Power Capacitors

COOPER Power Systems

Electrical Apparatus

230-10

McGraw-Edison® Type EX-7L™ Single-Phase Units and Accessories

McGraw-Edison Type EX-7L all-film capacitors (Figure 1) feature the latest Cooper Power Systems design innovation—extended foil/solderless connection* and laser-cut foil—with a high stacking factor. Designed, manufactured, and tested to meet or exceed the requirements of applicable NEMA, ANSI/IEEE, IEC and CSA standards, their low cost per kvar makes these capacitors a simple, economical reliable source of reactive power on electric power systems for:

- Improving power factor.
- Reducing line losses.
- Decreasing voltage drop.

Power capacitors can be installed singly or in factory-assembled switched or unswitched banks in:

- Pole mounting racks.
- Substation banks.
- Metal enclosures.

McGraw-Edison all-film, extended foil/solderless capacitors with a high stacking factor provide:

- Low dielectric losses (0.07 watt/kvar).
- Greater safety through an improved defined tank-rupture characteristic.
- Low capacitance change with respect to temperature.
- 10,000-amp fault current handling capability.
- Superior electrical performance and reliability.
- Environmentally acceptable Edison® ST dielectric fluid that eliminates adverse health and environmental hazards.

Figure 1.
The family of McGraw-Edison single phase, all film capacitors.

Capacitor Application

Capacitor application requires an evaluation of the power system to determine:

- The kvar needs.
- The most effective location.
- The necessary protection.

In general, capacitors are installed:

- At the substation, to supply the system var needs most effectively.
- At or near the load center, to obtain the optimum var supply and voltage correction.
- At the end of the line, to achieve maximum voltage correction.

Ratings

McGraw-Edison capacitors are rated in continuous kvar, voltage and frequency for operating within the –40 to +55°C ambient temperature range (–50° available, consult factory). Designed to produce not less than rated kvar at rated voltage and frequency, they are subjected to applicable NEMA, ANSI/IEEE, IEC, and CSA standard dielectric tests. Single-phase 50- through 500-kvar capacitors will operate safely at 135% of kvar rating. The 35% above-nameplate value includes:

- kvar caused by excess voltage at rated frequency.
- kvar added by the harmonic voltages superimposed on the power-frequency voltage.
- kvar attributable to manufacturing tolerances.

Capacitor rated voltage is the voltage that can be applied terminal to terminal; for example, a 2400-volt capacitor can be delta-connected on a 2400-volt system or wye-connected on a 2400-volt/4160-volt system. In each case, the voltage applied to the capacitor terminal is 2400 volts. Because a capacitor's kvar output varies as the square of the ratio of applied voltage to rated voltage, application at the proper voltage is essential for optimum operating performance and long service life.

*US Patent 4,633,369

TABLE 1
Ratings and Catalog Numbers for 60 Hz Standard Single and Double Bushing Capacitors

Ratings		50-kvar Capacitors		100-kvar Capacitors		150-kvar Capacitors		200-kvar Capacitors	
Voltage (volts)	BIL (kV)	Double-Bushing	Single-Bushing	Double-Bushing	Single-Bushing	Double-Bushing	Single-Bushing	Double-Bushing	Single-Bushing
2400	75	CEP120A1	CEP120B1	CEP131A1	CEP131B1	CEP132A1	CEP132B1	CEP140A1	CEP140B1
2770	75	CEP120A2	CEP120B2	CEP131A2	CEP131B2	CEP132A2	CEP132B2	CEP140A2	CEP140B2
4160	75	CEP120A3	CEP120B3	CEP131A3	CEP131B3	CEP132A3	CEP132B3	CEP140A3	CEP140B3
4800	75	CEP120A4	CEP120B4	CEP131A4	CEP131B4	CEP132A4	CEP132B4	CEP140A4	CEP140B4
6640	95	CEP120A5	CEP120B5	CEP131A5	CEP131B5	CEP132A5	CEP132B5	CEP140A5	CEP140B5
7200	95	CEP120A6	CEP120B6	CEP131A6	CEP131B6	CEP132A6	CEP132B6	CEP140A6	CEP140B6
7620	95	CEP120A7	CEP120B7	CEP131A7	CEP131B7	CEP132A7	CEP132B7	CEP140A7	CEP140B7
7960	95	CEP120A8	CEP120B8	CEP131A8	CEP131B8	CEP132A8	CEP132B8	CEP140A8	CEP140B8
8320	95	CEP124M7	CEP123M3	CEP126M4	CEP125M3	CEP128M6	CEP127M15	CEP130M13	CEP129M1
9540	95	CEP124M19	CEP123M4	CEP126M24	CEP125M4	CEP128M21	CEP127M21	CEP130M30	CEP129M31
9960	95	CEP120A9	CEP120B9	CEP131A9	CEP131B9	CEP132A9	CEP132B9	CEP140A9	CEP140B9
11400	95	CEP124M8	CEP123M5	CEP126M25	CEP125M19	CEP128M13	CEP127M22	CEP130M31	CEP129M19
	125	—	—	—	—	—	CEP127M27	CEP130M32	—
	150	—	—	—	CEP125M23	—	—	—	CEP129M20
12470	95	CEP120A10	CEP120B10	CEP131A10	CEP131B10	CEP132A10	CEP132B10	CEP140A10	CEP140B10
	125	CEP124M9	—	CEP126M3	—	CEP128M11	—	CEP130M9	—
	150	—	CEP123B6	—	CEP130B6	—	CEP139B6	—	CEP143B6
13280	95	CEP120A11	CEP120B11	CEP131A11	CEP131B11	CEP132A11	CEP132B11	CEP140A11	CEP140B11
	125	CEP124M10	—	CEP126M9	—	CEP128M9	—	CEP130M7	—
	150	—	CEP123B7	—	CEP130B7	—	CEP139B7	—	CEP143B7
13800	95	CEP120A12	CEP120B12	CEP131A12	CEP131B12	CEP132A12	CEP132B12	CEP140A12	CEP140B12
	125	CEP124M11	—	CEP126M20	—	CEP128M14	—	CEP130M2	—
	150	—	CEP123B8	—	CEP130B8	—	CEP139B8	—	CEP143B8
14400	95	CEP120A13	CEP120B13	CEP131A13	CEP131B13	CEP132A13	CEP132B13	CEP140A13	CEP140B13
	125	CEP124M2	—	CEP126M1	—	CEP128M5	—	CEP130M1	—
	150	—	CEP123B9	—	CEP130B9	—	CEP139B9	—	CEP143B9
15125	150	—	CEP123M6	—	CEP125M1	—	CEP127M23	—	CEP129M12
19920	150	—	—	—	CEP134B4	—	CEP133B4	—	CEP145B4
20800	150	—	—	—	CEP125M20	—	—	—	CEP129M38
21600	150	—	—	—	CEP134B5	—	CEP133B5	—	CEP145B5
22130	150	—	—	—	—	—	CEP127M29	—	CEP129M23
22800	150	—	—	—	CEP125M21	—	—	—	CEP129M10

The maximum recommended working voltage of a capacitor is 110% of rated voltage. McGraw-Edison capacitors include a safety factor that permits them to tolerate without damage momentary overvolt-ages caused by switching or load changes.

Table 1 lists the ratings and catalog numbers for standard McGraw-Edison single and double-bushing capacitors. Other unit kvar sizes, voltage ratings, frequency ratings and BIL ratings are available.

Construction Features

Construction features of McGraw-Edison power capacitors include:

- Stainless-steel tank with light-gray finish for resistance to severely corrosive atmospheres.
- Light-gray, wet-process-porcelain bushings; glazed for high strength and durability and hermetically sealed to the capacitor tank.
- Stainless-steel mounting brackets with industry-standard 15.62-in. mounting center for unit interchangeability; underside of each bracket is unpainted for positive grounding.
- Parallel-groove terminals accommodate copper or aluminum conductors from No. 8 solid to No.1 stranded.
- Parallel-groove connectors are supplied on all capacitors sold as individual units. The parallel groove connector should be removed and discarded on capacitors used as replacements in substation bank applications on which a leader ejection spring and associated hardware are used with an expulsion fuse. See Instruction Bulletin S230-30-3 for detailed information.
- Internal discharge resistors that reduce terminal voltage to 50 volts or less within five minutes after the capacitor has been disconnected.
- Stainless-steel nameplate containing required NEMA and ANSI/IEEE data.
- Blue non-PCB decal.
- All unit sizes weigh less than 100 lbs.

TABLE 1 (continued)
Ratings and Catalog Numbers for 60 Hz Standard Single and Double Bushing Capacitors

Ratings		300-kvar Capacitors		400-kvar Capacitors		500-kvar Capacitors	
Voltage (volts)	BIL (kV)	Double-Bushing	Single-Bushing	Double-Bushing	Single-Bushing	Double-Bushing	Single-Bushing
2400	75	—	—	—	—	—	—
2770	75	—	—	—	—	—	—
4160	75	—	—	—	—	—	—
4800	75	CEP132M20	—	—	—	—	—
6640	95	CEP160A5	CEP160B5	CEP170A5	CEP170B5	CEP180A5	CEP180B5
7200	95	CEP160A6	CEP160B6	CEP170A6	CEP170B6	CEP180A6	CEP180B6
7620	95	CEP160A7	CEP160B7	CEP170A7	CEP170B7	CEP180A7	CEP180B7
7960	95	CEP160A8	CEP160B8	CEP170A8	CEP170B8	CEP180A8	CEP180B8
8320	95	CEP132M9	CEP131M8	CEP134M10	CEP133M13	CEP150M1	CEP149M1
9540	95	CEP132M22	CEP131M22	CEP134M6	CEP133M14	CEP150M5	CEP149M2
9960	95	CEP160A9	CEP160B9	CEP170A9	CEP170B9	CEP180A9	CEP180B9
11400	95	CEP132M18	CEP131M23	CEP134M17	CEP133M15	CEP150M6	CEP149M3
	125	—	—	—	—	CEP150M7	—
	150	—	CEP131M28	—	—	—	CEP149M4
12470	95	CEP160A10	CEP160B10	CEP170A10	CEP170B10	CEP180A10	CEP180B10
	125	CEP132M14	—	CEP134M4	—	CEP183A6	—
	150	—	CEP163B6	—	CEP173B6	—	CEP183B6
13280	95	CEP160A11	CEP160B11	CEP170A11	CEP170B11	CEP180A11	CEP180B11
	125	CEP132M10	—	CEP134M8	—	CEP183A7	—
	150	—	CEP163B7	—	CEP173B7	—	CEP183B7
13800	95	CEP160A12	CEP160B12	CEP170A12	CEP170B12	CEP180A12	CEP180B12
	125	CEP132M13	—	CEP134M9	—	CEP183A8	—
	150	—	CEP163B8	—	CEP173B8	—	CEP183B8
14400	95	CEP160A13	CEP160B13	CEP170A13	CEP170B13	CEP180A13	CEP180B13
	125	CEP132M5	—	CEP134M2	—	CEP183A9	—
	150	—	CEP163B9	—	CEP173B9	—	CEP183B9
15125	150	—	CEP131M24	—	CEP133M16		CEP149M5
19920	150	—	CEP165B4	—	CEP175B4	—	CEP185B4
20800	150	—	CEP131M9	—	CEP133M17	—	CEP149M6
21600	150	—	CEP165B5	—	CEP175B5	—	CEP185B5
22130	150	—	CEP131M13	—	CEP133M26	—	CEP149M13
22800	150	—	—	—	CEP133M11	—	CEP149M7

NOTE: Special ratings available upon request for use on harmonic filter, SVC, HVDC applications.

TABLE 2
Bushing Characteristics and Weights

BIL (kV)	Creepage Distance (in.)	Strike Distance (in.)	60-Hz Withstand		Approximate Net Weight/ Bushing (lb)
			60-Sec. Dry (kV)	10-Sec. Wet (kV)	
75 **	10.38	6.25	35	30	3
95*	10.38	6.25	35	30	3
150*	18.12	9.50	60	50	5
150	22.00	9.50	60	50	5
200	26.00	14.00	80	75	7

* Bushings furnished on standard capacitors shown in Table 1 and Figure 2.
** Same bushing is used on 75 and 95 V BIL capacitor units.

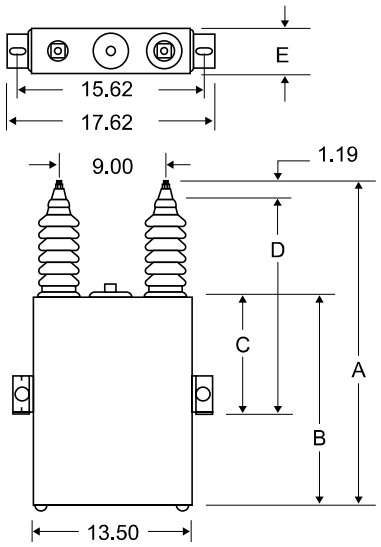

Figure 2.
Two bushing diagram. (See Table 3 for dimensions.)

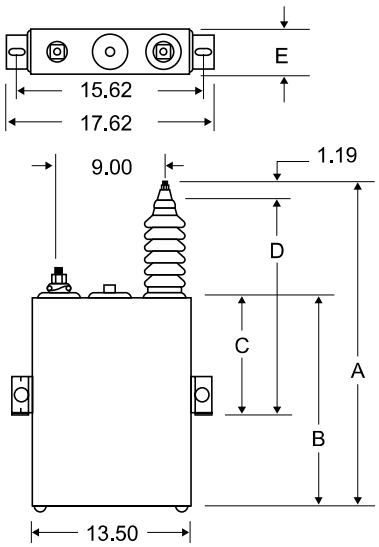

Figure 3.
One bushing diagram. (See Table 3 for dimensions.)

TABLE 3
Dimensions and Weights of 50-, 100-, 150-, 200-, 300-, 400-, and 500-kvar Capacitors

Ratings			Dimensions					Unit Weight (lbs.)*	
kvar	Voltage (volts)	BIL (kV)	A	B	C	D	E	Two Bushing	One Bushing
50	2400, 4160 to 4800	75	14.25	6.00	5.88	12.94	4.00	24	21
	2770	75	14.25	6.00	5.88	12.94	4.00	24	21
	6640 to 14400	95	14.25	6.00	5.88	12.94	4.25	25	22
	6640 to 14400	125	17.87	6.00	5.88	16.56	4.25	29	24
	6640 to 14400	150	17.87	6.00	5.88	16.56	4.25	—	24
	6640 to 14400	200	21.45	6.00	5.88	20.14	4.25	—	26
100	2400, 4160 to 4800	75	15.25	7.50	5.88	12.94	5.00	30	27
	2700	75	16.75	8.50	5.88	12.94	4.50	34	31
	6640 to 14400	95	15.25	7.00	5.88	12.94	5.00	30	27
	6640 to 14400	125	18.87	7.00	5.88	16.56	5.00	34	29
	6640 to 22800	150	18.87	7.00	5.88	16.56	5.00	—	29
	6640 to 22800	200	22.45	7.00	5.88	20.14	5.00	—	31
150	2400, 4160 to 4800	75	17.25	9.00	5.88	12.94	4.75	36	33
	2770	75	20.75	12.50	9.88	16.94	4.25	45	42
	6640 to 14400	95	17.25	9.00	5.88	12.94	5.00	38	35
	6640 to 14400	125	20.87	9.00	5.88	16.56	5.00	42	37
	6640 to 22800	150	20.87	9.00	5.88	16.56	5.00	—	37
	6640 to 22800	200	24.45	9.00	5.88	20.14	5.00	—	39
200	2400, 4160 to 4800	75	18.75	10.50	5.88	12.94	5.00	44	41
	2770	75	23.25	15.00	9.88	16.94	4.50	55	52
	6640 to 14400	95	19.75	11.50	5.88	12.94	5.00	46	43
	6640 to 14400	125	23.37	11.50	5.88	16.56	5.00	50	45
	6640 to 22800	150	23.37	11.50	5.88	16.56	5.00	—	45
	6640 to 22800	200	26.95	11.50	5.88	20.14	5.00	—	47
300	6640 to 14400	95	23.25	15.00	9.88	16.94	5.25	60	57
	6640 to 14400	125	26.87	15.00	9.88	20.56	5.25	64	59
	6640 to 22800	150	26.87	15.00	9.88	20.56	5.25	—	59
	6640 to 22800	200	30.45	15.00	9.88	24.14	5.25	—	61
400	6640 to 14400	95	26.75	18.50	9.88	16.94	5.00	72	69
	6640 to 14400	125	30.37	18.50	9.88	20.56	5.00	76	71
	6640 to 22800	150	30.37	18.50	9.88	20.56	5.00	—	71
	6640 to 22800	200	33.95	18.50	9.88	24.14	5.00	—	73
500	6640 to 14400	95	30.75	22.50	9.88	16.94	5.50	94	91
	6640 to 14400	125	34.37	22.50	9.88	20.56	5.50	98	93
	6640 to 22800	150	34.37	22.50	9.88	20.56	5.50	—	93
	6640 to 22800	200	37.95	22.50	9.88	24.14	5.50	—	95

*Note: Approximate dimensions and weights are given. Contact the factory for exact dimensions of a particular unit.

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