This section summarizes transformer overcurrent protection as required by the National Electrical Code (NEC) and Canadian Electric Code.

TRANSFORMERS - PRIMARY 1000 VOLTS OR LESS

If secondary fuse protection is not provided, primary fuses are to be selected according to Table 1. If both primary and secondary fuses are used, they are to be selected according to Table 2.

Table 1 - Primary Fuse Only

Transformer Primary Amperes	Maximum Primary Fuse % Rating
9 or more	125*
2 to less than 9	167
less than 2	300

Table 2 - Primary & Secondary Fuses

Transformer Secondary Amperes	Maximum Primary Fuse % Rating	
	Primary Fuse	Secondary Fuse
9 or more	250	125*
less than 9	250	167

* If 125% does not correspond to a standard ampere rating, the next higher standard rating shall be permitted.

TRANSFORMER MAGNETIZING INRUSH CURRENTS

When voltage is switched on to energize a transformer, the transformer core normally saturates. This results in a large inrush current which is greatest during the first half cycle (approximately 0.01 second) and becomes progressively less severe over the next several cycles (approximately 1 second) until the transformer reaches its normal magnetizing current.

To accommodate this inrush current, fuses are often selected which have time-current withstand values of at least 12 times transformer primary rated current for .1 second and 25 times for .01 second. Recommended primary fuses for popular, low voltage 3-phase transformers are shown on the next page. Some small dry-type transformers may have substantially greater inrush currents. For these applications, the fuse may have to be selected to withstand 45 times transformer primary rated current for .01 second.

SECONDARY FUSES

Selecting fuses for the secondary is simple once rated secondary current is known. Fuses are sized at 125% of secondary FLA or the next higher rating; or at maximum 167% of secondary FLA, see Table 2 for rules. The preferred sizing is 125% of rated secondary current Isec or next higher fuse rating. To determine I_{sec}, first determine transformer rating (VA or kVA), secondary voltage (V_{sec}) and use formulas below.

1. Single Phase : $I_{sec} = \frac{\text{Transformer VA}}{V_{sec}}$

or $\frac{\text{Transformer kVA x 1000}}{V_{sec}}$

2. Three Phase : $I_{sec} = \frac{\text{Transformer VA}}{1.73 \times V_{sec}}$

or $\frac{\text{Transformer kVA x 1000}}{1.73 \times V_{sec}}$

When I_{sec} is determined, multiply it by 1.25 and choose that fuse rating or next higher rating.
[I_{sec} x 1.25 = Fuse Rating]

Fusing for Three Phase Transformer Primaries without Secondary Protection

Transformer kVA	240V Primary		480V Primary		600V Primary	
	FLA	TR-R Fuse Rating	FLA	TRS-R Fuse Rating	FLA	TRS-R Fuse Rating
3	7.2	9	3.6	4-1/2	2.9	4
5	12	15	6	8	4.8	6
7.5	18	25	9	12	7.2	9
9	22	30	11	15	9	12
15	36	45	18	25	14	20
30	72	90	36	45	29	35
45	108	150	54	70	43	60
75	180	225	90	125	72	90
100	241	300	120	150	96	125
112.5	271	350	135	175	108	150
150	361	450	180	225	144	200
225	541	600	371	350	217	300
300	722	-	361	450	289	350
500	1203	-	601	-	481	600

** Where fuse sizes do not correspond to a standard ampere rating, the next higher standard rating shall be permitted.*

Fusing for Three Phase Transformers - Primary and Secondary Protection

Transformer (kVA)	Primary Fuse Series and Ratings					Secondary Series and Ratings			
	240 V Primary					120 V Secondary		208 V Secondary	
	FLA	AJT/A2D-R	A4BT	A4BY	A4BQ	FLA	Fuse Rating	FLA	Fuse Rating
3	7.2	15	-	-	-	14	20	8	12
5	12	25	-	-	-	24	30	14	17-1/2
7.5	18	40	-	-	-	36	45	21	30
9	22	45	-	-	-	43	60	25	35
15	36	60	-	-	-	72	100	42	60
30	72	150	-	-	-	145	200	83	110
45	108	225	-	-	-	217	300	125	175
75	180	400	-	-	-	361	450	208	300
100	241	450	-	-	-	482	600	278	350
112.5	271	500	-	-	-	542	700	313	400
150	361	600	-	-	-	723	900	417	600
225	541	-	800	900	1200	1084	1350	625	800
300	722	-	1200	1200	1600	1445	1800	834	1200
500	1203	-	1800	2000	2500	2408	2500	1390	1600

Transformer (kVA)	Primary Fuse Series and Ratings					Secondary Fuse Ratings					
	480 V Primary					120 V Secondary		208 V Secondary		240 V Secondary	
	FLA	AJT/A6D-R	A4BT	A4BY	A4BQ	FLA	Fuse Rating	FLA	Fuse Rating	FLA	Fuse Rating
3	3.6	6	-	-	-	14	20	8	12	7	9
5	6	12	-	-	-	24	30	14	17-1/2	12	15
7.5	9	15	-	-	-	36	45	21	30	18	25
9	11	25	-	-	-	43	60	25	35	22	30
15	18	35	-	-	-	72	100	42	60	36	45
30	36	60	-	-	-	145	200	83	110	72	100
45	54	100	-	-	-	217	300	125	175	108	150
75	90	175	-	-	-	361	450	208	300	181	250
100	120	225	-	-	-	482	600	278	350	241	350
112.5	135	300	-	-	-	542	700	313	400	271	350
150	180	400	-	-	-	723	900	417	600	361	500
225	371	500	-	-	-	1084	1350	625	800	542	700
300	361	600	-	-	-	1445	1800	834	1200	723	1000
500	601	-	1000	1000	1200	2408	2500	1390	1600	1204	1600
750	902	-	1400	1600	2000	3613	4000	2084	2500	1806	2000
1000	1203	-	1800	2000	2500	4817	5000	2779	3000	2408	2500

Transformer (kVA)	Primary Fuse Series and Ratings					Secondary Fuse Ratings					
	600 V Primary					120 V Secondary		208 V Secondary		240 V Secondary	
	FLA	AJT/A6D-R	A4BT	A4BY	A4BQ	FLA	Fuse Rating	FLA	Fuse Rating	FLA	Fuse Rating
3	2.9	5	-	-	-	14	20	8	12	7	9
5	4.8	10	-	-	-	24	30	14	17-1/2	12	15
7.5	7.2	15	-	-	-	36	45	21	30	18	25
9	9	17-1/2	-	-	-	43	60	25	35	22	30
15	14	25	-	-	-	72	100	42	60	36	45
30	29	45	-	-	-	145	200	83	110	72	100
45	43	80	-	-	-	217	300	125	175	108	150
75	72	150	-	-	-	361	450	208	300	181	250
100	96	200	-	-	-	482	600	278	350	241	350
112.5	108	225	-	-	-	542	700	313	400	271	350
150	144	300	-	-	-	723	900	417	600	361	500
225	217	450	-	-	-	1084	1350	625	800	542	700
300	289	500	-	-	-	1445	1800	834	1200	723	1000
500	481	-	700	900	1000	2408	2500	1390	1600	1204	1600
750	722	-	1200	1400	1600	3613	4000	2084	2500	1806	2000
1000	962	-	1600	1800	2000	4817	5000	2779	3000	2408	2500

Control circuit transformers used as part of a motor control circuit are to be protected as outlined in Tables 1 & 2 with one important exception. Primary fuses may be sized up to 500% of transformer rated primary current if the rated primary current is less than 2 amperes.

When a control circuit transformer is energized, the typical magnetizing inrush will be 25-40 times rated primary full load current (FLA) for the first 1/2 cycle and dissipates to rated current in a few cycles. Fuses must be sized so they do not open during this inrush. We recommend that fuses be selected to withstand 40 x FLA for .01 sec. and to stay within the NEC guidelines specified above.

For example: 300VA Transformer, 600V primary.

$$\text{Ipri} = \frac{\text{Transformer VA}}{\text{Primary V}} = \frac{300}{600} = 1/2\text{A} = \text{FLA}$$

The fuse time-current curve must lie to the right of the point 40 x (1/2A) = 20A @ .01 sec.

Secondary fuses are still sized at 125% of the secondary FLA.

Recommended Primary Fuses for Single Phase Control Transformers

Trans	600 Volt Primary						480 Volt Primary					
VA	FLA	ATQR	ATMR	A6D-R+	AJT+	TRS-R	FLA	ATQR	ATMR	A6D-R+	AJT+	TRS-R
25	.042	1/10	2/10	2/10	-	1/10	.052	1/10	1/4	1/4	-	1/10
50	.083	1/4	3/10*	4/10	-	2/10	.104	1/4	1/2*	1/2	-	2/10
75	.125	1/4	1/2*	6/10	-	2/10	.156	3/10	3/4*	6/10	-	2/10
100	.167	3/10	3/4*	8/10	-	3/10	.208	4/10	1	1	1	3/10
130	.22	4/10	1	1	1	4/10	.27	1/2	1	1	1-1/2	4/10
150	.25	1/2	1*	1-1/4	1	4/10	.313	1/2	1-1/2	1-4/10	1-1/2	4/10
200	.33	1/2	1-1/2	1-6/10	1-1/2	6/10	.417	6/10	2	2	2	6/10
250	.42	6/10	2	2	2	6/10	.52	8/10	2	2-1/2	2-1/2	6/10
300	.50	1	2	2-1/2	2	8/10	.62	1-1/2	3	3	3	8/10
350	.583	1-1/4	2	2-8/10	2	1	.73	1-1/2	3-1/2	3-1/2	3-1/2	1
500	.833	1-1/2	4	4	4	1-1/4	1.04	2	5	4	4	1-4/10
750	1.25	2-1/2	6	4	4	1-6/10	1.56	3*	7	5	5	2
1000	1.67	3	8	5	5	2-1/4	2.08	4+	-	5+	5+	3
1500	2.5	5+	-	6+	6+	4	3.125	7+	-	6-1/4+	6-1/4+	4
2000	3.33	8+	-	8+	8+	5	4.17	10+	-	7+	7+	5
3000	5.00	12+	-	12+	12+*	8	6.25	15+*	-	15+*	15+	8
5000	8.33	20+*	-	20+*	20+**	12+	10.4	-	-	25+*	25+*	15+
7500	12.5	30+*	-	30+*	30+**	17-1/2+	15.6	-	-	35+**	35+**	20+
10000	16.7	-	-	40+*	40+**	25+	20.8	-	-	50+**	50+**	30+
		240 Volt Primary					120 Volt Primary					
25	.104	2/10	1/2	1/2	-	2/10	.21	4/10	1	1	1	3/10
50	.21	4/10	1	1	1	3/10	.42	6/10	2	2	2	6/10
75	.31	1/2	1-1/2	1-4/10	1-1/2	4/10	.6	1	3	3	3	8/10
100	.42	6/10	2	2	2	6/10	.83	1-1/2	4	4	4	1
130	.54	1	2-1/2	2-1/2	2-1/2	8/10	1.08	2-1/2	5	4	4	1-6/10
150	.625	1	3	3	3	8/10	1.25	2-1/2	6	4	4	1-6/10
200	.83	1-1/2	4	3-1/2	3-1/2	1	1.67	3*	8	5	5	2-1/4
250	1.04	2	5	4	4	1-4/10	2.08	4+	-	5+	5+	2-8/10
300	1.25	2-1/2	6	4	4	1-6/10	2.5	5+	-	6+	6+	3-2/10
350	1.46	3*	7	5	5	2	2.92	7+	-	6+	6+	4
500	2.08	4+	-	5+	5+	2-8/10	4.17	10+	-	10+	6	5-6/10
750	3.13	7+	-	6-1/4+	6-1/4+	4	6.25	15+*	-	15+**	15+	8
1000	4.2	10+	-	7	7	5-6/10	8.33	20+*	-	20+**	20+*	12+
1500	6.25	15+	-	15+	15+	8	12.5	30+*	-	30+	30+	15
2000	8.3	20+*	-	20+**	20+**	12	16.7	-	-	40+**	40+	25+
3000	12.5	30+*	-	30+**	30+**	15	25	-	-	60+**	60+*	35+
5000	20.8	-	-	50+**	50+*	25	41.7	-	-	100+**	100+**	60+
7500	31.3	-	-	70+**	70+**	40+	62.5	-	-	150+**	150+**	90+
10000	41.7	-	-	100+**	100+**	60+	83.3	-	-	200+**	200+**	125+

The above fuses will withstand 40 x FLA for .01 second except where noted.
+ Secondary fusing required.

** Fuse will withstand 30 x FLA for .01 second.*
*** Fuse will withstand 35 x FLA for .01 second.*

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