

Transformer Protection

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

Transformers - Primary 600 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 .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 I_{sec} or next higher fuse rating. To determine I_{sec}, first determine transformer rating (VA or kVA), secondary voltage (V_{sec}) and use formulas below.

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

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

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

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

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]

Transformers - Primary Over 600 Volts

If in unsupervised locations, fuses are to be selected according to Table 3. Where the required fuse rating does not correspond to a standard ampere rating, the next higher standard rating shall be permitted. In supervised locations, fuses are to be selected according to Table 4.

Table 3- Unsupervised Locations

Transformer Secondary Amperes	Primary Fuse	Maximum % Rating	
		Secondary Fuse	
		Over 600V	600V or Less
6 or less	300*	250*	125*
More than 6 & not more than 10	300*	225*	125*

Table 4- Supervised Locations

Transformer Rated % Impedance	Primary Fuse	Maximum % Rating	
		Secondary Fuse	
		Over 600V	600V or Less
All	250*	-	-
6 or less	300	250	250
More than 6 & not more than 10	300	225	250

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

Primary Fuses For 3-Phase LV Transformers

Recommended Primary Fuses for 240 Volt, Three Phase Transformers

Transformer Rating kVA	240 Volt Primary					
	Primary Full Load Amps	TR-R	A2D-R*	A4BT*	A4BY*	A4BQ*
3	7.2	9	15	-	-	-
5	12	15	25	-	-	-
7-1/2	18	25	40	-	-	-
9	22	30	45	-	-	-
15	36	45	60	-	-	-
30	72	90	150	-	-	-
45	108	150	225	-	-	-
75	180	225	400	-	-	-
100	241	300	450	-	-	-
112-1/2	271	350	500	-	-	-
150	361	450	600	-	-	-
225	541	600	-	800	900	1200
300	722	-	-	1200	1200	1600
500	1203	-	-	1800	2000	2500
750	1804	-	-	-	3000	4000
1000	2406	-	-	-	5000	5000
1500	3608	-	-	-	6000	-

Recommended Primary Fuses for 480 & 600 Volt, Three Phase Transformers

Transformer Rating kVA	480 Volt Primary						600 Volt Primary					
	Primary Full Load Amps	TRS-R	AJT* or A6D-R*	A4BT*	A4BY*	A4BQ*	Primary Full Load Amps	TRS-R	AJT* or A6D-R*	A4BT*	A4BY*	A4BQ*
3	3.6	4-1/2	6	-	-	-	2.9	4	5	-	-	-
5	6.0	8	12	-	-	-	4.8	6	10	-	-	-
7-1/2	9.0	12	15	-	-	-	7.2	9	15	-	-	-
9	11	15	25	-	-	-	9.0	12	17-1/2	-	-	-
15	18	25	35	-	-	-	14	20	25	-	-	-
30	36	45	60	-	-	-	29	35	45	-	-	-
45	54	70	100	-	-	-	43	60	80	-	-	-
75	90	125	175	-	-	-	72	90	150	-	-	-
100	120	150	225	-	-	-	96	125	200	-	-	-
112-1/2	135	175	300	-	-	-	108	150	225	-	-	-
150	180	225	400	-	-	-	144	200	300	-	-	-
225	271	350	500	-	-	-	217	300	450	-	-	-
300	361	450	600	-	-	-	289	350	500	-	-	-
500	601	-	-	1000	1000	1200	481	600	-	700	900	1000
750	902	-	-	1400	1600	2000	722	-	-	1200	1400	1600
1000	1203	-	-	1800	2000	2500	962	-	-	1600	1800	2000
1500	1804	-	-	-	3000	4000	1443	-	-	2000	2500	3000
2000	2406	-	-	-	4000	5000	1925	-	-	-	4000	4000
2500	3007	-	-	-	5000	6000	2406	-	-	-	5000	5000

*When using these fuses, the secondary of the transformer must be fused to comply with the Code.

Secondary Fuses for LV Transformers

TRANS-FORMER RATING (kVA)	SECONDARY FULL LOAD AMPS AT RATED VOLTAGE (VAC) 3-PHASE					SECONDARY FUSE RATING FOR 120V				SECONDARY FUSE RATING FOR 240V				SECONDARY FUSE RATING FOR 480V				SECONDARY FUSE RATING FOR 600V			
	120	240	480	600		*A2D-R, AJT, or *TR-R	A4BQ	A4BY	A4BT	*A2D-R, AJT, or *TR-R	A4BQ	A4BY	A4BT	*A6D-R, AJT, or *TRS-R	A4BQ	A4BY	A4BT	*A6D-R, AJT, or *TRS-R	A4BQ	A4BY	A4BT
3	14	7	4	3	20	-	-	-	9	-	-	-	5	-	-	-	4	-	-	-	-
5	24	12	6	5	30	-	-	-	15	-	-	-	8	-	-	-	6	-	-	-	-
7.5	36	18	9	7	45	-	-	-	25	-	-	-	12	-	-	-	9	-	-	-	-
9	43	22	11	9	50	-	-	-	30	-	-	-	15	-	-	-	12	-	-	-	-
15	72	36	18	14	90	-	-	-	45	-	-	-	25	-	-	-	20	-	-	-	-
30	145	72	36	29	200	-	-	-	90	-	-	-	45	-	-	-	35	-	-	-	-
45	217	108	54	43	300	-	-	-	150	-	-	-	70	-	-	-	60	-	-	-	-
75	361	181	90	72	450	-	-	-	225	-	-	-	125	-	-	-	90	-	-	-	-
100	482	241	120	96	600	-	-	-	300	-	-	-	150	-	-	-	125	-	-	-	-
112.5	542	271	135	108	700	700	700	700	350	-	-	-	175	-	-	-	150	-	-	-	-
150	723	361	181	145	900	900	900	900	450	-	-	-	250	-	-	-	200	-	-	-	-
225	1084	542	271	217	1350	1350	1350	1400	700	700	700	700	350	-	-	-	300	-	-	-	-
300	1445	723	361	289	1800	1800	1800	2000	900	900	900	900	450	-	-	-	400	-	-	-	-
500	2408	1204	602	482	3000	3000	3000	-	1500	1500	1500	1500	-	750	750	750	600	-	-	-	-
750	3613	1806	903	723	4500	4500	6000	-	2200	2200	3000	-	-	1000	1000	1000	-	900	900	900	900
1000	4817	2408	1204	963	6000	6000	-	-	3000	3000	-	-	-	1500	1500	1500	-	1200	1200	1200	1200
1500	7225	3613	1806	1445	-	-	-	-	4500	4500	-	-	-	2500	2500	-	-	2000	2000	2000	2000
2000	9634	4817	2408	1927	-	-	-	-	6000	6000	-	-	-	3000	3000	-	-	2500	2500	2500	2500
2500	12042	6021	3011	2408	-	-	-	-	-	-	-	-	-	4000	4000	-	-	3000	3000	3000	3000
3000	14451	7225	3613	2890	-	-	-	-	-	-	-	-	-	5000	5000	-	-	3500	3500	3500	3500
3750	18064	9032	4516	3613	-	-	-	-	-	-	-	-	-	6000	6000	-	-	5000	5000	5000	5000
5000	24085	12042	6021	4817	-	-	-	-	-	-	-	-	-	-	-	-	-	6000	6000	6000	6000

*Use A2D(Amp)/R, A6D(Amp)/R, TR(Amp)/R, or TRS(Amp)/R.