PRODUCT SELECTION AND APPLICATION

In the selection and application of molded-case circuit breakers, consideration should be given to the following factors:

1. Voltage of the circuit
2. Ampacity of the circuit
3. Frequency of the power source
4. Fault current available
5. Operating conditions

VOLTAGE OF CIRCUIT

The system voltage should not exceed the listed voltage rating of the circuit breaker.

AMPACITY OF CIRCUIT

The listed continuous current rating of the circuit breaker should not exceed the allowable ampacity of the conductors. Where the allowable ampacity of the conductor does not correspond to listed current ratings for circuit breakers, the next larger breaker rating is permitted, providing it does not exceed the conductor ampacity by more than 25%. An exception to this rule is permitted for motor circuits or other circuits where high inrush currents may persist for an appreciable time. (See National Electric Code Table 430-146, Overcurrent Protection for Motors).

FREQUENCY OF POWER SOURCE

I-T-E molded-case circuit breakers are calibrated for use on direct current or 60-cycle alternating current. For 400-cycle operation, derating is not necessary for one-, two- or three-pole EQ®-P, EQ-B, E, EH and EF breakers. All larger frame sizes, however, do require derating for 400-cycle operation. In these cases, consult your local I-T-E Sales Office.

FAULT CURRENT AVAILABLE

The interrupting rating of the circuit breaker should be at least equal to the maximum available short circuit current at the point of application. The short circuit current from some power sources, such as engine driven generators, is limited, and the instantaneous trip of the circuit breaker, when adjustable, should be set to open such low magnitude faults without delay.

OPERATING CONDITIONS

I-T-E molded-case circuit breakers are calibrated for operation at 40C, as specified by the Underwriters' Laboratories, Inc. Sound engineering practice dictates that continuous loads should not exceed 80% of the breaker rating for most types of enclosures. Refer to Table 1 for the continuous current ratings of breakers at various ambients.

TABLE 1
EQ® and ET® Circuit Breaker Continuous Current Ratings at Various Ambients (Based on Calibration for 40°C)

Breaker Type(s)	Rating Amperes	Applied in Ambients of 40°C	50°C	60°C
EQ-T	15	15	12	10
	20	20	18	16
	30	30	27	25
	40	40	37	35
EQP, EQ-B	15	15	13	11
	20	20	19	17
	30	30	27	25
	40	40	38	36
	50	50	47	44
	70	70	66	63
	90	90	86	81
	100	100	97	92
	125	125	121	115
QJ-225	125	125	110	92
	150	150	141	131
	175	175	162	149
	200	200	182	161
	225	225	198	180
E, EH, EF, HE	15	15	13	10
	20	20	17	15
	30	30	27	24
	40	40	37	35
	50	50	48	44
	70	70	66	63
	90	90	82	74
	100	100	93	84
FJ	70	70	60	47
	90	90	79	70
	100	100	89	77
	125	125	107	90
	150	150	130	110
	175	175	152	138
	200	200	172	147
	225	225	192	170
JJ,*JL, HJ, CJ	70	70	63	58
	90	90	80	70
	100	100	92	83
	125	125	113	102
	150	150	142	128
	175	175	162	150
	200	200	182	165
	225	225	205	185
	250	250	225	200
	275	275	240	206
	300	300	270	235
	350	350	310	265
	400	400	363	318
KM, HM, CM†	125	125	118	103
	150	150	135	118
	175	175	157	138
	200	200	185	158
	225	225	206	178
	250	250	227	198
	275	275	250	213
	300	300	270	233
	350	350	316	279
	400	400	365	346
	500	500	455	430
	600	600	550	510
	700	700	640	610
	800	800	730	700
KP	800	800	730	670
	1000	1000	925	825
	1200	1200	1100	1000
HP, CP	800	800	730	670
	1000	1000	925	825
	1200	1200	1100	1000
	1400	1400	1300	1200
	1600	1600	1450	1350
CE	15	15	13	11
	20	20	19	17
	30	30	27	25
HR	1800	1800	1650	1500
CR	2000	2000	1850	1650

* JJ-frame breaker available in ratings from 250 through 400 ampere only; HJ and CJ-frame breakers available in ratings from 125 through 400 ampere only.

† HM and CM-frame breakers available in ratings from 400 through 800 ampere only.

PRODUCT SELECTION AND APPLICATION (continued)

OPERATING CONDITIONS (continued)

When the type of load is unusual, intermittent, or one which involves momentary peak currents, such as motor loads, consideration should be given to the heating effect on the protective device over a period of time. The duty cycle of a motor which is started and stopped frequently may require a circuit breaker with a higher rating than an infrequently started motor. Resistance welder applications require a careful analysis of the duty cycle in order to select the proper size breaker for primary short circuit protection.

The presence of excessive dust, moisture, corrosive fumes or explosive atmosphere requires the use of enclosures suitable for such atmospheres. (See Sections 2.7.1 and 2.7.5.) For applications in regions where fungus growth may occur, circuit breakers should be treated with a fungus-resistant material. (See Sections 2.6.1 and 2.6.5.)

PROTECTION OF CONDUCTORS—GENERAL

The primary function of a circuit breaker is the protection of the insulation of conductors and thermal-magnetic breakers automatically adjust for temperature changes that closely parallel the temperature correction factors for conductors. For application at temperatures above 30C, conductors should be derated in accordance with the National Electric Code for both ambient temperature and continuous loading. Conductors which are loaded continuously should be derated to 80% of their allowable ampacity. Refer to Table 2.

PROTECTION OF NON-MOTOR LOAD CONDUCTORS

Refer to Tables 1 and 2, and match the current rating of the circuit breaker to the allowable ampacity of the conductor. If the ampacity of the conductor falls between standard breaker ratings, select the higher breaker-current rating. Be sure to check the voltage and interrupting rating of the circuit breaker to assure that they are adequate for the electrical system.

These ampacities relate only to conductors described in NEC Table 310-2(a).

** The ampacities for Types FEP, FEPB, RHH and THHN conductors for sizes AWG 14, 12 and 10 shall be the same as designated for 75C conductors in this Table.

† The ampacities for Types RHH and THHN conductors for sizes AWG 12, 10 and 8 shall be the same as designated for 75C conductors in this Table.

‡ For three-wire, single-phase service and sub-service circuits, the allowable ampacity of RH, RH-RW, RHH, RHW, and THW aluminum conductors shall be for sizes #2-100 Amp., #1-110 Amp., #1/0-125 Amp., #2/0-150 Amp., #3/0-170 Amp. and #4/0-200 Amp.

TABLE 2
Ampacities of Insulated Conductors
(From 1971 National Electric Code)

Not More Than Three Conductors in Raceway or Cable or Direct Burial (Based on Room Temperature of 30°C., 86°F.)

Size AWG MCM	Temperature Rating of Conductor* 60°C (140F)	75°C (167F)	85–90°C (185F)	101°C (230F)	125°C (257F)	200°C (392F)
COPPER CONDUCTORS (FROM NEC TABLE 310-12)						
14	15	15	25**	30	30	30
12	20	20	30**	35	40	40
10	30	30	40**	45	50	55
8	40	45	50	60	65	70
6	55	65	70	80	85	95
4	70	85	90	105	115	120
3	80	100	105	120	130	145
2	95	115	120	135	145	165
1	110	130	140	160	170	190
0	125	150	155	190	200	225
00	145	175	185	215	230	250
000	165	200	210	245	265	285
0000	195	230	235	275	310	340
250	215	255	270	315	335	
300	240	285	300	345	380	
350	260	310	325	390	420	—
400	280	335	360	420	450	
500	320	380	405	470	500	
600	355	420	455	525	545	
700	385	460	490	560	600	
750	400	475	500	580	620	—
800	410	490	515	600	640	
900	435	520	555	—	—	
1000	455	545	585	680	730	
1250	495	590	645	—	—	
1500	520	625	700	785	—	—
1750	545	650	735	→	—	
2000	560	665	775	840	—	
ALUMINUM CONDUCTORS (FROM NEC TABLE 310-14)						
12	15	15	25†	25	30	30
10	25	25	30†	35	40	45
8	30	40	40†	45	50	55
6	40	50	55	60	65	75
4	55	65	70	80	90	95
3	65	75	80	95	100	115
2‡	75	90	95	105	115	130
1‡	85	100	110	125	135	150
0‡	100	120	125	150	160	180
00‡	115	135	145	170	180	200
000‡	130	155	165	195	210	225
0000‡	155	180	185	215	245	270
250	170	205	215	250	270	
300	190	230	240	275	305	
350	210	250	260	310	335	—
400	225	270	290	335	360	
500	260	310	330	380	405	
600	285	340	370	425	440	
700	310	375	395	455	485	
750	320	385	405	470	500	
800	330	395	415	485	520	—
900	355	425	455	—	—	
1000	375	445	480	560	600	
1250	405	485	530	—		
1500	435	520	580	650		
1750	455	545	615	—	—	—
2000	470	560	650	705		
CORRECTION FACTORS, ROOM TEMPERATURES OVER 30°C (86F)						
C F						
40 104	.82	.88	.90	.94	.95	
45 113	.71	.82	.85	.90	.92	—
50 122	.58	.75	.80	.87	.89	
55 131	.41	.67	.74	.83	.86	
60 140		.58	.67	.79	.83	.91
70 158	—	.35	.52	.71	.76	.87
75 167		—	.43	.66	.72	.86
80 176		—	.30	.61	.69	.84
90 194				.50	.61	.80
100 212	—	—	—	—	.51	.77
120 248				—	—	.69
140 284				—		.59

PRODUCT SELECTION AND APPLICATION (continued)

PROTECTION OF MOTOR CIRCUITS

Molded-case circuit breakers are used in motor circuits as a disconnecting means and for short-circuit protection, and should be used in conjunction with motor-running overcurrent-protection devices. The circuit breaker should have a continuous-current rating of not less than 115% of the motor full-load current, and its characteristics should permit the motor to start without nuisance tripping from motor-inrush current.

Motor Branch Circuits

When the breaker is mounted at a distance from the motor starter, thermal-magnetic circuit breakers conform to the National Electrical Code requirements for motor branch and feeder circuit protection when properly applied in conjunction with motor-running overcurrent protective devices. The recommended circuit-breaker ratings shown in Table 3 provide adequate time delay for starting the majority of three-phase induction motors.

Motor Feeder Circuits

To determine the ampere rating of the circuit breaker needed to protect a motor feeder, add the rating of the breaker used to protect the largest motor branch circuit in the group to the full-load currents of the remaining motors in the group.

TABLE 3

EQ® and ET® CIRCUIT BREAKERS (thermal-magnetic trip) for branch breaker use with alternating-current combination motor starters.

3-PHASE INDUCTION-TYPE MOTORS

Motor Horsepower Rating	200 and 208 V Motors			230 V Motors			460 V Motors			575 V Motors		
	240 V Circuit Breaker Data‡			240 V Circuit Breaker Data‡			480 V Circuit Breaker Data‡			600 V Circuit Breaker Data‡		
	Breaker Frame	Catalog Number	Rating Amperes	Breaker Frame	Catalog Number	Rating Amperes	Breaker Frame	Catalog Number	Rating Amperes	Breaker Frame	Catalog Number	Rating Amperes
½	EQ-P*	QP3-B015	15	EQ-P*	QP3-B015	15	EH	EH3-B015	15	EF	EF3-B015	15
¾		QP3-B015	15		QP3-B015	15		EH3-B015	15		EF3-B015	15
1		QP3-B015	15		QP3-B015	15		EH3-B015	15		EF3-B015	15
1½		QP3-B015	15		QP3-B015	15		EH3-B015	15		EF3-B015	15
2		QP3-B020	20		QP3-B015	15		EH3-B015	15		EF3-B015	15
3		QP3-B030	30		QP3-B020	20		EH3-B015	15		EF3-B015	15
5	EQ-P*	QP3-B040	40	EQ-P*	QP3-B030	30	EH	EH3-B015	15	EF	EF3-B015	15
7½		QP3-B060	60		QP3-B050	50		EH3-B030	30		EF3-B020	20
10		QP3-B070	70		QP3-B070	70		EH3-B030	30		EF3-B030	30
15		QP3-B100	100		QP3-B090	90		EH3-B040	40		EF3-B035	35
20		QJ3-B125	125		QP3-B100	100		EH3-B050	50		EF3-B050	50
25	QJ	QJ3-B150	150	QJ	QJ3-B125	125	EH	EH3-B070	70	EF	EF3-B060	60
30		QJ3-B175	150		QJ3-B150	150		EH3-B090	90		EF3-B070	70
40		QJ3-B200	200		QJ3-B175	175		EH3-B100	100		EF3-B090	90
50		QJ3-B225	225		QJ3-B200	200		EH3-B100	100		EF3-B100	100
60	JL†	JL3-B300	300	QJ	QJ3-B225	225	FJ or JL†	FJ3-B125 JL3-B125	125 125	EF	EF3-B100	100
75	JL†	JL3-B400	400	JL†	JL3-B350	350	FJ or JL†	FJ3-B175 JL3-B175	175 175	FJ or JL†	FJ3-B125 JL3-B125	125 125
100	JL†	JL3-B400	400	JL†	JL3-B400	400	FJ or JL†	FJ3-B200 JL3-B200	200 200	FJ or JL†	FJ3-B175 JL3-B175	175 175
125	KM	KM3-B600	600	KM	KM3-B500	500	FJ or JL†	FJ3-B225 JL3-B225	225 225	FJ or JL†	FJ3-B200 JL3-B200	200 200
150	KM	KM3-B600	600	KM	KM3-B600	600	JL†	JL3-B300	300	FJ or JL†	FJ3-B225 JL3-B225	225 225
200	KM	KM3-B800	800	KM	KM3-B800	800	JL†	JL3-B350	350	JL†	JL3-B300	300
250	—	—	—	—	—	—	JL†	JL3-B400	400	JL†	JL3-B400	400
300	—	—	—	—	—	—	KM	KM3-B600	600	JL†	JL3-B400	400
350	—	—	—	—	—	—	KM	KM3-B700	700	KM	KM3-B500	500
400	—	—	—	—	—	—	KM	KM3-B800	800	KM	KM3-B600	600
500	—	—	—	—	—	—	—	—	—	KM	KM3-B800	800

‡ **Notes:** The selection of breakers for this table is in accordance with Article 430, 1968 National Electric Code.
Recommended circuit breakers are for full voltage starting and special consideration is necessary for reduced voltage starting.
For recommended instantaneous trip settings of FJ, JJ, JL and KM frame breakers, see table ETI breakers on opposite page.

* For bolted applications, substitute the EQ-B breaker for the QP, or an E frame breaker can be substituted.

† For non-interchangeable trip applications, substitute the JJ breaker for the JL.

PRODUCT SELECTION AND APPLICATION (continued)

When the circuit breaker is mounted immediately ahead of the motor starter, ETI magnetic-trip breakers are recommended for use in combination motor starters to provide selective short-circuit protection for the motor branch circuit. The adjustable instantaneous-trip feature of the ETI circuit breaker provides for a trip setting slightly above the peak motor-inrush current. With this setting, no delay is introduced in opening the circuit when a fault occurs. This circuit breaker has no time-delay element and therefore must be used in conjunction with, and immediately ahead of, the motor-running overcurrent-protective device. (See Table 4.)

TABLE 4

ETI CIRCUIT BREAKERS (instantaneous trip only) for branch-circuit use with alternating-current combination full voltage motor starters.

3-PHASE INDUCTION-TYPE MOTORS

Horsepower Rating of Motor					Circuit Breaker Data								Trip Setting Position				
								Adjustable Trip Range									
115 Volts	200 Volts	230 Volts	460 Volts	575 Volts	Breaker Frame	Catalog Number	Continuous Amperes	Lo	2	3	4	Hi	115 Volts	200 Volts	230 Volts	460 Volts	575 Volts
—	—	—	½	½	EF	**EF3-A003**	3	7	10	12	16	21	—	—	—	3	2
	—	—	¾	¾		**EF3-A003**	3	7	10	12	16	21		—	—	4	3
	—	—	—	1		**EF3-A003**	3	7	10	12	16	21		—	—	—	4
	½	½	1	1½		**EF3-A005**	5	14	18	22	29	41		4	3	3	3
	—	—	1½	2		**EF3-A005**	5	14	18	22	29	41		—	—	4	4
½	¾	¾	2	3	EF	**EF3-A010**	10	27	36	45	58	84	3	2	2	2	3
¾	1	1	3	—		**EF3-A010**	10	27	36	45	58	84	Hi	3	3	4	—
—	1½	1½	—	—		**EF3-A010**	10	27	36	45	58	84	—	Hi	4	—	—
1	2	2	—	5		**EF3-A010**	10	27	36	45	58	84	Hi	Hi	Hi	—	Hi
—	—	—	5	—	EF	**EF3-A025**	25	75	105	125	170	210	—	—	—	2	—
1½	3	3	7½	7½		**EF3-A025**	25	75	105	125	170	210	2	3	2	3	2
2	5	5	10	10		**EF3-A025**	25	75	105	125	170	210	4	4	4	4	3
—	—	—	—	15		**EF3-A025**	25	75	105	125	170	210	—	—	—	—	Hi
—	7½	7½	15	20		**EF3-L050**	50	160	210	260	330	470	—	3	3	3	3
—	10	10	20	25		**EF3-L050**	50	160	210	260	330	470	—	4	4	4	4
	15	15	25	30	EF	**EF3-H050**	50	320	400	475	565	670		4	3	2	2
	—	—	30	40		**EF3-H050**	50	320	400	475	565	670		—	—	3	3
—	20	20	40	50		**EF3-A100**	100	475	630	750	930	1125	—	3	3	2	2
	25	25	50	60		**EF3-A100**	100	475	630	750	930	1125		4	3	3	3
	30	30	60	75		**EF3-A100**	100	475	630	750	930	1125		Hi	4	4	4
	40	40	75	100	FJ or JL†	**FJ3-A225** or **JL3-A225**	225	960	1200	1550	1850	2000		2	2	2	2
—	50	50	100	125									—	3	3	3	3
	60	60	125	150			225	960	1200	1450	1800	2000		3	3	3	3
	—	75	150	200			400	1900	2300	2700	3100	3500		—	4	4	4
—	100	100	200	250	JL†	**JL3-L400**	400	1900	2300	2700	3100	3500	—	3	3	3	3
	125	125	250	300		**JL3-L400**	400	3200	3600	4100	5100	5600		4	4	3	3
—	150	150	300	400	KM	**KM3-L800**	800	3200	3600	4100	5100	5600	—	3	Lo	Lo	2
	—	200	400	500		**KM3-L800**	800	3200	3600	4100	5100	5600		—	4	2	Lo
	—	250	500	—		**KM3-H800**	800	5000	6100	6700	7400	8000		—	2	2	—

† For non-interchangeable trip applications, substitute the JJ breaker for the JL.

For further information or assistance in the selection and application of molded-case circuit breakers, consult your local I-T-E Distributor or Sales Office.