fixed at*) (*variable between*) (..... percent lag) (..... percent lead). Minimum load applied to the voltage-stabilizing transformer will be

**Specify percent of rated load.** | ..... percent of rated load.

**Include only for harmonic-filtered units.** | The harmonic content of the voltage-stabilizing transformer output shall be limited to three percent at full-load.

**Specify overload or transient current characteristics.** | The load characteristic includes.....  
.....

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**Reference:** GEA-5754 Voltage Stabilizing Transformers

# Lighting Busway—Type LTG

For Rating of Equipment Refer to Table G

---

## GUIDE FORM SPECIFICATIONS

### General

The prefabricated plug-in busway system shall be rated 300 volts, 50 amperes and consist of a rigid enclosure, bus bars and insulators.

All equipment shall be listed by Underwriters' Laboratories, Inc., and so labeled.

### Housing

The housing shall include an integrally formed polarizing lip to permit installation of outlet devices in only one position to assure maintenance of phase rotation. The form of the housing shall be such that a positive grip is provided for the hangers. A maximum  $\frac{5}{8}$ -inch slot in the bottom of the housing shall provide a continuous outlet for power takeoffs.

Housings shall be finished in ASA No. 49 medium-light-grey enamel over a rust inhibitor.

### Bus Bars

Bus bars shall be of the hollow trapezoid type. Bus bars shall be silver plated throughout their length. Bus bars shall be formed so that the electrical connections between sections shall be made by the insertion of spring-loaded bus connectors into bus bars of adjacent sections.

### Insulators

The bus bars shall be rigidly supported in and insulated from the housing by insulators molded from a thermosetting compound having high-impact and dielectric strength.

**Cross out two** | Busway and fittings shall be (two) (three) (four) poles.

### Hanging

**Cross out two** | The housing shall be supported at intervals not exceeding 5 feet in accordance with the National Electrical Code by means of (steel rods) (brackets) (messenger cable) attached to hanger plates, coupling plates, and hangers.

**Cross out two** | The (steel rods) (brackets) (messenger cable) shall be provided by the installer.

### Outlet Devices

All outlet devices shall be of the polarized type to prevent incorrect phasing, and provide means for balancing single-phase loads. They shall be designed so that they may be inserted in the busway at any point without the necessity of using access doors or removing sections or end caps. Outlet devices, elbows and feed-in boxes shall be of the type and rating shown on the plans.

### Installation

**Include if desired** | The busway shall be installed by the General Electric roll-in system using the devices specifically designed for that purpose. A roller hanger shall be clamped on each hanger rod. The spacing of the hangers shall be maintained by a messenger cable the full length of the run and attached to the hanger rods. The busway shall be installed using the proper lead-in head and coupling plate.

---

**Reference:** GEA-6170 Type LTG Lighting Busway

# Plug-in and Feeder Busway, Type DH

For Rating of Equipment Refer to Table G

## GUIDE FORM SPECIFICATIONS

### General

Busway shall be of the plug-in type, and the system shall be polarized. The maximum voltage drop shall be 2.6 volts per 100 feet at least favorable power factor carrying rated load equally distributed along the run. Complete system shall be listed by Underwriters' Laboratories, Inc., and so labeled.

### Ratings

Busway rating shall be 100 amperes continuous at maximum 55 C rise above ambient, 600 volts. Short-circuit rating 15,000 RMS asymmetrical amperes.

**Cross out two.** *(three-wire, three-phase) (four-wire, three-phase, full-rated neutral) (three-wire, solid neutral)*

### Construction

The busway shall be of the totally enclosed type consisting of formed sheet-steel housing with external mounting flanges. Bus bars shall be electro-silver-plated aluminum. Joints between components shall be assembled by placing overlapping parts together and tightening six bolts. It shall be possible to remove any component from run without disturbing any other components.

### Outlets

**Include for plug-in busway.**

Outlets shall be of the steel knockout type. With knockout removed, an insulator shall provide dead-front construction. This insulator shall permit the attachment of plugs in only one position, to assure proper polarization. Eighteen outlets shall be provided per 10-foot length, nine on each side. Any nine of these outlets may be used at one time, provided no two back-to-back are used.

### Elbows

**Cross out if not desired.**

An adjustable length shall be included adjacent to each tap box, elbow, tee or cross. This length shall be adjustable from 42 to 54 inches.

### Finish

Entire system shall be finished in medium-light-gray baked-on enamel ASA No. 49 over a rust inhibitor.

**Reference:** GEA-6172 Type DH Busway

# Plug-in and Feeder Busway, Type DE

For Rating of Equipment Refer to Table G

## GUIDE FORM SPECIFICATIONS

### General

The low-voltage-drop busway system shall be furnished in accordance with these plans and specifications. System shall consist of totally enclosed lengths and fittings. Wherever possible, furnish standard 10-foot lengths. All equipment shall be listed by Underwriters' Laboratories, Inc., and so labeled. Maximum voltage drop shall be  $2\frac{1}{4}$  volts per 100 feet at least-favorable power factor for the system on a distributed-load basis.

### Rating

Select one. | Cross out three. | Busway rating shall be 600 volts, [225 amperes continuous, 25,000 amperes RMS asymmetrical short circuit] [(400) (600) (800) (1000) amperes continuous, 50,000 amperes RMS asymmetrical short circuit],  
Cross out one. | (~~three-wire, three-phase~~), (~~four-wire, three-phase, full-rated neutral~~).

### Busway Lengths

Busway shall consist of a totally enclosed housing with external mounting flanges drilled for mounting busway. Bus bars shall be high-tensile-strength aluminum tubes with solid aluminum bars welded into the end for joint connection. Bus bars shall be electro-silver-plated and continuously enclosed in butyl to prevent traveling arcs. Insulated bus bars and spacer blocks shall be bound with high-tensile-strength steel strapping to withstand short-circuit forces.

### Joints

Joints shall be of high compression type with one bolt to clamp all bus bars at one time. Joints can be checked for tightness without deenergizing system. Joint covers shall be removable so a length or fitting can be removed from busway without disturbing adjacent units.

### Plug Outlets

Include for plug-in busway. | Plug outlets shall be of the dead-front type with positive catch arranged so that in opening or closing the cover, the installer will not touch live parts or damage housing. Furnish twelve outlets per 10-foot length and four per 5-foot length, half on each side of busway, all usable simultaneously. Outlets shall be polarized and arranged so plugs can be inserted or removed only when plug is in the OFF position.

### Fittings

Elbows, tees, crosses and switchboard stubs shall be of the rigid type with minimum length legs. An adjustable length with 12-inch adjustment shall be provided adjacent to each fitting to provide proper fitting to the busway layout.

### Hanging

Cross out one. | Snap-on hangers, suitable for attachment to the busway at any point along the run, shall be provided. Maximum spacing of hangers 10 feet per NEC Article 3643. Horizontal runs shall be hung (~~edgewise~~) (~~flatwise~~).

### Finish

Busway shall be finished in medium-light-gray ASA No. 49 over a rust inhibitor. Hardware shall be cadmium or zinc plated.

**Reference:** GEA-6173 Type DE Plug-in Busway

**Plug-in Busway, Type LVDP, Feeder Busway, Type LVD  
Feeder Busway—Type CL—For Rating of Equipment Refer to Table G**

**GUIDE FORM SPECIFICATIONS**

**GENERAL**

The busway shall be of the following type and in accordance with the specifications and plans attached. All components necessary for a complete system shall be included. Busway shall conform to NEMA standards.

Omit for Type CL

(and shall be listed by Underwriters' Laboratories, Inc.)

Housing shall be of fabricated sheet metal providing adequate mechanical protection for the conductors and shall include mounting rails to which hangers may be attached at any point. Housing shall be finished in ASA No. 49 medium-light-grey enamel over a rust inhibitor.

Bus bars shall be silver plated at all contact points and suitably braced for the specified short-circuit rating. Entire system shall be polarized.

Cross out one

Provide hangers suitable for (edgewise) (flatwise) mounting. Hanger rods shall be furnished by installers.

Include if required

In vertical riser sections of each run, provide special clamp-type hangers which support each section of busway separately and bolt it rigidly to the building structure to eliminate any strain on joints.

**RATINGS**

Busway shall have following ratings:

Fill in ratings  
Specify one if required

..... amperes continuous  
..... amperes RMS asymmetrical short circuit  
..... wire, ..... phase ..... volts  
with (half) (full) neutral

Fill in ratings  
Cross out one

Voltage drop shall not exceed ..... volts per 100 feet at ..... percent power factor with rated load (concentrated at end of run) (distributed throughout length of run).

Cross out one

It shall be of the ventilated (indoor type) (outdoor type).

Cross out one

Bus bars shall be of (aluminum) (copper).

Bus Bars shall be insulated for their entire length except at joints and any plug openings. Joints shall have suitable enclosing covers and it shall be possible to assemble the joint entirely from one side of the busway.

Include only if plug-in sections are required  
Not outdoor type

Where shown on plans, provide standard 10-foot sections with 10 plug-in outlets, five per side, all usable simultaneously. Provide rotating plug outlet covers. Provide phase-collection straps with each section.

Fill in ratings  
Include for type CL only

Busway shall have sufficient reactance to reduce short-circuit current from ..... amperes RMS asymmetrical at the input end to ..... amperes at the output end. Provide necessary transposition straps in all bus bars including neutral bar to assure equal balance of current in bus bars.

Include for Type CL only

Busway shall be of the ventilated type with steel side rails and aluminum covers.

**Reference:** GEA-6736 HI-capacity Busway System

# Plug-in Busway, Type FVK

For Rating of Equipment Refer to Table G

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## GUIDE FORM SPECIFICATIONS

### General

The plug-in busway system shall be as shown on the plans which form a part of this specification. All equipment shall be listed by Underwriters' Laboratories, Inc., and so labeled, and shall conform to the NEMA standards for busways. Loads shall be connected to the plug-in busway by means of plug-in switching devices.

Wherever possible, the busway shall be furnished in standard 10-foot lengths. At the joints between all sections, a removable joint inspection cover shall be provided to facilitate the bolting together of the various sections and to make it possible to inspect the joint easily.

### Rating

Cross out seven. Busway rating shall be [(250 volts, d-c, two-wire) (240 volts a-c, two-wire) (120/240 volts a-c, single-phase, three-wire) (240-volt, three-phase, three-wire) (208Y/120 volts, three-phase, four-wire, half-capacity neutral) (600 volts, a-c, two-wire) (600 volts, a-c, three-phase, three-wire) (480Y/277 volts, three-phase, four-wire, half-capacity neutral)]; [(225) (400) (600) (800) (1000)] amperes.

Cross out four.

### Bus Bars

Bus bars shall be of (copper) (aluminum), hard-drawn. Each joint shall be of the overlapped type, with at least two bolts passing through each joint. Bus bars shall be silver-dip finish throughout their length and at the joints.

### Housing

The housing shall consist of standardized assemblies of formed sheet steel to provide a rigid enclosure. The form of the housing shall be a continuous molding, providing a convenient method for attachment of the supporting hangers. The housing shall be provided with an internal splice plate attached to one end of each section, arranged to telescope into the adjoining length to assure alignment.

### Insulators

Insulators shall be porcelain of high dielectric strength. Insulators shall be spaced on maximum 24-inch centers. They shall be protected with felt against mechanical injury.

### Outlets

Outlets in each 10-foot length shall be of sufficient number and arrangement so that a minimum of ten openings shall be available for the attachment of plugs, regardless of whether mounted in the flatwise or edgewise position. Each plug outlet shall be supplied with an outlet cover plate. The shape of the outlets and the spacings of the bus bars shall permit insertion of plug-in units in only one position to assure proper polarization.

---

**References:** GEA-6470 Type FVK Plug-in Busway



# Cable—For Rating of Equipment Refer to Table G

## GUIDE FORM SPECIFICATIONS

### Flamencol Insulated Cables

Fill in quantity, size and rating	This specification covers ..... linear feet of ..... (Awg) (MCM), (single-) (three-) (.....) conductor cable for operation at (600) (5000) volts maximum.
Cross out as required	(Note: Select 5000 volts only for series street-lighting applications)
Omit if not required.	Three bare, neutral, ground wires shall be stranded into the interstices of the three-conductor cable. Each ground wire shall be of ..... Awg.  Materials, construction and test shall be in accordance with the applicable requirements of the Insulated Power Cable Engineers Standard S-61-402 "Thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy."
Select for single conductor cable only.	Insulation shall be of polyvinylchloride meeting the requirement of Para. 3.8 of the IPCEA Standard, and listed by Underwriters' Laboratories for use as Type THW, 75 C rating and shall be oil-resistant.
Select for control cable only.	Insulation on multiconductor control cable shall have wall thickness of 20 mils of polyethylene meeting the requirements of Para. 3.9 and over that a 10-mil jacket of compatible semirigid polyvinylchloride meeting the requirements of Para. 4.3.1. Color coding shall conform to IPCEA standard, Sec. 6.5.5.2 Method No. 3 for conductor identification.
Omit if not required.	Over-all jacket of the multiconductor cables shall be of suitable thickness of polyvinylchloride meeting the requirements of Para. 4.3.1.

### Versatol Geoprene Cables

Fill in ratings. Cross out as required.	This specification covers ..... linear feet of ..... (Awg) (MCM), (single-) (two-) (three-) conductor cable for operation at (600) (1000) volts maximum. Materials, construction and tests shall be in accordance with the applicable requirements of the Insulated Power Cable Engineers Standard S-19-81, 3rd edition, "Rubber Insulated Wire & Cable for the Transmission and Distribution of Electrical Energy."  Insulation shall be an SBR rubber meeting the requirements of Para. 3.13 (except the initial SIC shall be 0.6 max.) and shall be listed by Underwriters' Laboratories as Type RHW.  Jacket shall be a polychloroprene meeting requirements of Para. 4.13.3 and having suitable thickness in accordance with Table 26 for single conductor cables and Table 29 or 30 for two or three conductor cables.
--	--

### Super Coronol Cables

Fill in quantity, size, and ratings. Cross out as required.	This specification covers ..... linear feet of ..... (Awg) (MCM), (single-) (three-) conductor cable for operation on a (600-volt) (5000-volt) (grounded-neutral) (ungrounded-neutral) system. Line-to-line circuit voltage shall be ..... volts.
Omit if not required.	Three bare neutral ground wires shall be stranded into the interstices of the three-conductor cable. Ground wire in each interstice shall be ..... AWG.  Materials, construction and tests shall be in accordance with applicable requirements of the Insulated Power Cable Engineers Standard S-19-81, 3rd edition. Rubber-Insulated Wire for the Transmission and Distribution of Electrical Energy.  Insulation shall be butyl rubber compound meeting the requirements of Para. 3.15 of IPCEA standards.
Select for 600-volt cables only.	The insulation shall also be listed by the Underwriters' Laboratories for use as Type RHH heat-resisting for operation at 90 C copper temperature.
Select for 5-kv cables. Cross out one. Cross out if not required.	(5-kv cable shall be operated at 90 C) copper temperature, (and over the insulation shall have a shielding tape of tinned copper spirally wound to form a continuous shield along the entire length).
Cross out one.	Jacket shall be of (polyvinylchloride meeting the requirements of Para. 4.13.5) (polychloroprene meeting the requirements of Para. 4.13.3 of IPCEA Standards). Jacket thickness shall be in accordance with Table 26 for single conductor non-shielded cable, Table 28 for single conductor shielded cable or Table 29 for three conductor cable.

# Cable—For Rating of Equipment Refer to Table G

## GUIDE FORM SPECIFICATIONS

### Vulkene Insulated Cables

- Fill in quantity, size, and ratings. | This specification covers ..... linear feet of ..... (AWG) (MCM), (single-) (three-) conductor cable for operation on a (600-volt) (grounded-neutral) (ungrounded-neutral) (grounded-neutral) (ungrounded-neutral) system. Line-to-line circuit voltage shall be ..... volts.
- Cross out as required. |
- Omit if not required. | Three bare neutral ground wires shall be stranded into the interstices of the three-conductor cable. Ground wire in each interstice shall be ..... AWG.
- Contracture and tests shall be in accordance with applicable requirements of the Insulated Power Cable Engineers Standard S-19-81, "General Specifications for Wire and Cable with Rubber, Rubber-like and Thermoplastic Insulation."
- Select for 5-kv cables. | (5-kv cable shall be operated at 90 C) copper temperature, (and over the insulation shall have a shielding tape of tinned copper spirally wound to form a continuous shield along the entire length).
- Cross out one. |
- Cross out if not required. | No jacket is required on 600 volt and 5 kv unshielded cables. For 5 kv shielded cables the jacket shall be polyvinylchloride meeting the requirements of Appendix J except with the cold bend test at minus 40 C.

### Interlocked Armor Cable

- Fill in quantity, size, and ratings. | This specification covers ..... linear feet of ..... (Awg) (MCM) (three-conductor) (four-conductor) interlocked armor cable for operation at (600) (5000) volts maximum. The cable shall conform with applicable requirement of the IPCEA standard ("Specification for Varnished-cambric Insulated Cables") (S-19-81, 3rd edition "Rubber Insulated Wire & Cable for the Transmission and Distribution of Electrical Energy").
- Cross out as required. |
- Use of varnished-cambric insulated cables | Insulation shall be heat-resisting varnished cloth. The cloth shall contain a minimum amount of sizing or dressing.
- Colored tapes shall be applied over the varnished-cambric insulated conductors for phase identification. One conductor shall have a white tape, one red and the other black.
- Assembly and jacket—the three insulated conductors shall be twisted together with a suitable pitch with treated fibrous fillers, as necessary, and binder tape applied over the twisted assembly. (A jacket of polyvinylchloride meeting the requirements of Para. 4.13.5 shall be applied over the assembly.)
- Cross out for rubber-insulated or 600-volt V-C cables |
- Cross out two. | Armor—Over the jacket assembly there shall be applied a single-strip positive-interlocking armor of (galvanized steel) (aluminum) (bronze).
- Omit if not required. | Jacket of (black) (.....) polyvinylchloride shall be applied over the armor and shall specify color. | closely conform to the convolutions of the armor.

### References

#### General Electric Publications

- Electric Equipment Specifications Manual—  
Book I ..... Section 6  
Flamenol Cable ..... 19-578  
Versatol Geoprene Power and Control Cable  
..... 19-105  
Super Coronol Cable ..... WC-8419  
Interlocked Armor Cable ..... 19-555

#### General Electric Wire and Cable Handbook

- Flamenol Cable ..... Section CM-408  
Versatol Geoprene Cable ..... Section CM-450  
Super Coronol Cable ..... Section CM-451  
Interlocked Armor Cable  
..... Sections CM-502, CM-503

#### IPCEA Standard

- General Specifications for wire and cable with Rubber, Rubber-like and Thermoplastic Insulations  
..... S-19-81

## SECTION III

# GUIDE FORM SPECIFICATIONS FOR POWER UTILIZATION EQUIPMENT

This section contains guide form specifications for motor and motor control equipment and outdoor lighting equipment.

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### Motor and Motor Control Equipment

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# Squirrel-cage Induction Motors—Three-phase

## GUIDE FORM SPECIFICATIONS

### General

This specification is intended to cover the functional requirements, features, and general construction of three-phase induction motors of the squirrel-cage type.

All motors shall be built in accordance with current NEMA, AIEE, and ASA standards where applicable. They shall be of the type and quality described by the specification, fully capable of performing in accordance with manufacturer's nameplate rating, and free from defective material and workmanship.

### Rating

(Quantity) (normal) (high) starting torque, (low) (5-8 percent) (8-13 percent) slip, squirrel-cage induction motor(s) rated .....horsepower continuous, .....rpm, .....volts\*, .....phase, .....cycle, (open) (dripproof) (totally enclosed fan-cooled) (totally enclosed nonventilated) construction, with service factor and temperature rise in accordance with NEMA standards for the class of insulation and enclosure employed.

\* Specify a motor voltage from the following table corresponding to the nominal system voltage:

Nominal System Voltage	120	208Y/120	240	480	600	2400	4160
Motor Voltage, Polyphase	110	208-220	208-220	440	550	2300	4000

Fill in blanks and include only applicable features.

### Application

Cross out one in each pair. If "other" describe fully.

The motor(s) shall be suitable for (indoor) (other) operation in (clean, dry) (other) ambient air not in excess of 40 C at an altitude not to exceed 3300 feet.

Cross out and/or fill in. Indicate type of machine.

The output shaft(s) shall be suitable for (direct connection) (belt-drive) (other type of drive) to .....

### Electrical Characteristics

Motors shall be suitable for full-voltage starting and noninjurious heating when operated on power systems with a combined variation in voltage and frequency not more than plus or minus 10 percent of rated voltage and frequency, provided the frequency variation does not exceed five percent.

Use for 200-hp and below only.

Locked-rotor and breakdown torques and locked-rotor currents shall be as called for in the NEMA standards for the design involved.

Fill in for 250-hp and larger only.

Locked-rotor torque shall be at least .....percent full-load torque at 100 percent rated volts.

### Mechanical Characteristics

#### Fractional Horsepower

Motor shell shall be rigid, welded-steel designed to maintain accurate alignment of motor components and provide adequate protection. End shields shall be reinforced, lightweight die-cast aluminum. Windings shall be of varnish-insulated wire with slot insulation of polyester film, and baked-on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses and other hazards. Motor shafts shall be made from high-grade cold-rolled shaft steel with drive-shaft extensions carefully machined to standard NEMA dimensions for (specify type) drive connection. Bearings shall be (quiet all-angle sleeve bearings with large oil reservoir that prevents leakage and permits motor operation in any position).

If moderate thrust load, specify sleeve bearings.

If heavy thrust load, specify ball bearings.

(Carefully selected precision ball bearings with extra quality, long-life grease and large reservoir providing 10 years' normal operation without relubrication.)

# Squirrel-cage Induction Motors—Three-phase

## Squirrel-cage Induction Motors—Single-phase

### Integral-horsepower

Motor frames and end shields shall be cast iron or heavy fabricated steel of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.

Windings shall be random or form wound, adequately insulated and securely braced to resist failure due to electrical stresses and vibrations. Winding and insulating materials shall consist of one or more of the following as dictated by the motor design: silicone rubber, polyester film, synthetic varnish, or glass cloth.

The shaft shall be made of high-grade machine steel or steel forging, of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be ground and polished.

Rotors shall be made from high-grade steel laminations adequately fastened together, and to the shaft. Rotor squirrel-cage winding may be cast-aluminum or bar-type construction with brazed end rings.

Use this paragraph for integral-hp motors through 125 hp.

Motors shall be equipped with end-shield-mounted ball bearings made to A.F.B.M.A. standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of grease out of the bearing cavity.

Use this paragraph for motors 150 hp and larger.

Bearings shall be the ring-lubricated sleeve type, of a design permitting easy removal for repair or replacement. The bearing babbitt shall be securely anchored to the bearing shell. The housing shall provide ample oil-storage capacity, have convenient fill and drain fittings, and be designed adequately to protect against the entrance of foreign material and leakage of oil out of the oil reservoirs.

If additional tests are required, describe in detail.

**Other:** All motors shall receive routine tests in accordance with AIEE test procedures.

List all required accessories.

Motor accessories shall be provided as follows: (*Explain in detail requirements for brakes, thermocouples, plugging switches, bearing temperature relays, forced lubrication system, resistance temperature detectors, inherent overload protection, or other special features to be mounted on or furnished with the motor.*)

## Squirrel-cage Induction Motors—Single-phase

(Guide form specifications for single-phase motors are as given on page 14 for polyphase motors, for the "general," "application" and "electrical characteristics" portions. "Rating" section would be as follows):

### Rating

Fill in blanks and cross out where necessary.

..... (Split-phase) (Capacitor-start) induction motor(s) rated .....horsepower continuous, .....rpm, (115) (230) volts\*, single-phase (60) (50) cycles, (open) (dripproof) (totally enclosed fan-cooled) construction, with temperature rise in accordance with NEMA standards for the class of insulation and enclosure employed.

Mechanical characteristics for fractional-hp single-phase motors would be the same as for polyphase fractional-hp motors on page 14.

Mechanical characteristics for integral-hp single-phase motors would be the same as for integral-hp polyphase squirrel-cage motors.

\* Specify motor voltage from table below corresponding to nominal system voltage:

Nominal System Voltage	120	208Y/120	240
Motor Voltage	115	115	230

# Wound-rotor Induction Motors

## GUIDE FORM SPECIFICATIONS

### General

This specification is intended to cover the functional requirements, features, and general construction of horizontal 3-phase wound-rotor induction motors. All motors shall be built in accordance with current NEMA, AIEE, and ASA standards where applicable.

### Rating

Fill in blanks. \_\_\_\_\_, Wound-rotor induction motor(s) rated \_\_\_\_\_horse-  
power continuous, \_\_\_\_\_rpm, \_\_\_\_\_volts, \_\_\_\_\_  
Cross out one. \_\_\_\_\_phase, \_\_\_\_\_cycle, (*dripproof*) (*totally enclosed fan-cooled*) con-  
struction, with service factor and temperature rise in accordance with  
NEMA standards for the class of insulation employed.

### Application

Cross out where necessary. The motor(s) shall be suitable for (*indoor*) (*other*) operation in (*clean, dry*)  
If "other" describe fully. (*other*) ambient air not in excess of 40 C altitude not to exceed 3300 feet.  
Cross out and/or fill in. The output shaft(s) shall be suitable for (*direct connection*) (*belt-drive*)  
Indicate type of machine. (*other type of drive*) to \_\_\_\_\_.

### Requirements

Electrical: Motors shall be suitable for full-voltage starting with normal secondary resistance across the slip rings. Motor heating shall not be injurious when operated on power systems with a combined variation in voltage and frequency not more than plus or minus 10 percent of rated voltage and frequency, provided the frequency variation does not exceed 5 percent, in accordance with appropriate NEMA standards. The breakdown torque of the motor(s) shall be \_\_\_\_\_ percent of full-load torque. The inertia of the load (Wk<sup>2</sup>) when referred to the motor shaft will be \_\_\_\_\_lb-feet squared.

Fill in. \_\_\_\_\_  
Mechanical: Motor frames and end shields shall be cast-iron or heavy fabricated steel of such design and ample proportions to permanently and rigidly hold all motor components in proper position and provide dripproof protection. Windings shall be random- or form-wound, insulated and braced to give long and satisfactory operating life under the conditions described. Winding and insulating materials shall consist of one or more of the following as dictated by the design: silicone rubber, polyester film, synthetic varnish, or glass cloth.

The rotor windings will be well insulated and adequately retained to withstand the electrical and mechanical stresses of operation. The rotor shall be designed to withstand operation at a speed 25% above normal rated speed.

Collector rings will be of a high quality brass alloy or equivalent, adequately insulated, with liberal spacing and creepage paths to ground and between rings.

Omit reference to NEMA standards for ratings above 200 hp.

Cross out one. \_\_\_\_\_

The shaft shall be of ample size and strength and shall be made from high-grade machine steel or forged steel. The shaft extension shall be suitable for (*direct*) (*belled*) connection (in accordance with NEMA standards).

Use this paragraph for motors 1 through 125 hp.

Motors shall be equipped with end-shield mounted grease-lubricated ball bearings of ample capacity to assure long bearing life. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without motor disassembly. The bearing housing shall be designed to protect against the entrance of foreign matter into the bearings, or leakage of grease out of the bearing cavity.

Use this paragraph for motors 150 hp and larger.

Motors shall be provided with end-shield mounted, oil-lubricated sleeve bearings, except where the motor manufacturer recommends and the purchaser concurs, that for the specific rating and or application herein, pedestal-mounted sleeve bearings or antifriction bearings provide a more suitable arrangement. The bearing housings shall be designed to protect against the entrance of foreign particles or leakage of oil out of the housing. The bearing housing shall have sufficient capacity to minimize the need for frequent relubrication, and have fittings to permit draining and refilling with ease.

If additional tests are required, describe in detail.

Other—All motors shall be tested in accordance with AIEE commercial test procedures.

# Synchronous Motors

## GUIDE FORM SPECIFICATIONS

### General

This specification covers three-phase salient-pole synchronous motors of the horizontal two-bearing type with single standard shaft extension.

The motors shall be manufactured in accordance with current applicable ASA, AIEE, and NEMA standards, shall be of the type and quality specified and shall be free of defective material and workmanship.

### Rating

Fill in quantity.  
Fill in blanks, cross out one.  
Indicate enclosure required.

Cross out one

..... Synchronous motor(s) for driving ....., shall be rated ..... hp, ..... rpm, ..... volts, (1.0) (0.8) PF, 3-phase, 60 cycles, (*open*) (*dripproof*) (*enclosed for forced ventilation*) (*weather-protected*) (*totally enclosed self-ventilated with air-to-water heat exchanger*) continuous rated with (1.0) (1.15) service factor, and temperature rise in accordance with standards for the class of insulation used.

### Application

Cross out as required.  
If "other" describe fully.

The motor(s) shall be suitable for (*indoor*) (*other*) operation in (*clean, dry*) (*other*) ambient air not in excess of 40 C at an altitude not to exceed 3300 feet.

### Electrical Features

Fill in type of load and its inertia.

The motor(s) shall be suitable for across-the-line starting with full-voltage torques in accordance with appropriate NEMA standards for the rating. The motor(s) shall be designed to accelerate and synchronize the ..... having ..... lb-ft<sup>2</sup> inertia maximum.  
The motor(s) shall be suitable for operation with 10 percent plus or minus voltage variation, or five percent frequency variation in accordance with ASA standards.

### Mechanical Features

Indicate arrangement and mounting required.

The motor(s) shall be furnished (*with base*) (*without base but with foundation caps*) (*without base or foundation caps*) for mounting on (*concrete foundation*) (*subbase furnished by others*).

All motors shall be assembled at the factory to assure that all parts are properly fitted and working clearances checked. Suitable provision shall be made for lifting parts, requiring disassembly as units, without damage to the parts.

### Stator

The stator frame shall be of fabricated or cast construction designed to give ample strength and rigidity for support of the stator punchings. The stator core shall be built up of thin sheets of high-grade low-loss silicon sheet steel securely supported and clamped under heavy pressure in the frame. Each lamination shall be coated with high-grade insulating enamel.

Stator windings shall be random or form wound, insulated and braced to resist failure due to electrical stresses and vibrations. Insulating materials shall consist of one or more of the following as dictated by the motor design: silicone rubber, varnished cambric, polyester film, synthetic varnish, or glass cloth.

# Synchronous Motors

---

Specify value of possible overspeed.  
Standard design covers 25 percent.

## Rotor

The rotors shall be designed to withstand safely the peripheral and axial forces of operation at .....percent overspeed in terms of normal rated speed in either direction of rotation.

The shaft shall be of ample size and strength to assure conservative stresses and shall be made from high-grade machine steel or forged steel. The bearing journals shall be ground and polished.

The rotor coils shall consist of rectangular copper wire or edge-wise wound copper strip. The coil insulation will be cemented between turns and baked. The start and finish ends of the coil shall be silver brazed to copper terminal strips in order to produce reliable mechanical and electrical joints.

## Field Poles

The field-pole laminations shall be assembled accurately under heavy pressure and securely riveted to form the field poles. The field poles shall be secured firmly to the rotor spider with a design that insures conservative stresses at the specified overspeed.

The amortisseur bars shall be securely built into the field poles and joined to the end-ring segments to provide a low resistance and mechanically strong starting windings. The end-ring construction shall permit any pole or group of poles to be removed without difficulty.

## Collector Rings

The collector rings shall be easily accessible for maintenance and stoning from the end of the motor frame and shall be well insulated and the shaft end rigidly supported thereto with accurate, concentric alignment.

The brush rigging shall be rigidly supported from the bearing housing with at least two brushes per ring. Brushes shall be accessible without disassembling any part of the equipment. An adjustable spring-tension device shall be provided.

## Bearings

The bearings shall be of the sleeve type arranged with rings for self oiling. The babbitt lining shall be securely anchored to the bearing shell. The bearing housing shall be designed to provide an ample oil reservoir and to prevent leakage of oil. The bearings shall be of a design permitting easy removal and replacement.

List all required accessories.

Motor accessories shall be provided as follows: (*Explain in detail requirements for brakes, thermocouples, bearing temperature devices, or other special features to be mounted on or furnished with the motor(s)*).



# Squirrel-cage Induction-motor Control

## GUIDE FORM SPECIFICATIONS Manual Squirrel-cage Induction-motor Starters

### General

- Cross out one.** | This specification covers a nonreversing manual (*full-voltage*) (*reduced-voltage*) starter to control a .....hp, .....volt, .....  
**Fill in.** | .....phase, .....cycle, .....C rise squirrel-cage induction motor.

### Full Voltage

- Fill in.** | Full-voltage motor starter, NEMA Size ....., .....pole  
**Cross out one.** | (*toggle operated*) (*push-button operated*), with thermal overload protection, and mounted in a NEMA type.....enclosure.  
**Fill in.** | .....

### Reduced Voltage

- Cross out one.** | Reduced-voltage autotransformer-type motor starter with instantaneous undervoltage protection, (*two*) (*three*) phase overload protection, STOP-RESET button in cover and mounted in a General Purpose, NEMA Type 1 dead-front enclosure. Autotransformer to have a core and three coils, each with taps marked 50% and 65% (50%, 65%, and 80% for over 50 hp) of line voltage. Starter handle to be mechanically interlocked to prevent starting on full voltage.

## Magnetic Squirrel-cage Induction-motor Starters

### General

- Cross out one.** | This specification covers a magnetic (*nonreversing*) (*reversing*) starter, (*full-voltage*) (*reduced-inrush*) for a .....hp, .....volt, .....  
**Cross out one.** | .....phase, .....cycle, .....C rise squirrel-cage induction motor driving a .....

- Fill in.** | Control to be NEMA Size .....

- Cross out two.** | It shall have (1) (2) (3) phase thermal overload protection and undervoltage protection when used with momentary-contact pilot devices or undervoltage release when used with maintained-contact pilot devices.

Reduced-inrush starter shall be of the:  
autotransformer type with closed-circuit transition. Taps shall be provided at 50% and 65% (also 80% for 50 hp and above) of line voltage.

- Fill in.** | primary-resistor type, .....steps, with NEMA Class (*116*) (*general starting duty*) (*156 heavy starting duty*) (.....) resistor.  
**Cross out two.** | .....

Select one for  
reduced-inrush  
starters.

primary-reactor type, with one step of reduced voltage with taps for 50% and 65% (also 80% for 50 hp and above) of line voltage.

- Cross out one.** | part-winding reduced-inrush, type (*3-3 pole*) (*4-2 pole*).

- Cross out one.** | wye-delta (*open*) (*closed*) transition type.

# Squirrel-cage Induction-motor Control

Omit for full-voltage starters. | Starter shall contain a definite time-delay relay to transfer from start to run connection.

Reversing starter only. | Reversing contactors shall be interlocked to prevent one picking up when the other is energized.

Cross out one. | The starter shall be of the *(non-combination type capable of interrupting 10 times motor full load rating) (combination type)* with:

Use for combination forms Size 0-5.

Cross out three. | *(molded-case circuit breaker) (fusible\* disconnect switch) (short-circuit device) (or non-fusible disconnect switch)* mounted within the enclosure.

Cross out one. | The *(circuit breaker) (disconnect)* shall have an interrupting rating of  
Fill in. | .....amperes RMS asymmetrical.

Use for combination forms Size 6-9.

Cross out four. | *(molded-case circuit breaker) (switchgear-type stationary air circuit breaker) (switchgear-type drawout air circuit breaker) (fused motor-circuit switch with current-limiting fuses) (combined air circuit breaker and current-limiting fuses)* capable of interrupting an available short-circuit current of .....RMS amperes asymmetrical at the load terminals of the starter.

Fill in. | .....RMS amperes asymmetrical at the load terminals of the starter.

## Enclosure

Include only type of enclosure wanted. | Enclosure to be *(general-purpose, NEMA Type 1) (NEMA Type 1 gasketed) (driptight NEMA Type 2) (weather-resistant NEMA Type 3) (watertight, NEMA Type 4) (Class I, Groups C and D, NEMA Type 7) (Class II, Groups E, F and G, NEMA Type 9) (dust-tight and industrial-use, NEMA Type 12)*.

Include for combination starters only.

Cross out two. | The *(circuit breaker) (disconnect switch) (motor-circuit switch)* shall be operable by hand from outside the enclosure and shall be so interlocked with the door or doors that it must be returned to the OFF position before the door can be opened.

*(Specify push button or other pilot devices to be used with above).*

\* Fuses are not supplied with the switch.

# Wound-rotor Induction-motor Control

## GUIDE FORM SPECIFICATIONS

### Fully Magnetic Controllers

#### General

**Cross out as necessary.** This specification covers an a-c magnetic air-break primary and secondary full-voltage (*non-reversing*) (*reversing*) controller for (*starting*) (*starting and speed regulating*) of a ..... hp, ..... volt, ..... phase, ..... cycle, ..... rpm, ..... C rise wound rotor induction motor driving ..... Control to be NEMA size ..... It shall have (2) (3)-phase thermal overload protection and undervoltage protection when used with momentary-contact pilot devices or undervoltage release when used with maintained-contact pilot devices.

#### Primary

**Cross out one.** It shall be of the (*noncombination type without short-circuit protection*) (*combination type*) with:  
**Select only one—for combination type only.** (*molded-case circuit breaker*) (*switchgear type stationary air-circuit breaker*) (*switchgear type drawout air circuit breaker*) (*fused motor-circuit switch with current-limiting fuses*) (*combined air circuit breaker and current-limiting fuses*) capable of interrupting an available  
**Specify.** short-circuit current of ..... RMS amperes asymmetrical at the load terminals of the controller.  
**Reversing starters only.** Reversing contactors shall be mechanically interlocked.

#### Secondary

**Fill in blanks.** Secondary control shall be fully magnetic and shall provide automatic acceleration through ..... steps with uniform torque peaks using a NEMA Class ..... resistor.  
**Fill in for regulating service only.** The control shall provide for continuous speed regulation at ..... points of speed reduction with a maximum reduction of ..... percent full-load speed at ..... percent full-load torque.  
**Cross out one.** The secondary resistor shall be (*mounted, wired, and enclosed in the same panel or type of panel as the primary control*) (*furnished for separate mounting and wiring at installation*).

#### Enclosures

**Indicate type of enclosure desired.** Enclosure to be (*general-purpose, NEMA Type 1*) (*NEMA Type 3, weather-resistant*) (.....).  
**Cross out one.** The (*circuit breaker*) (*motor-circuit switch*) shall be operable by hand from outside the enclosure and shall be so interlocked with the door or doors that it must be returned to the OFF position before the door can be opened.  
**Include for combination starters only.**

### Magnetic Primary—Manual or Motor-operated Secondary Controllers

**Primary Control.** Specify full-voltage nonreversing or reversing controller per pages 16 and 17.

#### Secondary Control

**Use if required.** **Manually Operated Drum Switch.** The secondary controller shall consist of a ..... amp  
**Fill in.** 11-point manually operated drum switch providing .....balanced points for continuous operation. The switch shall be provided with a (*horizontal operating handle*) (*switchboard-type operating mechanism with handwheel*).  
**Cross out one.**  
**Use if required. Fill in.** **Motor-operated Cam Switch.** The secondary controller shall consist of a ..... amp (13) (20)-point motor-operated cam switch with all points balanced for continuous operation. The switch shall be enclosed in a (*conventional cam-switch housing*) (*NEMA Type ..... enclosure to match and line up with the primary control*). The pilot motor shall operate from a .....-volt (*three-phase a-c*) (*d-c*) system, and shall be provided with a control panel  
**Cross out one. Fill in.** giving automatic acceleration through three points for starting.  
**Fill in blank and cross out one.**

#### Resistor

**Fill in.** **Starting-duty Only.** The secondary resistor shall be NEMA Class ..... providing uniform  
**Fill in.** torque peaks through ..... starting steps. The resistor shall be furnished in the form of  
**Cross out one.** (*open boxes suitable for stacking*) (*open multitier frames suitable for floor mounting*).  
**Speed-regulating with Starting Section.** The secondary resistor shall provide a maximum  
**Fill in.** speed reduction of ..... percent at ..... percent full-load torque. Intermediate speed points shall be selected on the basis of efficient design. The starting section shall be NEMA Class .....  
**Fill in.** providing uniform torque peaks through ..... starting steps. The resistor shall be furnished  
**Cross out one.** in the form of (*open boxes suitable for stacking*) (*in open multitier frame suitable for floor mounting*).

# Synchronous-motor Control—Magnetic

## GUIDE FORM SPECIFICATIONS

### General

**Cross out one.** This specification covers an a-c magnetic, air-break, nonreversing (*full-voltage*) (*reduced-voltage autotransformer type with closed-circuit transition*) starter for a  
**Fill in.** .....hp, .....volt, .....phase, .....cycle .....rpm,  
.....power factor, .....C rise synchronous motor driving.....

**Fill in.** Control to be NEMA size.....

It shall provide undervoltage protection when operated with momentary-contact pilot devices and undervoltage release when operated with maintained-contact pilot devices. It shall also provide

- 1) stator-winding thermal overload protection
- 2) graduated squirrel-cage winding overheating protection.

**Cross out one.** It shall be (*without short-circuit protection*) (*combination type*) with:

**Include form required only.** (*molded-case circuit breaker*) (*switchgear type stationary air circuit breaker*) (*switchgear type drawout air circuit breaker*) (*fused motor-circuit switch with current-limiting fuses*) (*combined air circuit breaker and current-limiting fuses*) capable of interrupting an available short-circuit current of .....RMS amperes asymmetrical at the load terminals of the starter.  
**Fill in ampere rating.**

### Field Application and Removal

D-c field control shall be fully magnetic and fully automatic and shall provide

- 1) precision-angle switching to apply field at the point of maximum flux between rotor and stator poles and
  - 2) load-angle field removal to disconnect the (*field*) (*field and armature*) before the motor falls out of step on overload.
- Cross out one.**

### Enclosure

**Indicate one.** Enclosure to be (*NEMA Type 1, general-purpose*) (*NEMA Type 3, weather-resistant*) (*other* .....

The field starting and discharge resistor shall be mounted on top of the enclosure or inside the enclosure as dictated by best design.

**Cross out one.** The (*circuit breaker*) (*fused motor-circuit switch*) shall be operable by hand from outside the enclosure and shall be interlocked with the door or doors so that the latter cannot be opened until the (*breaker*) (*switch*) is returned to the OFF position.  
**Cross out one.**

**Specify finish required.** Finish shall be (*ASA-61 gray enamel over a phosphate undercoat for indoor use*) (*ASA-49 enamel over one or more rust-resistant undercoats for outdoor use*).

|(Specify push button or other pilot devices to be used with above).

# Motor Control Centers

## GUIDE FORM SPECIFICATIONS

This specification covers a NEMA Class (I) (II) Type (A) (B) (C) motor control center in NEMA Type \_\_\_\_\_ enclosure for installation at \_\_\_\_\_

The control center shall have a short-circuit capacity of \_\_\_\_\_ rms amp asymmetrical available at the incoming-line terminals.

### SECTIONS

The control centers shall consist of (90) (78) in. high (20) (13) in. deep vertical sections bolted together to form a single-unit assembly. A removable lifting angle shall be provided at the top. Removable floor sills shall be provided at the bottom.

### WIRING COMPARTMENTS

Pull-box compartments for horizontal wiring shall be provided at top and bottom of the control center. A vertical wiring compartment provided with a separate front door and isolated from device compartments shall be provided in each section. A rear compartment accessible through grommetted (when specified) holes in front and doors and covers in the rear shall also be available for vertical section wiring. Terminal boards for each section (used in Type C wiring) shall be located at the (top) (bottom).

### UNIT COMPARTMENTS

Each unit compartment shall be provided with an individual front door. Starters and feeder unit doors shall be interlocked mechanically with the unit disconnect device to prevent unintentional openings of the door with power on and unintentional application of power while door is open. Means shall be provided for releasing the interlock for intentional access to the interior at any time and intention application of power, if desired, while door is open. Padlocking arrangements except for low-voltage power breakers shall permit locking the disconnect device (OFF) (ON and OFF) with a maximum of three padlocks with door closed or open.

Overload relays shall be reset from outside the enclosure by means of an insulated bar or button.

Starter disconnect devices shall be operable from outside the enclosure and shall show position of disconnect device whether compartment door is closed or open.

Starter units shall be drawout (if NEMA Type B or C wiring) in Sizes 1 through 4 except for load terminals in Sizes 3 and 4. Stab-in power terminals shall be of a type that will increase contact pressure on short circuits.

### BUS

Power shall be distributed horizontally within the control center by three-phase bus rated (600) (1200) amp continuous and braced for (25000) (50000) amp rms asymmetrical short-circuit current. The bus shall be effectively isolated from all wiring troughs and other working areas. Access shall be provided for inspection and maintenance from the front.

Power within vertical sections shall be distributed by insulated three-phase bus.

Insulation shall be by UL listed flame-retardant material.

Phase relationship of stab-in terminals for back-mounted starter and feeder units shall be the same as for front-mounted units.

Ground bus (shall) (shall not) be provided. Neutral bus (shall) (shall not) be provided.

### INCOMING-LINE PROVISION

Provision shall be made for termination of incoming-line (cable) (busway) —

- (a) at terminals of incoming power protective device,
- (b) at terminal board(s) in (upper) (lower) space unit of designated section(s),
- (c) at terminal board in blank incoming-cable section,
- (d) at busway entrance,
- (e) in transition section from transformer,
- (f) in transition section furnished as part of G-E switchboard.

### OUTGOING CABLE PROVISION

Space shall be provided for carrying outgoing cables through either top or bottom of all standard sections.

## EQUIPMENT

Control center shall be furnished with the following items of equipment:

### INCOMING-LINE DEVICES

Incoming-line molded-case circuit breaker, \_\_\_\_\_ amp frame size, \_\_\_\_\_ amp trip rating.

Incoming-line low-voltage power circuit breaker \_\_\_\_\_ amp frame size, \_\_\_\_\_ amp trip coil, with (long-time and instantaneous) (long-time, short-time and instantaneous) adjustable trips.

Incoming-line fused switch rated \_\_\_\_\_ amp continuous and equipped with \_\_\_\_\_ amp current limiting fuses.

Incoming-line fusible switch, rated \_\_\_\_\_ amp continuous.

Incoming-line hook-stick-operated current-limiting fuses rated \_\_\_\_\_ amp.

Incoming-line reactor rated (600) (800) (1000) amp continuous for limiting a maximum of 100000 amp available short-circuit current to (15000) (25000) rms amp.

# Motor Control Centers

## SQUIRREL-CAGE MOTOR STARTERS

(Circuit-breaker) (Fusible-switch) combination starters for squirrel-cage induction motors as follows:

Qty \_\_\_\_\_ (Full-voltage) (Reduced-voltage) (nonreversing) (reversing) starter for \_\_\_\_\_ hp, \_\_\_\_\_ rpm motor driving \_\_\_\_\_

Starter to be provided with \_\_\_\_\_. (Indicate fuses, push buttons, indicating lights, interlocks and other modifications or accessories.)

## SYNCHRONOUS-MOTOR STARTERS

(Circuit-breaker) (Fusible-switch) combination starters for synchronous motors as follows:

Qty \_\_\_\_\_ (Full-voltage) (Reduced-voltage) starter for \_\_\_\_\_ hp, (0.8) (1.0) PF, \_\_\_\_\_ rpm synchronous motor driving \_\_\_\_\_

Starter to be provided with \_\_\_\_\_. (Indicate fuses, push buttons, indicating lights, interlocks and other modifications or accessories.)

## WOUND-ROTOR-MOTOR STARTERS

(Circuit-breaker) (Fusible-switch) combination starters for wound-rotor induction motors as follows:

Qty \_\_\_\_\_. (Nonreversing) (Reversing) starter with NEMA Class 135 resistor and NEMA standard number of accelerating points for \_\_\_\_\_ hp, \_\_\_\_\_ rpm wound-rotor induction motor driving \_\_\_\_\_. Starter to be provided with \_\_\_\_\_. (Indicate fuses, push buttons, indicating lights, interlocks, and other modifications and accessories required.)

## OPERATOR'S PANELS

Operator's panels shall be provided as follows:

Unit No. \_\_\_\_\_. Panel containing (push buttons) (selector switches) (indicating lights) (volts) (ammeters) (other devices) for control of \_\_\_\_\_. (Indicate starter units or other units to be controlled.)

## RELAY PANELS

Relay panels shall be provided to contain the following:

(Specify type of relay and function.)

## FEEDER UNITS

Feeder units shall be provided as follows:

### Molded-Case Circuit Breakers

Qty \_\_\_\_\_, \_\_\_\_\_-amp frame size molded-case circuit breaker with \_\_\_\_\_-amp trip for \_\_\_\_\_. (Indicate service designation.)

### Low-voltage Power Circuit Breakers

Qty \_\_\_\_\_, \_\_\_\_\_-amp frame size (stationary) (drawout) (manually operated) (electrically operated) low-voltage power circuit breaker with long-time and instantaneous characteristics, and \_\_\_\_\_-amp trip for \_\_\_\_\_. (Indicate service designation.)

### Fusible Switches

Qty \_\_\_\_\_, \_\_\_\_\_-amp fusible switch equipped with \_\_\_\_\_-amp (CLF) (NEC) fuses.

## LIGHTING PANELBOARDS

Lighting panelboards with plug-in breakers and main lugs only.

Qty \_\_\_\_\_, \_\_\_\_\_-circuit, \_\_\_\_\_-volt \_\_\_\_\_-wire, \_\_\_\_\_-phase panelboard for \_\_\_\_\_. (service designation).

## LIGHTING OR POWER TRANSFORMER

Dry-type transformer(s) complete with primary (circuit breaker) (fusible switch) as follows:

Qty \_\_\_\_\_, \_\_\_\_\_kva (single-phase) (three-phase) transformer with (120) (120/240) (120/208 Y) volt secondary.

## OTHER EQUIPMENT

(Specify other equipment to be included and indicate function: If equipment is to be supplied to control manufacturer for mounting, supply dimensions.)

## FINISH

Control center to be finished in manufacturer's standard (indoor) (outdoor) finish. (Specify other finish if required.)

## PANEL LAYOUT

Panel layout to be (in accordance with manufacturer's approved plan) (in accordance with sketch enclosed).

## Reference:

GEA-7238 7700 Line Motor Control Centers  
GET-3101 7700 Line Motor Control Centers  
(Selection and Application)

# Cabinetrol Power Centers

## GUIDE FORM SPECIFICATIONS

This specification covers Cabinetrol Power Center(s) to provide the functions and/or electrical equipment as follows: (Itemize or indicate by one-line diagram.)

Incoming-line devices	Incoming-line ( <i>stationary</i> ) ( <i>drawout</i> ) switchgear-type circuit breaker ( <i>manually</i> ) ( <i>electrically</i> ) operated. Incoming-line fused switch equipped with current-limiting fuses. Incoming-line current-limiting reactor for reducing available short-circuit current of 100,000 amp to 25,000 amp. Incoming-line terminals on power center bus.
Motor starters	( <i>Full-voltage</i> ) ( <i>reduced-voltage</i> ) ( <i>reversing</i> ) ( <i>nonreversing</i> ) combination starter for ___ hp, ___ volt, ___ rpm ( <i>squirrel-cage</i> ) ( <i>wound-rotor</i> ) ( <i>synchronous</i> ) ( <i>d-c</i> ) motor for driving. ( <i>Indicate it multi-speed or adjustable speed and method of speed control required. Indicate operator's devices to be furnished.</i> )
Feeders	( <i>Circuit-breaker</i> ) ( <i>fused-switch</i> ) feeder rated ___ amp.
Lighting panels	( <i>number</i> ) -circuit lighting panel rated ___ volts, ___ amp.
Instruments and meters	List items by function.
Relaying and sequencing	Describe or include elementary diagram.
Additional equipment	List equipment and/or special functions required.
Power supply	The power center shall be designed to be fed from a ___ volt, ___ phase, ___ wire, ___ cycle power supply. It shall be capable of interrupting a short-circuit current of ___ amp RMS asymmetrical available at the point of connection to the power supply.
Panel construction	Electrical equipment shall be housed in 90-inch high metal cabinets bolted together and mounted on supporting floor sills. A removable lifting angle shall be provided by which an entire panel or shipping length can be handled. Metal cabinets shall be fabricated from smooth 3/32-inch sheet steel. All-welded construction shall be used and outside joints ground to a smooth finish. Angle iron members shall be welded in position to support enclosed equipment. No bolt heads shall show on front of panel. Cabinets shall be divided by sheet-steel barriers into individual compartments for motor starters or other units. Each compartment shall have an individual front door equipped with T-

handle and cylinder lock and labeled with laminated plastic nameplate. A full-length access door shall be provided at the rear of all cabinets and shall be equipped with handle and cylinder lock.

Doors shall be of pan type with edges turned back 90 degrees and shall be mounted on fully concealed hinges with stops for the 90 degree open position. Doors shall close on L-shaped flanges in a construction which will effectively exclude dust.

Power within the center shall be distributed by an overhead three-phase power bus rated in accordance with NEMA temperature-rise standards. It shall be braced to withstand short-circuit current equal to the interrupting rating of the center.

Ground bus (*is*) (*is not*) required.

Terminal boards shall be provided at the rear of motor starters and other units for connection of load and external control cable. The terminal board shall be labeled in accordance with the wiring diagram and shall be provided with solderless-type connectors. It shall be possible to bring incoming and outgoing cables through either the top or bottom of a cabinet.

Operating handles for manually operated air-circuit breakers and fused switches shall be mounted on front compartment doors. Handle operating mechanisms on motor starter compartments shall be mechanically interlocked so that the starter door cannot be opened unless breaker or switch is "OFF." The operating mechanism shall have provision for locking in either "ON" or "OFF" position.

A reset button shall be provided on each starter door for external resetting of overload relays.

The power center shall be built in (*indoor*) (*outdoor*) (*outdoor "walk-in"*) enclosure. It shall be finished in (*two-tone gray, ASA-61, with ASA-33, interior finish*) (*ASA-49 outdoor finish*) (*other*).

All components of a given size and rating shall be of like manufacture and shall be tested for operation at the factory before shipment.

### Drawings

Engineering sketches of panel layout and elementary diagram shall be submitted to purchaser for approval before manufacture. Finished drawings of panel layout, elementary diagram and connection diagram shall be furnished for installation in the field.

**Reference:** GEA-7080 Cabinetrol Power Centers  
GET-3041 Cabinetrol Power Centers  
(Application Information)

# Limitamp Control

## GUIDE FORM SPECIFICATIONS

### general

**Cross out if individual starter.** | These specifications cover a (*line-up*) of high-interrupting-capacity medium-voltage controller(s),  
**Cross out one in each group.** | (*full-voltage*) (*reduced-voltage, reactor type*) starting, (*nonreversing*) (*reversing*)  
**Fill in.** | for control of.....type motor(s) rated .....hp, .....volt,  
 .....phase, .....cycle, .....PF .....C rise.

**Cross out one.** | Controller(s) shall be fused-type employing current-limiting power fuses that give the controller an interrupting capacity of (*150,000 kva, 3-phase, symmetrical at 2300 volts, 50/60 cycles*) (*250,000 kva, 3-phase, symmetrical at 4000 volts or 4600 volts, 50/60 cycles*). Controller(s) shall employ magnetic air-break line contactor(s) rated 400 amp, 5000 volts and have an interrupting capacity of 50,000 kva, 3-phase, asymmetrical.

**State arrangement required and fill in type of enclosure.** | Controller(s) shall be  
 In a line-up of NEMA.....enclosures with 3-phase, 1000-amp, a-c power bus.  
 In free-standing individual NEMA.....enclosure(s) with incoming-power terminal board.

For safety to personnel, enclosure(s) shall be compartmented into low-voltage control compartment, medium-voltage control compartment, a-c bus compartment and cable-entrance compartment.

The controller shall be isolated by externally operated drawout fuses with shutter mechanism. The isolating device shall also open the secondary of the control power transformer.

Interlocks shall be provided to prevent (1) inadvertent operation of the isolating mechanism under load, (2) opening the medium-voltage compartment door without isolating the controller, and (3) closing the line contactor with door open.

Line contactors shall be draw-out type.

For overload protection, ambient-compensated thermal overload relays, hand-reset, shall be included in two phases.

*RECOMMENDED OPTION: Ground-fault protection utilizing "feed-through" current transformer and instantaneous overcurrent relay.*

### for wound-rotor induction motors

**Fill in.** | Secondary control shall be fully magnetic. It shall provide automatic acceleration through.....

**Fill in.** | starting steps with uniform torque peaks using a NEMA Class.....resistor.

**Fill in this section only if regulating duty is required.** | The control shall provide for continuous speed regulation with.....points of speed reduction with a maximum reduction of.....percent from full-load speed at.....percent full-load torque.

### for synchronous motors

D-c field control shall be fully magnetic and fully automatic and shall provide

1. Precision-angle switching to apply field at the point of maximum flux.

**Cross out one.** | 2. Load-angle field removal to disconnect the (*field*) (*field and armature*) before the motor falls out of step on overload.

Protection for the squirrel-cage starting winding shall be provided by graduated ambient-compensated thermal relay.

### additional functions

Control power shall be provided from a control-power transformer, 230-volt secondary, in each controller. Current-limiting fuses for the transformer shall be provided.

**Cross out one.** | Instantaneous undervoltage protection shall be provided, when used with a momentary-contact push button (*mounted on the controller door*) (*mounted externally*).

**Cross out one.** | Undervoltage release shall be provided when used with a maintained-contact control switch (*mounted on the controller door*) (*mounted externally*).

**Include paragraph applying.**

### finish shall be

**State finish required.** | ASA-61 gray enamel over rust-resistant phosphate undercoat (indoor use).

**State finish required.** | ASA-49 enamel over one or more rust-resistant undercoats (outdoor use).

**Reference:** GEA-6893A Limitamp Motor Control



# Speed-variator Drives—3–500 Hp

## GUIDE FORM SPECIFICATIONS

### General

**Describe type of load.** This specification covers a packaged adjustable-speed drive providing power to (.....).  
It shall consist of a d-c motor(s), conversion unit and operator's control station.

### Motor

**Fill in and select rating.** The motor shall be ..... hp, (1750) (1150) (850) rpm base speed, (8) (.....): 1 speed range constant torque by armature control, .....: 1 speed range constant horsepower by field control, 240 volts d-c, shunt wound.

**Cross out three.** Enclosure (*open*) (*dripproof*) (*blower ventilated*) (*totally enclosed, fan-cooled*).  
(See Book II, Sect. 3 for d-c motor details.)

**Cross out two.** (*Concentric*) (*offset*) (.....) gear, with ..... rpm corresponding to base motor speed, gear ratio .....:1.  
**Fill in rating.**

**Specify if speed indication is required (tachometer may be included to meet drive requirements).** Motor mounted (*a-c*) (*d-c*) tachometer generator with (*panel*) (*switchboard*) ..... instrument calibrated ..... (*ipm*) (*fpm*) (*rpm*) (.....) equalling ..... rpm of the motor with scale 0 to ..... (*ipm*) (*fpm*) (*rpm*).

**Cross out one.** Instrument shall be mounted on the (*operator's panel*) (.....).

**Cross out one.** Motor-mounted blower (*with*) (*without*) filter; blower-motor power supply ..... volts, ..... phase, ..... cycles.  
**Fill in rating.**

**Omit if not required.** Blower-motor starter to be included in control.

Optional.  
Specify as  
required.

### Power Unit

**Specify hp equal to total motor hp, indicate power supply.** The ..... hp, power rated for (208) (230) (460) (600) volt, three-phase, (*sixty*) ( ) cycle power supply, shall consist of a sheet-steel cabinet with service doors, containing the following machines, functions and devices:

Two-unit, four-bearing m-g set with full Class B insulated d-c generator and induction motor mounted on a self-supporting base.

Air filter.

**Specify this paragraph for 1-150 hp.** M-g set starter consisting of full-voltage line starter with overload and undervoltage protection.

**Specify this paragraph for 200-500 hp.** Electrically operated air circuit breaker, full-voltage, m-g set starter with overcurrent and undervoltage protection, open- and close-position indicator and provision for padlocking in the open position. Breaker to be suitable for ..... ampere interrupting capacity.  
**Fill in.**

START-STOP cabinet-mounted push button for m-g set.

**Select one** Static regulator with adjustable rates of acceleration and deceleration and with silicon rectifier a-c to d-c conversion. Regulator to provide speed regulation of (5) (2) (.5) (.1) % of base speed.

Loop contactor.

Thermal overload protection for each d-c motor.

Silicon rectifier exciter for control and motor field power.

D-c control instantaneous overcurrent protection.

List other desired functions such as reversing, jogging, dynamic braking, full-field starting, etc., describing as fully as possible, purpose of function.

### Operator's Control Panel

**Use this paragraph for standard station.** Operator's control station shall be in NEMA 1 wall-mounted enclosure and shall include "start" and "stop" push buttons for the d-c motor together with speed-adjusting potentiometer.

Select  
one  
paragraph.

**Use this paragraph for special stations and list in detail the functions to be included.** Operator's control station shall be furnished in (*NEMA Type 1*) (*oiltight*) enclosure for (*wall*) (*floor*) (*special*) mounting and shall contain suitable units for providing control functions as required.

**Parmatic (Amplistat) Speed Variator 1-200 hp  
Thymotrol (Thyratron tube) Speed Variator 1-10 hp  
Inductrol (Inductrol and Silicon Diode) Drives**

**GUIDE FORM SPECIFICATIONS**

**General**

**Cross out three** | This specification covers a (*Parmatic Speed Variator*) (*Thymotrol Speed Variator*) (*Inductrol*) d-c drive providing power to (.....).  
**Describe type of machine.** | It shall consist of a d-c motor, static conversion unit and operator's control station.

**Item A. Motor**

Motor details would be similar for each type of drive.

**Fill in rating. See Book II, Section 3 for d-c motor data.** | The motor shall be ..... hp (*3450*) (*2500*) (*1750*) (*1150*) (*850*) rpm base speed, (*50*) (*33*) (*20*) (*8*) (.....) to 1 speed range constant torque by armature control, (*4*) (.....) to 1 speed range constant horsepower by field control, voltage as determined by system design.

**Cross out three.** | Enclosure (*open*) (*dripproof*) (*blower-ventilated*) (*totally enclosed, fan-cooled*).

**See Book II, Section 5 for gear-motor details.** | (*Concentric*) (*offset*) (.....) gear, with ..... rpm gear output speed corresponding to base motor speed.

Optional. Specify as required.

**Specify if speed indication is required (tachometer may be included to meet drive requirements).** | Motor-mounted (*a-c*) (*d-c*) tachometer generator ..... with (*panel*) (*switchboard*) type instrument calibrated ..... (*ipm*) (*fpm*) (*rpm*) (.....) equalling ..... rpm of the motor with scale 0 to ..... (*ipm*) (*fpm*) (*rpm*) (.....).

**Indicate mounting.** | Instrument shall be mounted on the (*operator's panel*) (.....).

**Cross out one. Indicate rating.** | Motor-mounted blower (*with*) (*without*) filter; blower motor (*208*) (*220*) (*440*) (*550*) volts, three-phase (*25*) (*50*) (*60*) cycles. (*Blower-motor starter to be included in control.*)

**Item B. Power Unit—Thymotrol Drive**

**Select rating. Select hp equal to total motor hp.** | The controller shall be for a ..... hp motor and shall operate from a (*208*) (*230*) (*460*) three-phase, (*50*) (*60*) cycle power supply. It shall be housed in a NEMA Type 1 general-purpose enclosure. It shall consist of an anode transformer, controlled rectifiers, and shall provide the following functions:

Include only those items required.

- Specify regulation.** | Speed regulation no-load to full-load, (*5*) (*2*) (*.5*) (*.1*) % of base
- Dynamic braking—Jogging—Reversing
  - Quick slowdown
  - Thymotrol drive to follow speed changes in main drive
  - Tachometer feedback
  - Auxiliary starters or relays—number and functions

**Cross out one.** | (*Autotransformer*) (*Isolation transformer*) shall be used in power supply.  
 Describe any special drive requirements.

**Parmatic (Amplistat) Speed Variator 1-200 hp**  
**Thymotrol (Thyratron tube) Speed Variator 1-10 hp**  
**Inductrol (Inductrol and Silicon Diode) Drives**

**Item B. Conversion Unit—Power-amplistat Drive**

Select rating.  
 Select hp equal  
 to total motor hp.

The ..... hp power unit for (208) (230) (460) volt, three-phase, (50) (60) cycle power supply shall consist of a sheet-steel cabinet with service doors. It shall consist of controlled magnetic amplifiers and rectifiers, and shall include the following functions and devices:

Static regulator with independently adjustable rates of acceleration and deceleration and with silicon rectifier a-c to d-c conversion.

Fill in. | Speed regulator 25-100 % load (2) (1) (.5) (.1) % of top speed

Thermal overload protection for each d-c motor.

Silicon rectifier exciter for control and motor field power.

D-c control instantaneous overcurrent protection.

List other desired functions such as reversing, jogging, dynamic braking, etc., describing as fully as possible purpose of function.

**Item B. Conversion Unit—Inductrol D-c Drives**

Fill in rating. | The controller shall be for a ..... hp motor and shall operate from a

Cross out three. | (208) (230) (460) volt, three-phase, (50) (60) cycle power supply.  
 Cross out two. | It shall be housed in NEMA Type 1 general-purpose floor-mounted enclosures. It shall consist of an induction-voltage regulator, a voltage changing transformer, and a silicon rectifier. The following features shall be provided:

Reversing

Jogging

Dynamic Braking

Specify  
 features  
 required.

Fill in. | Timed acceleration, ..... rpm to ..... rpm in .....secs.

Fill in. | Timed deceleration, ..... rpm to ..... rpm in .....secs.

Automatic acceleration to preset speed

Fill in. | Speed regulation no-load to full-load ..... % of base speed.

**Item C. Operator's Control Station**

Use this paragraph for  
 standard station.

Operator's control station shall be in NEMA 1 wall-mounted enclosure and shall include "start" and "stop" push buttons for the d-c motor together with speed-adjusting potentiometer.

Use this para-  
 graph for special  
 stations and list  
 in detail the  
 functions to be  
 included.

Cross out one.  
 Cross out two.

Operator's control station shall be furnished in (NEMA Type 1) (oiltight) enclosure for (wall) (floor) (special) mounting and shall contain suitable units for providing the following functions: .....

# Kinatrol (Eddy-current Coupling) Speed Variator Drives 1-750 hp

## GUIDE FORM SPECIFICATIONS

### Kinatrol Eddy-current Coupling Drive

Specify quantity  
and  
describe machine.

This specification covers a packaged adjustable-speed drive to power and control a ..... machine. It shall consist of ..... eddy-current coupling drive unit(s) with control and operator's control station as follows:

Fill blanks and cross out choices to specify rating.

#### Drive Unit

Eddy-current coupling drive unit(s) ..... hp, ..... rpm for (208) (230) (460) volts, three-phase, (50) (60) cycle power supply (air cooled dripproof) (water cooled) horizontal, ball-bearing, to operate over a speed range of ..... rpm to ..... rpm with tachometer generator for speed regulation. Torque will be ..... and ..... foot-pounds, respectively.

#### Drive-unit Accessories

Speed-reducing gear with ..... rpm maximum output speed corresponding to ..... rpm drive-unit speed, gear ratio ..... to 1, Class I AGMA gear.

Optional.

Advise speeds required.

Eddy-current brake for control of overhauling loads providing ..... foot-pounds retarding torque at ..... rpm speed.

Advise torque and speed.

Advise torque and service.

Friction brake of ..... foot-pounds braking capacity for (holding) (other) service.

#### Control

Cross out one.

(Electronic) (static) speed regulator providing controlled conversion of a-c to d-c for coupling coil excitation.

Cross out one.

Full-voltage motor starter with overload and undervoltage protection (with) (without) fused disconnect switch for short-circuit protection.

Specify regulation

Speed regulator 25-100 % load (2) (1) (.5) (.1) % of top speed  
Timed acceleration  
Jogged  
Threading  
Brake control  
Torque limit

#### Operator's Control Panel

Specify for standard station.

Specify for special station.

Wall-mounted operator's control unit to include in a sheet-metal enclosure: Operator's control station shall be furnished in (NEMA Type 1) (oiltight) enclosure for (wall) (floor) mounting and shall contain suitable units for providing the following functions:

Specify for standard or special station.

- a. Start push button for a-c motor.
- b. Stop push button for a-c motor.
- c. Speed control dial.
- d. Run push button for coupling.
- e. Stop push button for coupling.

For special stations only.

- f. List other functions as desired.

#### References:

GEA-7028 Kinapac Speed Variator  
GEA-6885 Kinatrol Eddy-current Coupling  
GEA-7012 Parmatic Speed Variator  
GEA-7019 Thymotrol Speed Variator  
GEA-6643 Speed Variators

# Gear-motors and Speed Reducers

## GUIDE FORM SPECIFICATIONS

### General

- Indicate which. | This specification covers (*gear-motors*) (*speed reducers*) to be manufactured in accordance with applicable AGMA standards.
- Gears are to be heat-treated and finish-machined for long, quiet operation. Where applicable to gear-motors, removable pinion and gear must be available to permit easy ratio change. Cast-iron housing must be used to provide corrosion resistance and rigid support for gear elements.
- Include for gear-motors and helical speed reducers. | Select one. | Mounting position—(*floor*) (*ceiling*) (*sidewall*) (*inclined* ..... *deg*).
- Select one. | Shaft position—(*right*) (*left*) (*up*) (*down*).
- Specify, if any. | Special operating conditions .....

### Fractional-hp Gear-motors

- Fill in quantity. | ..... [208–220/440 volts, three-phase, 60 cycles, normal-starting-torque, low-slip, squirrel-cage induction motor] [115/230 volts, single-phase, 60 cycles, capacitor-start induction motor] [(115) (230) volts, compound-wound, d-c motor] [.....],
- Select construction. (If other, specify.) | ..... hp, ..... gear-motor frame, ..... rpm output speed.
- Fill in rating. | Motor enclosure and temperature rise—(*open*, 40 C) (*totally enclosed*, 55 C).
- Cross out one. | Gear-motor construction—(*concentric*) (*right-angle shaft*).

### Integral-hp Gear-motors

- Fill in quantity. | ..... [(220/440) (550) volts, three-phase, 60 cycles, (*normal-starting-torque*, *low-slip*) (*high-starting-torque*, *high-slip*) squirrel-cage induction motor] [240 volts shunt-wound, d-c motor] [.....],
- Select construction. (If other, specify.) | ..... hp, ..... gear-motor frame, ..... rpm output speed.
- Fill in rating. | Motor enclosure and temperature rise—
- For a-c motors, cross out one. | (*dripproof*, 40 C) (*totally enclosed*, 55 C)
- For d-c motors, cross out one. | (*dripproof*, 60 C) (*totally enclosed*, 75 C)
- Cross out two. | Gear-motor construction—(*offset-shaft*) (*integral-type*) (*all-motor*).
- Cross out two. | Gear class (*I*), (*II*), (*III*), (AGMA defined classes of service).

### Helical Speed Reducer

- Fill in blanks. | Quantity ....., gear-unit No. ...., prime-mover hp ....., input speed (rpm) if other than 1750 ....., type of prime mover ....., hours loaded per day .....
- Cross out two. | Type of load—(*uniform*) (*moderate shock*) (*heavy shock*).
- Cross out one. | Reduction—(*double*) (*triple*).

### Shaft-mounted Speed Reducer

- Fill in blanks. | Quantity ....., gear-unit No. ...., motor hp .....
- Cross out one. | Reduction—(*single*) (*double*).
- Specify, if required. | Overload release for torque arm ....., backstop ....., bushing for driven shaft .....
- Cross out one. | Position of driven shaft—(*horizontal*) (*vertical*).
- Indicate. | Driven-shaft diameter .....
- Specify, if any. | Special operating conditions .....

# Auxiliary Control—Magnetic

## GUIDE FORM SPECIFICATIONS

### Contactors

Use paragraph indicating type of service.

Fill in and/or cross out as necessary. | A-c magnetic contactor, NEMA size ..... with ..... main poles and (with) (without) undervoltage (protection) (release). Operating coil to be ..... volt, ..... cycles.  
 Fill in, and cross out 5. | For control of a ..... ampere (inductive) (non-inductive) (incandescent lamp) (fluorescent lamp) (capacitor) (transformer) load.  
 Fill in blanks. | For control of a ..... hp, ..... volt, ..... phase, ..... cycle, ..... rpm, ..... C rise squirrel-cage induction motor.  
 Fill in. | Enclosure to be .....

### Relays

Fill in all blanks. | A-c general-purpose relay rated ..... amperes, ..... volts, continuous, with ..... normally open and ..... normally closed contacts.  
 Fill in. | Operating coil to be ..... volts, ..... cycles.  
 If enclosed indicate type of enclosure. | Relay to be (open) (mounted in a ..... enclosure).

### Regulators

A-c only. Use for d-c exciters. Use for d-c generators.

Indicate one. | A voltage regulator shall be supplied to be used to control the output voltage of a (a-c generator) (d-c generator) (d-c exciter)  
 Fill in all blanks. | manufactured by .....; driven by .....; serial number .....; and rated ..... (kw) (kva), ..... volts, ..... rpm, ..... cycles, ..... phase,  
 Cross out one. | (shunt) (compound) wound  
 Cross out one. | (self-excited) (separately excited at ..... volts)  
 Fill in. | continuous overload ..... percent full-load rating,  
 Fill in all blanks. | volts no load ..... , full-load ..... (2) (3) wire operating-speed range ..... rpm to ..... rpm,  
 Indicate type of excitation. | (self-excited) (separately excited from outside source) (separately excited from constant voltage, max volts ..... min volts ..... ) (separately excited from own variable-voltage exciter [also fill out data for exciter]).  
 Indicate. | Type of load .....

### Brakes

Brakes shall be of the shoe type, spring set, for operation on an a-c system. They shall be (solenoid) (Thrustor, 3-phase) operated with a  
 Fill in blank, cross out one. | torque rating of ..... lb ft (continuous) (60 min). The brake is  
 Fill in rating. | for operation on a ..... volt, ..... phase, ..... cycle system.  
 The brake shall have three simple adjustments for shoe clearance, (solenoid) (Thrustor) mechanism gap, and brake torque. The brake lining shall consist of a specially woven asbestos lining and be easily removable. The wheel shall consist of a molybdenum alloy for long life, and shall be stress annealed. The brake shall be furnished with a type (A open) (B splashproof enclosure for outdoor use) (C dust-tight and water-tight enclosure). It shall also be equipped with a (hand release) and (corrosion-resistant fittings.)  
 Indicate enclosure required. |

### Solenoids

Fill in and/or cross out as necessary. | Solenoid to be (pull) (push) type, for operation from ..... volts, (..... cycle a-c) (d-c) supply.  
 Fill in. | Starting load will be ..... pounds at ..... inch stroke and seated load ..... pounds.  
 Cross out three. | Solenoid to be (end) (side) (throat) (through-bolt) mounted.  
 Cross out two. | Movement of plunger to be (with gravity) (against gravity) (horizontal).  
 Fill in. | Duty cycle of ..... operations per minute with ..... percent time energized in an ambient of ..... C.

# Outdoor Lighting

## GUIDE FORM SPECIFICATIONS

### Filament Luminaire

Specify quantity desired

—Filament luminaires shall be provided. The luminaire shall be equal to General Electric PMG-114, Cat. No. C619G001, suitable for use on multiple circuits. The luminaire shall consist of precision-cast aluminum base for attachment to a 3 inch O.D. pole, a rippled-glass globe, a diffuse aluminum reflector, and a canopy and shall be furnished in (*specify color*) finish.

### Colonial Design Mercury Luminaire

Specify quantity desired.  
Fill in as necessary

—Colonial design mercury luminaires shall be provided. The luminaires shall be equal to General Electric PMC-116, Cat. No. (*Specify*), consisting of cast-aluminum base with access doors, acrylic plastic prismatic refractor, hinged aluminum canopy perforated on the underside, sturdy aluminum scrolls and pre-wired terminal board. The luminaire shall be suitable for use with (*100W, 175W, 250W*) vertical burning mercury lamp.

The base shall be constructed of cast-aluminum for use on 3-inch outside diameter pole.

### Contemporary Post-mounted Mercury Luminaire

Specify quantity desired.  
Fill in as necessary

—Contemporary post-mounted mercury luminaires shall be provided. The luminaire shall be equal to General Electric PMA-115, Cat. No. (*Specify*) consisting of cast-aluminum base with access door, internally mounted ballast, acrylic plastic prismatic refractor, hinged aluminum canopy, perforated on underside, and pre-wired terminal board. The luminaire shall be suitable for use with (*100W, 175W, 250W*) vertical burning mercury lamp. The cast aluminum base shall be suitable for use on 3 inch outside diameter pole. The luminaire shall be furnished in (*Specify color*) finish.

### Post Mounted Fluorescent Luminaire

Specify quantity desired.  
Fill in as necessary

—Post mounted fluorescent luminaires shall be provided. The luminaire shall be equal to General Electric PMF-104A, Cat. No. (*Specify*) consisting of sturdy aluminum housing, specular aluminum reflector, diffused acrylic globe hinged on the street side for easy access to components, and shall contain an integral pre-wired ballast. The luminaire shall be suitable for use with 4 foot Type F48PG17/CW lamps. It shall be furnished in (*Specify color*) finish.

### Large Area Lighting Mercury Luminaire

Specify quantity desired.  
Fill in as necessary

—Area Lighting mercury luminaires shall be provided. The luminaire shall be equal to General Electric A-4000 Cat. No. (*Specify*) consisting of heavy spun aluminum canopy, diffuse acrylic plastic globe, cast aluminum slipfitter for four inch outside diameter pole, and pre-wired ballast components. The luminaire shall be suitable for use with 1000W vertical burning mercury lamps. It shall be furnished in (*Specify color*) finish.

## Outdoor Lighting

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### Quartz-flood Floodlights

Specify quantity desired.  
Select one.  
Fill in as necessary.  
Select one

—Quartz-flood floodlights shall be provided. The floodlight shall be equal to General Electric (*QF-500, QF-1500*) Cat. No. (*Specify*), suitable for mounting on (*pole, wall, pipe, crossarm, outlet box*). The floodlight shall consist of a heavy cast-aluminum housing with hinges, (*rear access door on QF-500 only*), Alzak aluminum reflector, tempered door glass, and ( $\frac{1}{2}$  inch swivel fitter, aluminum trunion bracket with integral wiring compartment).

### Mercury Floodlight

Specify quantity desired.  
Select one

—Mercury floodlights shall be provided. The floodlight shall be equal to General Electric (*P-400, P-1000*) Cat. No. (*Specify*), consisting of durable cast-aluminum housing and integral ballast compartment, Alzak aluminum reflector, heat resistant gaskets, galvanized steel trunion mounting bracket with repositioning stop and vertical degree marking scale.

In addition to the above listed equipment, for further information on other standard General Electric Outdoor Lighting equipment and specialized lighting equipment, contact your nearest General Electric Apparatus sales representative. The Outdoor Lighting Department of the General Electric Company has established a headquarters group who are in a position to offer application and design assistance for any specialized Outdoor Lighting equipment that is being considered for use in the New York World's Fair.



# Frequency Converters for High Frequency Fluorescent Lighting

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## General

The frequency converter shall contain in a single enclosure all components for changing 60 cycle power to 1000 cycle power for fluorescent lighting. The units shall be completely static. Rectification and inversion shall be accomplished by means of hermetically sealed silicon diodes and silicon controlled rectifiers. All components shall be readily accessible from the front of the units.

## Rating

Continuous Rating	5, 10 and 20 kw
Input	
Voltage	208 volts
Phases	3 phase
Frequency	60 cycles
Output	
Voltage	280 volts
Phases	1 phase
Frequency	1000 cycles

## Enclosures

The frequency converter shall be enclosed in a dead-front general purpose enclosure with a hinged door. The 5 and 10 kw units shall be flush wall mounted. The 20 kw shall be floor mounted.

## Connections

All connections and terminals shall be readily accessible from the front of the unit.

## Operation

The frequency converter shall be energized by closing a single circuit breaker in the lighting circuit breaker panelboard without additional control being required. The unit shall be self protected to prevent damage to the components from external circuit conditions.

