Type “2”

Motor Starter Protection Fuse Guide

Motor Starter Protection

The electrical power distribution system is a plant's lifeline. In today's high tech commercial and industrial manufacturing facilities, proper protection of costly motors and starters is a must. Efficiency, productivity, and safety are major concerns. No facility can afford to have these areas affected by unscheduled downtime. To minimize unscheduled downtime, it is necessary to make certain that the best protection is chosen.

Choice of Coordination Levels

Many IEC and NEMA type devices are tested to meet IEC 947-4-1 and UL 508E (Outline of Investigation) which differentiate between two types of coordination, or damage levels:

Type "1" *Requires that, under short-circuit conditions, the contactor or starter shall cause no danger to persons or installation and may not be suitable for further service without repair and replacement of parts.* (Damage is allowed, requiring component replacement. Short-circuit protective devices interrupt the fault current, but are not required to provide component protection.)

Type "2" *Requires that, under short-circuit conditions, the contactor or starter shall cause no danger to persons or installation and shall be suitable for further use. The risk of contact welding is recognized, in which case the manufacturer shall indicate the measures to be taken as regards the maintenance of the equipment.* (No damage is allowed to either the contactor or overload relay. Light contact welding is permitted, but contacts must be easily seperable. No damage protection typically can only be provided by a current-limiting device.)

Type "2" Coordination (No-Damage Protection) for IEC and NEMA devices assures that the motor starter will be operable after a fault occurs and the fault corrected. Type "2" Coordination (No-Damage Protection) cannot prevent the initial fault from occurring. However, it assures all other components in the motor starter remain functional.

Achieving Type "2" Coordination (No-Damage Protection)

To obtain Type "2" Coordination (No-Damage Protection) with either IEC or NEMA devices, motor starter manufacturers evaluate and test each combination of contactor, overload relay, and short-circuit protective device. The tests are as follows:

- *A discrete low level fault test is performed at rated voltage.*
- *A high level short circuit withstand test, such as 100,000 amps, at rated voltage, is performed to check for the integrity of the contactor and overload relay.*
- *An overload relay and calibration test verifies operating characteristics and reliability. This test is performed before and after the low and high-level fault tests to determine if the overload relays sustained any damage during the test.*
- *Dielectric tests are performed to prove insulation adequacy after the low and high-level fault current tests have been completed.*

While third party testing is not required by IEC 947-4-1, testing completed as a basis for the tables in this publication was verified by a qualified third party testing laboratory. Motor control manufacturers selected the short-circuit protective devices used in these verification programs. The short-circuit device must carry motor starting inrush currents. The short-circuit device must have a high degree of current limitation to provide maximum protection against faults.

Selecting the Short-Circuit Device

To achieve proper Type "2" Coordination (No-Damage Protection) with fuses, popular options are: Time-delay Class J, RK1, and CC current-limiting fuses. These fuses carry motor inrush currents, open to protect against damage due to low and high-level faults, and limit both the Ip (peak current) and I^2t to prevent starter damage. With the proper size and type of fuses, Type "2" Coordination (No-Damage Protection) can be achieved for motor starters. Consult the tables on the following pages.

Prepared by the NEMA Fuse Technical Committee for North American Fuse Manufacturers.

Additional copies can be obtained from the National Electrical Manufacturers Association or NEMA Fuse Section Member Companies.

How To Use The Tables:

Column 1
Motor horsepower ratings.

Column 2
Full load amps from NEC Tables 430-147 through 430-150.

Column 3
North American fuse classes. Sizing for these charts is based upon time-delay fuses.

Column 4
These ampere ratings are the largest fuse, independent of the manufacturer, that provides Type 2 coordination for any NEMA starter that was tested for Type 2 coordination. *

Column 5
These ampere ratings are the largest fuse, independent of manufacturer, that provides Type 2 coordination for any IEC starter that was tested for Type 2 coordination. *

Column 6
When the sizes shown in Columns 4 and 5 are not sufficient to start the motor, a larger size is allowed. The sizes in Column 6 are the larger of the sizes allowed by NEC 430-52 (c)(1) Exception No. 1, or NEC 430-52 (c)(1) Exception No. 2.

Column 7
Sizes listed are for general-purpose magnetic controllers (single speed, full-voltage for limited plugging and jogging-duty) as shown in NEMA Standards Publication ICS-2-1993.

Column 8
Copper wire sizes are based upon 125% (NEC 430-22) of values shown in Column 2 and ampacities listed in Table 310-16 for 75°C equipment.

* Consult the fuse or starter manufacturer for specific part numbers of tested combinations. Other combinations must be tested to verify Type “2” coordination.

200 Volt Three-Phase

1 Motor Size (HP)	2 Motor FLA (AMPS)	3 Fuse Class	4 NEMA Max Fuse for Type 2 Coordination (AMPS)	5 IEC Max Fuse for Type 2 Coordination (AMPS)	6 NEC Max for Heavy Start (AMPS)**	7 Min. NEMA Starter Size	8 Min. THHN, AWG or KCMIL Copper Wire Size	1 Motor Size (HP)	2 Motor FLA (AMPS)	3 Fuse Class	4 NEMA Max Fuse for Type 2 Coordination (AMPS)	5 IEC Max Fuse for Type 2 Coordination (AMPS)	6 NEC Max for Heavy Start (AMPS)**	7 Min. NEMA Starter Size	8 Min. THHN, AWG or KCMIL Copper Wire Size
1/2	2.5	CC	4.5	3	10	00	14	7-1/2	25.3	RK1	40	NA	50	1	10
1/2	2.5	J	3	3	6	00	14	10	32.2	J	60	40	70	2	8
1/2	2.5	RK1	2.8	NA	6	00	14	10	32.2	RK1	50	NA	70	2	8
3/4	3.7	CC	6	5	15	00	14	15	48.3	J	80	70	100	3	6
3/4	3.7	J	5	5	10	00	14	15	48.3	RK1	70	NA	100	3	6
3/4	3.7	RK1	4	NA	10	00	14	20	62.1	J	100	70	125	3	4
1	4.8	CC	10	8	17-1/2	00	14	20	62.1	RK1	100	NA	125	3	4
1	4.8	J	6	8	10	00	14	25	78.2	J	125	150	175	3	3
1	4.8	RK1	7	NA	10	00	14	25	78.2	RK1	125	NA	175	3	3
1-1/2	6.9	CC	12	10	25	00	14	30	92	J	150	150	200	4	2
1-1/2	6.9	J	10	10	15	00	14	30	92	RK1	150	NA	200	4	2
1-1/2	6.9	RK1	10	NA	15	00	14	40	120	J	200	150	250	4	1/0
2	7.8	CC	20	15	30	0	14	40	120	RK1	175	NA	250	4	1/0
2	7.8	J	12	15	17-1/2	0	14	50	150	J	200	200	300	5	3/0
2	7.8	RK1	15	NA	17-1/2	0	14	50	150	RK1	200	NA	300	5	3/0
3	11	CC	25	20	NA	0	14	60	177	J	250	200	350	5	4/0
3	11	J	17.5	20	20	0	14	60	177	RK1	250	NA	350	5	4/0
3	11	RK1	17.5	NA	20	0	14	75	221	J	350	300	450	5	300
5	17.5	J	30	25	35	1	12	75	221	RK1	350	NA	450	5	300
5	17.5	RK1	25	NA	35	1	12	100	285	J	NA	300	600	6	500
7-1/2	25.3	J	40	30	50	1	10								

230 Volt Three-Phase

1/2	2.2	CC	3	3	10	00	14	7-1/2	22	RK1	35	NA	45	1	10
1/2	2.2	J	3	3	6	00	14	10	28	J	45	40	60	2	10
1/2	2.2	RK1	2.8	NA	6	00	14	10	28	RK1	45	NA	60	2	10
3/4	3.2	CC	6	5	12	00	14	15	42	J	70	50	90	2	6
3/4	3.2	J	5	5	7	00	14	15	42	RK1	70	NA	90	2	6
3/4	3.2	RK1	4	NA	7	00	14	20	54	J	90	70	110	3	4
1	4.2	CC	6	6	15	00	14	20	54	RK1	80	NA	110	3	4
1	4.2	J	6	6	10	00	14	25	68	J	100	100	150	3	4
1	4.2	RK1	6	NA	10	00	14	25	68	RK1	100	NA	150	3	4
1-1/2	6	CC	10	8	20	00	14	30	80	J	150	150	175	3	3
1-1/2	6	J	10	8	15	00	14	30	80	RK1	125	NA	175	3	3
1-1/2	6	RK1	10	NA	15	00	14	40	104	J	175	150	225	4	1
2	6.8	CC	20	10	25	0	14	40	104	RK1	175	NA	225	4	1
2	6.8	J	15	10	15	0	14	50	130	J	200	200	250	4	2/0
2	6.8	RK1	10	NA	15	0	14	50	130	RK1	200	NA	250	4	2/0
3	9.6	CC	30	15	NA	0	14	60	154	J	200	200	300	5	3/0
3	9.6	J	15	15	20	0	14	60	154	RK1	200	NA	300	5	3/0
3	9.6	RK1	17.5	NA	20	0	14	75	192	J	300	200	400	5	250
5	15.2	CC	NA	25	NA	1	14	75	192	RK1	300	NA	400	5	250
5	15.2	J	25	20	30	1	14	100	248	J	400	300	500	5	250
5	15.2	RK1	25	NA	30	1	14	100	248	RK1	400	NA	500	5	250
7-1/2	22	J	35	30	45	1	10								

**These values may not provide type 2 coordination. Consult fuse or starter manufacturer.

460 Volt Three-Phase

1 Motor Size (HP)	2 Motor FLA (AMPS)	3 Fuse Class	4 NEMA Max Fuse for Type 2 Coordination (AMPS)	5 IEC Max Fuse for Type 2 Coordination (AMPS)	6 NEC Max for Heavy Start (AMPS)**	7 Min. NEMA Starter Size	8 Min. THHN, AWG or KCMIL Copper Wire Size	1 Motor Size (HP)	2 Motor FLA (AMPS)	3 Fuse Class	4 NEMA Max Fuse for Type 2 Coordination (AMPS)	5 IEC Max Fuse for Type 2 Coordination (AMPS)	6 NEC Max for Heavy Start (AMPS)**	7 Min. NEMA Starter Size	8 Min. THHN, AWG or KCMIL Copper Wire Size
1/2	1.1	CC	2	1.5	6	00	14	15	21	J	35	30	45	2	10
1/2	1.1	J	1.5	1.5	3	00	14	15	21	RK1	30	NA	45	2	10
1/2	1.1	RK1	1.6	NA	3	00	14	20	27	J	40	40	60	2	10
3/4	1.6	CC	2.25	2	6-1/4	00	14	20	27	RK1	40	NA	60	2	10
3/4	1.6	J	2	2	3-1/2	00	14	25	34	J	60	50	70	2	8
3/4	1.6	RK1	1.6	NA	3-1/2	00	14	25	34	RK1	50	NA	70	2	8
1	2.1	CC	3	3	10	00	14	30	40	J	60	50	90	3	6
1	2.1	J	3	3	6	00	14	30	40	RK1	60	NA	90	3	6
1	2.1	RK1	2.8	NA	6	00	14	40	52	J	90	70	110	3	6
1-1/2	3	CC	5.6	5	12	00	14	40	52	RK1	80	NA	110	3	6
1-1/2	3	J	5	5	6	00	14	50	65	J	100	70	125	3	4
1-1/2	3	RK1	4	NA	6-1/4	00	14	50	65	RK1	100	NA	125	3	4
2	3.4	CC	6	5	15	00	14	60	77	J	125	150	150	4	3
2	3.4	J	5	5	7	00	14	60	77	RK1	125	NA	150	4	3
2	3.4	RK1	4	NA	7	00	14	75	96	J	175	150	200	4	1
3	4.8	CC	10	8	17-1/2	0	14	75	96	RK1	150	NA	200	4	1
3	4.8	J	8	8	10	0	14	100	124	J	200	200	250	4	2/0
3	4.8	RK1	8	NA	10	0	14	100	124	RK1	200	NA	250	4	2/0
5	7.6	CC	15	15	30	0	14	125	156	J	200	200	350	5	3/0
5	7.6	J	10	10	15	0	14	125	156	RK1	200	NA	350	5	3/0
5	7.6	RK1	15	NA	15	0	14	150	180	J	250	200	400	5	4/0
7-1/2	11	CC	20	20	NA	1	14	150	180	RK1	250	NA	400	5	4/0
7-1/2	11	J	20	20	20	1	14	200	240	J	400	300	500	5	350
7-1/2	11	RK1	20	NA	20	1	14	200	240	RK1	400	NA	500	5	350
10	14	CC	30	25	NA	1	14	250	302	J	600	300	NA	6	3/0 2/phase
10	14	J	25	20	30	1	14	250	302	RK1	600	NA	NA	6	3/0 2/phase
10	14	RK1	25	NA	30	1	14								

575 Volt Three-Phase

1/2	0.9	CC	NA	1.6	1-1/2	00	14	15	17	J	25	20	35	2	12
1/2	0.9	J	2	1.5	3	00	14	15	17	RK1	25	NA	35	2	12
1/2	0.9	RK1	NA	NA	3	00	14	20	22	J	35	30	45	2	10
3/4	1.3	CC	3	2	6	00	14	20	22	RK1	35	NA	45	2	10
3/4	1.3	J	2	2	3	00	14	25	27	J	40	40	60	2	10
3/4	1.3	RK1	2	NA	3	00	14	25	27	RK1	40	NA	60	2	10
1	1.7	CC	3	3	10	00	14	30	32	J	50	40	70	3	8
1	1.7	J	2	3	3-1/2	00	14	30	32	RK1	50	NA	70	3	8
1	1.7	RK1	2	NA	3-1/2	00	14	40	41	J	70	50	90	3	6
1-1/2	2.4	CC	4.5	3	10	00	14	40	41	RK1	60	NA	90	3	6
1-1/2	2.4	J	3	3	6	00	14	50	52	J	90	80	110	3	6
1-1/2	2.4	RK1	2.8	NA	6	00	14	50	52	RK1	80	NA	110	3	6
2	2.7	CC	6	4	10	00	14	60	62	J	100	80	125	4	4
2	2.7	J	4	4	6	00	14	60	62	RK1	100	NA	125	4	4
2	2.7	RK1	2.8	NA	6	00	14	75	77	J	125	150	150	4	3
3	3.9	CC	10	5	15	0	14	75	77	RK1	125	NA	150	4	3
3	3.9	J	6	5	10	0	14	100	99	J	175	150	200	4	1
3	3.9	RK1	6	NA	10	0	14	100	99	RK1	150	NA	200	4	1
5	6.1	CC	20	10	20	0	14	125	125	J	200	200	250	5	2/0
5	6.1	J	10	10	15	0	14	125	125	RK1	200	NA	250	5	2/0
5	6.1	RK1	10	NA	15	0	14	150	144	J	200	200	300	5	3/0
7-1/2	9	CC	NA	15	NA	1	14	150	144	RK1	200	NA	300	5	3/0
7-1/2	9	J	10	15	20	1	14	200	192	J	300	200	400	5	250
7-1/2	9	RK1	15	NA	20	1	14	200	192	RK1	300	NA	400	5	250
10	11	CC	NA	20	NA	1	14	250	242	J	NA	300	500	6	350
10	11	J	17.5	20	20	1	14	250	242	RK1	NA	NA	500	6	350
10	11	RK1	17.5	NA	20	1	14	300	289	J	NA	300	600	6	500

**These values may not provide type 2 coordination. Consult fuse or starter manufacturer.

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