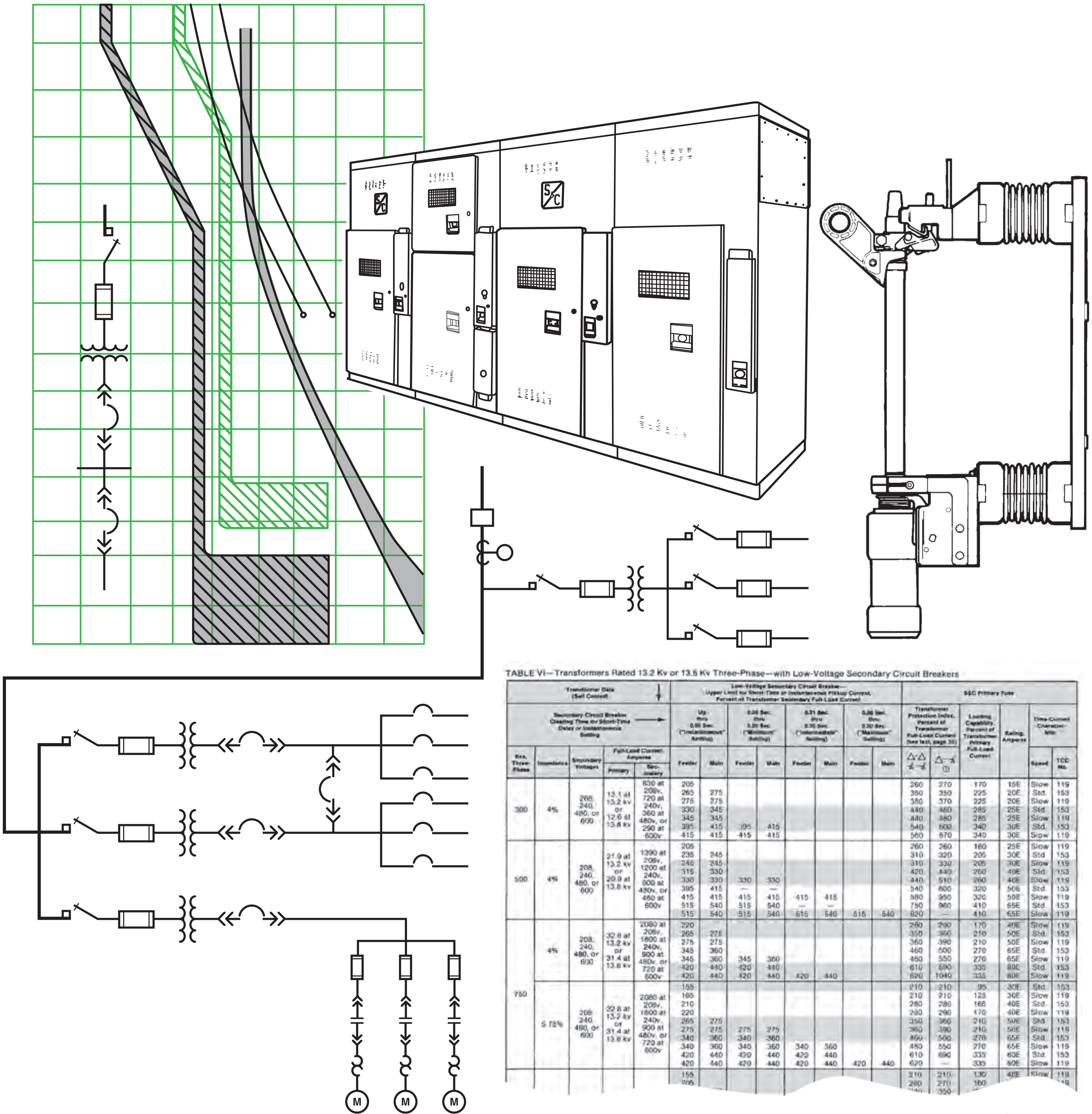

Price $7.50

SELECTION GUIDE FOR TRANSFORMER-PRIMARY FUSES IN MEDIUM-VOLTAGE INDUSTRIAL, COMMERCIAL, AND INSTITUTIONAL POWER SYSTEMS

S&C Power Fuses – Types SM, SML, and SMD-20
Indoor and Outdoor Distribution (4.16 kv through 34.5 kv)

Supersedes Data Bulletin 240-110 dated 4-12-82

S&C ELECTRIC COMPANY • Chicago
S&C ELECTRIC CANADA LTD. • Rexdale

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GENERAL

This data bulletin is a guide for the selection, application, and coordination of S&C Power Fuses—Types SM, SML, and SMD-20 when applied on the primary side of medium-voltage transformers in industrial, commercial, and institutional power systems. The information and recommendations presented in this publication apply regardless of whether the fuses are connected directly to the transformer primary or are remotely connected through insulated cable or enclosed bus duct. For the purpose of this guide, medium-voltage transformers are those having primary voltage ratings between 4.16 kv and 34.5 kv, with either low-voltage (208 v, 240 v, 480 v, or 600 v) or medium-voltage (2.4 kv or 4.16 kv) secondaries.

The function of a transformer primary-side protective device is, in general, to provide system protection as well as transformer protection. With respect to system protection, a primary-side protective device should detect a potentially damaging overcurrent condition and operate promptly to isolate only the faulted segment, thereby minimizing the short-circuit stresses on the remainder of the system and limiting the extent of the service interruption to only the affected segment. For transformer protection, a primary-side protective device should operate promptly in response to a bus or cable fault located between the transformer and the nearest secondary-side overcurrent protective device. It should further provide backup protection for the transformer in the event the secondary-side overcurrent protective device either fails to operate due to a malfunction, or operates too slowly due to incorrect (higher) ratings or settings. To best achieve these objectives, group protection of transformers is not generally recommended—each transformer should be individually protected. The ampere rating of a primary-side protective device selected to accommodate the total loading requirements of two or more transformers would typically be so large that only a small degree of secondary-fault protection—and almost no backup protection—would be provided for each individual transformer. Moreover, for group-protection situations involving transformers of unequal sizes, the ampere rating of the primary-side protective device might even be greater than the already large maximum ampere rating permitted by the National Electrical Code for the smallest transformer. In addition, with group protection of transformers, the degree of service continuity is significantly reduced, since a fault associated with any one transformer protected by a given device will result in the loss of service to all transformers protected by the device. A variety of primary-side protective devices such as circuit breakers, solid-material power fuses, and current-limiting fuses are available to accomplish the above tasks.

In industrial, commercial, and institutional power systems, circuit breakers have been used for applications requiring complex relaying schemes or high continuous currents. However, for most applications a choice of either circuit breakers or power fuses is available. Fuses have achieved widespread use in most such applications because of their simplicity, economy, fast response characteristics, and freedom from maintenance.

Circuit breakers and their associated relays are commonly used where the reclosing capability of the circuit breaker is an advantage, such as applications involving overhead lines which have a relatively high incidence of transient or temporary faults. This reclosing feature is neither useful nor desirable in industrial, commercial, and institutional power systems where the conductors are arranged in cable trays or enclosed in conduit or bus duct. The incidence of faults on these systems is low, and the rare faults that do occur are not transient and result in significant damage that would only be exacerbated by an automatic reclosing operation.

The relaying associated with circuit breakers is available in varying degrees of sophistication and complexity. Systems requiring differential protection, reverse-power relaying, or non-current-magnitude tripping of the protective device typically require circuit breakers. However, the sizes of transformers normally associated with industrial, commercial, and institutional power systems generally do not warrant such sophisticated protection. Indeed, many users find that the complexity of such protective relaying, with its requirement for periodic testing and recalibration, is a distinct disadvantage.

Circuit breakers are also used in applications requiring a very high—above 720 amperes—continuous current-carrying capability. While this may be an advantage in some cases, a higher degree of service continuity can be achieved with less expensive power fuses by subdividing the system into a larger number of discrete segments, with the result that a fault on one segment of the system affects fewer loads. This high degree of segmentation also allows the use of smaller transformers located strategically throughout the system, eliminating the need for the unnecessarily long, high-ampacity secondary conductors that are required where fewer, larger, widely separated transformers are used.

Where high continuous current-carrying capability is not required and where reclosing or sophisticated relaying is not justified—as is the case in the majority of transformer protection applications in medium-voltage industrial, commercial, and institutional power systems—power fuses offer a number of advantages. Power fuses are simple to install and require no maintenance of any kind—even after years of inattention, power fuses will operate properly. Recalibration is neither required nor possible. Hence, elaborate testing procedures are not needed, eliminating the possibility that a carefully engineered coordination plan will accidentally be disturbed. Power fuses, unlike circuit breakers, provide fault protection for the system without dependence on a source of control power, such as storage batteries and their chargers. Such batteries may be found completely discharged and thus incapable of tripping the circuit breaker should a fault occur. In addition, for high-magnitude faults, power fuses have inherently faster response characteristics than circuit breakers, permitting more rapid removal of faults from the system with these advantages:

1. The duration of the voltage "dip" associated with the fault is reduced significantly, minimizing the potential for disruption of the remaining loads;
2. The duration of stresses on motors in other segments of the system is shortened;
3. The conductor temperature rise due to the fault current is lessened, permitting the use of conductors one or more sizes smaller than those required by slower operating circuit breakers, resulting in considerable savings; and

4. The upstream protective device can be set to operate faster—for better protection—while still coordinating with the transformer-primary fuse.

Thermal damage to three-phase motors due to single-phasing—once thought to be a problem associated with the use of power fuses on the primary side of a transformer—is of no concern, since the National Electrical Code requires that motors be equipped with an overcurrent protective device in each of the three supply phases. In addition, devices are now widely available which detect open-phase conditions caused by blown fuses and such other events as utility-line burndown, broken conductors, single-phase switching, or equipment malfunctions, and which initiate a switching operation to isolate the load or transfer to an alternate source. Furthermore, power fuses provide selective isolation of only faulted phases of three-phase feeders serving *single-phase loads*, unlike the undiscriminating operation of circuit breakers which remove all three phases from the system—even on single-phase faults.

As mentioned above, there are two types of power fuses: solid-material fuses and current-limiting fuses, with significantly different performance characteristics which materially affect their suitability for transformer protection. S&C Types SM, SML, and SMD Power Fuses are of the solid-material type, and have fusible elements that are nondamageable and nonaging. The time-current characteristics of S&C Power Fuses are permanently accurate—neither age and vibration, nor surges that heat the element nearly to the severing point will affect the characteristics of these fuses. There is no need for any "safety zones" or "setback allowances." As a consequence of these performance characteristics, SM, SML, and SMD Power Fuses allow fusing closer to the transformer full-load current, providing the maximum degree of protection against secondary-side faults. In addition, the ability to fuse closer to the transformer full-load current facilitates coordination with upstream protective devices by allowing the use of lower ampere ratings or settings for these devices, resulting in faster response.

Current-limiting fuses on the other hand, because of their construction, are inherently susceptible to element damage caused by inrush currents that approach the fuse's minimum melting time-current characteristic curve. Because of this potential for damage, and because of the effects of loading and manufacturing tolerances on the time-current characteristic curve, a safety zone or setback allowance is typically required. This safety zone or setback allowance, combined with the "shape" of the time-current characteristic curve, results in the selection of a current-limiting fuse ampere rating substantially greater than the transformer full-load current. However, the use of such a high ampere rating is undesirable, since the degree of transformer protection will be reduced, and coordination with the upstream protective device may be jeopardized. Also, since high-ampere-rated current-limiting fuses typically require the use of two or three lower-ampere-rated fuses connected in parallel, increased cost and space requirements may be encountered.

Selection of the various types of transformer primary-side protective devices and their ratings and settings has been a matter of considerable complexity. This publication provides complete, simplified procedures for selecting the optimal transformer-primary fuse, taking into consideration all of the following factors associated with the application:

1. System voltage;
2. Available fault current;
3. Anticipated normal transformer loading schedule, including daily or repetitive peak loads, and emergency peak loads;

4. Transformer inrush current, including the combined effects of transformer magnetizing-inrush current and the energizing-inrush currents associated with connected loads—particularly following a momentary loss of source voltage;
5. The degree of protection provided to the transformer against damaging overcurrents;
6. Coordination with secondary-side as well as other primary-side overcurrent protective devices; and
7. Protection of the downstream primary-side conductors against damaging overcurrents.

These factors are discussed in detail in the next section, entitled "Application Principles." This discussion is followed by tables designed specifically to simplify the selection of the optimal transformer-primary fuse for your particular applications.

The fuse selection tables list fuse ampere ratings and speed characteristics which have been "precoordinated" with the full spectrum of low-voltage and medium-voltage overcurrent protective devices, such as circuit breakers, fuses, and Class E-2 high-voltage industrial control equipment, thereby *eliminating the need to perform graphical coordination studies.* The tables feature a specially designed "Transformer Protection Index" which indicates the degree of transformer protection provided by the primary fuse, as well as listings of the loading capabilities of the fuses when used with each of the transformers shown. You need only refer to these tables to obtain the information required to make your selection.

APPLICATION PRINCIPLES

Select the Primary Fuse Rating . . .

A transformer-primary fuse must be selected for the voltage rating, the available fault current, and the continuous current-carrying requirement of the circuit on which it is to be applied. Since there are a multitude of voltage, short-circuit interrupting, and maximum ampere ratings available, you should choose the most economical primary fuse that will meet both your present and your future requirements. In addition, from the wide variety of ampere ratings and speeds available, you should select the primary fuse providing the optimum protection for the transformer against secondary-side faults.

Voltage rating. The maximum design voltage rating of the transformer-primary fuse should equal or exceed the maximum phase-to-phase operating voltage level of the system. S&C Types SM, SML, and SMD Power Fuses are not "voltage critical," since they do not produce overvoltages, and therefore, they may be applied at any system operating voltage equal to *or less than* the maximum design voltage rating of the fuse. Current-limiting fuses, in contrast, inherently develop an overvoltage during fault-current interruption. This overvoltage typically restricts the application of current-limiting fuses to the same system-voltage class as the maximum voltage rating of the current-limiting fuse, in order to avoid exposing system components such as surge arresters and dry-type transformers to damage from excessive voltages.

Short-circuit interrupting rating. The symmetrical short-circuit interrupting rating of the transformer-primary fuse should equal or exceed the maximum available fault current at the fuse location. When determining the interrupting rating of the primary fuse, you should consider the X/R ratio of the system at the fuse location, since power fuses may have *higher-than-nominal* symmetrical interrupting ratings for those applications where the X/R ratio is *less* than the value of 15 specified by ANSI Standards.* You may as a result be able to use a less expensive primary fuse having a lower nominal symmetrical interrupting rating. Refer to the fuse manufacturer's recommendations for these higher symmetrical short-circuit interrupting ratings.

The interrupting rating of the transformer-primary fuse should be chosen with sufficient margin to accommodate anticipated increases in the interrupting duty due to system growth. Again, since fuses are available with a wide variety of interrupting ratings, you should choose a primary fuse having an interrupting rating only as large as necessary to meet your present and future requirements.

Ampere rating and speed characteristic. The ampere rating and speed characteristic of the transformer-primary fuse should be selected to (1) accommodate the anticipated normal transformer loading schedule, including daily or repetitive peak loads, and emergency peak loads; (2) withstand the magnetizing-inrush current associated with the energizing of an unloaded transformer, as well as the combined magnetizing- and load-inrush currents associated with the re-energization of a loaded transformer following a momentary

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* ANSI Standard C37.46, Specifications for Power Fuses and Fuse Disconnecting Switches.

loss of source voltage; (3) protect the transformer against damaging overcurrents; and (4) coordinate with secondary-side as well as other primary-side overcurrent protective devices. These principles, which are examined in greater detail in the following sections, provide the basic foundation of transformer-primary fuse selection.

Accommodate Expected Loading Levels . . .

In general, the transformer-primary fuse should be selected based on the anticipated normal transformer loading schedule, including daily or repetitive peak loads. The primary fuse ultimately selected should have a continuous loading capability, as differentiated from its ampere rating, equal to or greater than this highest anticipated loading level. Refer to the fuse manufacturer's recommendations for such loading capability values. Recommendations for S&C Power Fuses—Types SM, SML, and SMD-20 used for transformer protection are included in the fuse selection tables presented in this guide.

Conditions may occur during which the transformer will be loaded far in excess of the normal loading schedule. Such emergency peak loading typically occurs when one of two transformers (in a duplex substation, for example) is compelled, under emergency conditions, to carry the load of *both* transformers for a short period of time. Where emergency peak loads are contemplated, the transformer-primary fuse ultimately selected should have an emergency peak-load capability at least equal to the magnitude *and* duration of the emergency peak load. It is important to remember that a transformer-primary fuse should be selected to accommodate—*not to interrupt*—emergency peak loads. This requirement may result in the selection of a primary fuse ampere rating larger than would be required for a similarly rated single transformer installed alone, and therefore

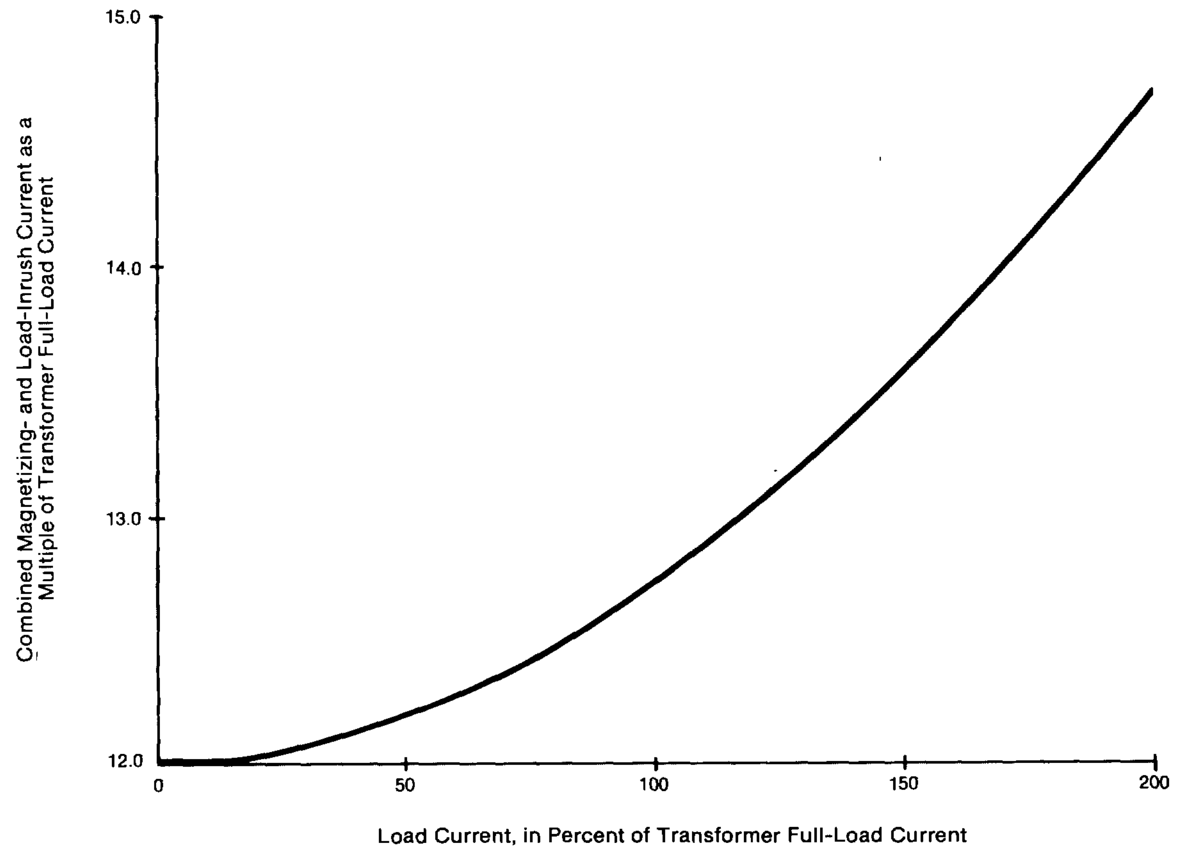

Figure 1. Curve for determining magnitude of combined magnetizing- and load-inrush current.

the degree of transformer protection provided by the primary fuse may be reduced.

Withstand Inrush Currents . . .

When an unloaded distribution or power transformer is energized, there occurs a short-duration inrush of magnetizing current which the transformer-primary fuse must be capable of withstanding without operating (or, in the case of current-limiting fuses, without sustaining damage to the fusible element). The integrated heating effect on the primary fuse as a result of this inrush current is generally considered equivalent to a current having a magnitude of 12 times the primary full-load current of the transformer for a duration of 0.1 second. The minimum melting time-current characteristic of the primary fuse should be such that the fuse will not operate (or again, in the case of current-limiting fuses, sustain damage to the fusible element) as a result of this magnetizing-inrush current.

The transformer-primary fuse must also be capable of withstanding the inrush current that occurs when a transformer that is carrying load experiences a momentary loss of source voltage, followed by re-energization (such as occurs when a source-side circuit breaker operates to clear a temporary upstream fault, and then automatically recloses). In this case, the inrush current is made up of two components: the magnetizing-inrush current of the transformer, and the inrush current associated with the connected loads. The ability of the primary fuse to withstand combined magnetizing- and load-inrush current is referred to as "hot-load pickup" capability.

The integrated heating effect on the transformer-primary fuse as a result of the combined magnetizing- and load-inrush current is equivalent to a current having a magnitude of between 12 and 15 times the primary full-load current of the transformer for a duration of 0.1 second. The specific multiple of primary full-load current is a function of the transformer load immediately preceding the momentary loss of source voltage, as illustrated in the curve in Figure 1. The minimum melting time-current characteristic of the primary fuse (adjusted as described below) should exceed the magnitude and duration of the combined inrush current.

The minimum melting time-current characteristic curves for medium-voltage power fuses are determined in accordance with ANSI Standards,* which specify testing of fuses at an ambient temperature of 25°C, and with no initial load. In practice, every fuse is carrying a load, which raises the temperature of the fusible element, and hence reduces the melting time for a given value of current. To ensure that the transformer-primary fuse can withstand hot-load pickup current (and to provide precise coordination between the primary fuse and downstream overcurrent protective devices), it is necessary to adjust the published minimum melting time-current characteristic curve of the primary fuse to reflect the reduced melting time for each specific level of fuse loading. Figure 2 illustrates a typical curve used for

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* ANSI Standard C37.46, Specifications for Power Fuses and Fuse Disconnecting Switches.

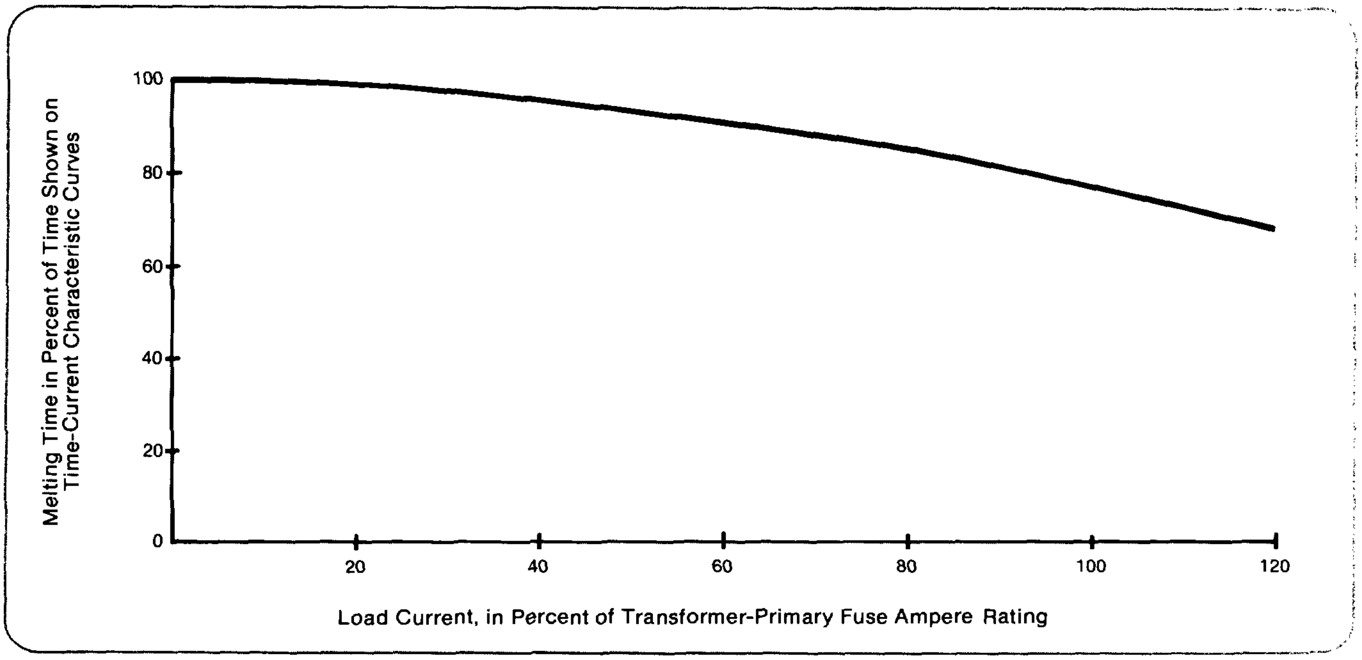


Figure 2. Curve for determining loading adjustment factor.

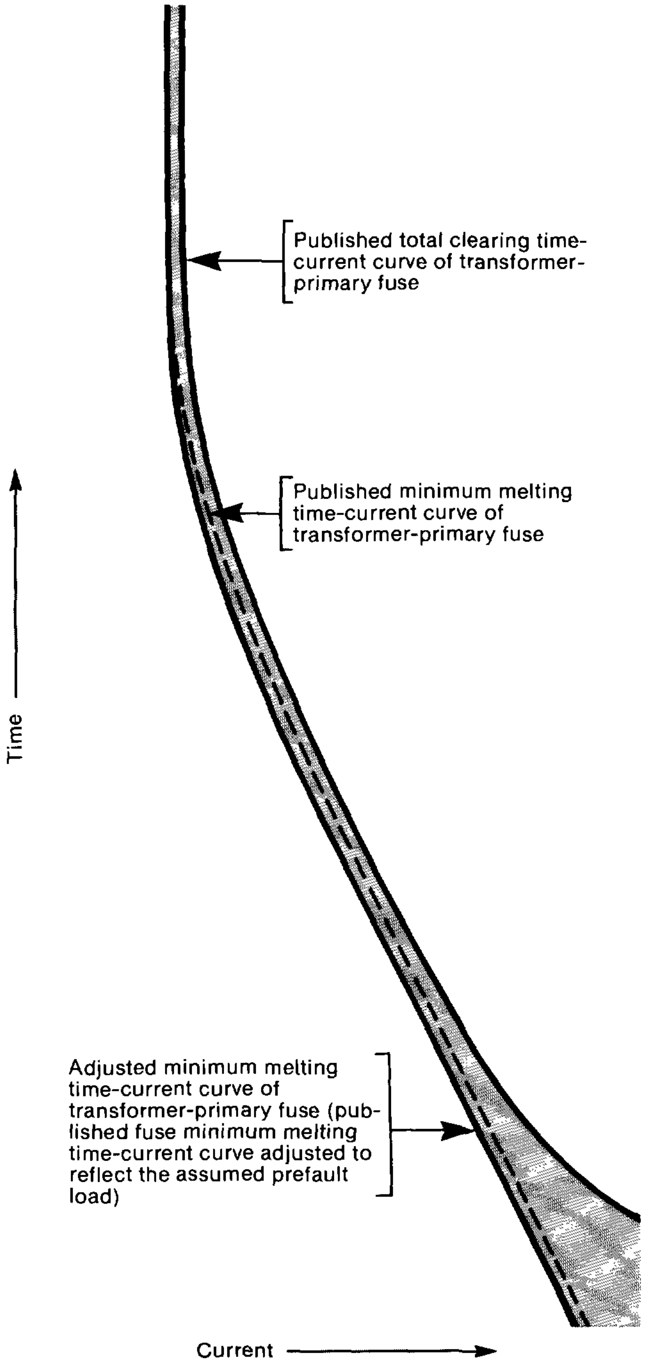


Figure 3. The total clearing and the minimum melting time-current curves of a 100E-ampere transformer-primary fuse, with the minimum melting curve adjusted to reflect the reduced melting time resulting from an assumed prefault load current of 87.5 amperes.

making such an adjustment, and Figure 3 illustrates the minimum melting time-current curve of a primary fuse so adjusted.

Solid-material power fuses have helically coiled, stress-relieved silver fusible elements that are of solderless construction and are surrounded by air. Because of this construction, the adjustment mentioned above regarding the level of prefault load is the only adjustment that need be made to ensure sufficient hot-load pickup capability and precise coordination with downstream protective devices. In such power fuses, the fusible element is free from mechanical and thermal stress and confining support, and therefore is not subject to damage—even by inrush currents that approach but do not exceed the fuse's minimum melting time-current characteristic curve, adjusted to reflect the assumed prefault load. Fuses with other element designs, in contrast, require additional or larger adjustments to their minimum melting time-current characteristic curves to recognize the physical or metallurgical damage to the fusible element that can result from such surge currents.

Current-limiting fuses, in particular, have fusible elements which consist of a number of very fine diameter silver wires, or one or more perforated or notched silver ribbons, surrounded by, and in contact with, a filler material such as silica sand. Because of this construction, current-limiting fuses are susceptible to element damage caused by current surges that approach the fuse's minimum melting time-current characteristic curve. This damage may occur in one or more of the following ways:

1. The fusible element may melt but not completely separate, because the molten silver is constrained by the filler material. The silver then solidifies, but with a different cross-sectional area.
2. One or more, but not all, of the parallel silver wires or ribbons of the fusible element may melt and separate.
3. The fusible element may break as a result of fatigue brought about by localized buckling of the fusible element from thermal expansion and contraction.

Certain current-limiting fuses utilize a eutectic or "M" spot consisting of a drop of tin or tin alloy deposited on the silver element. The tin or tin alloy melts and amalgamates (combines) with the silver element at a temperature lower than the melting temperature of the silver element, thereby initiating fuse operation at lower levels of fault current than for the silver element alone. Current-limiting fuses that utilize "M" spots are even more susceptible to element damage than other types of current-limiting fuses, since the "M" spot may only partially melt and amalgamate when exposed to current surges.

Damage to fusible elements of current-limiting fuses, as described above, may shift or alter their time-current characteristics, resulting in a loss of complete coordination between the fuses and other downstream overcurrent protective devices. Moreover, a damaged current-limiting fuse element may melt due to an otherwise harmless inrush current, but the fuse may fail to clear the circuit due to insufficient power flow—with the fuse continuing to arc and burn internally due to load-current flow.

Because of the potential for damage to the fusible element from inrush currents, and because of the effects of loading and manufacturing tolerances, current-limiting fuse manufacturers typically require that, when applying such fuses, the minimum melting time-current characteristic curves be adjusted to allow for these variables. These adjustments are referred to as "safety zones" or "setback allowances," and range from 25% in terms of *time* to 25% in terms of *current*. The latter can result in an adjustment of 250% or more in terms of *time*, depending on the slope of the time-current characteristic curve at the point where the safety zone or setback allowance is measured.

The S&C Types SM, SML, and SMD-20 Power Fuses covered in this publication are available in two speed characteristics: Standard Speed, TCC No. 153; and Slow Speed, TCC No. 119. The time-current characteristic curves for these fuses are of the inverse-time form with sufficient time delay so that, in either speed, a fuse having an ampere rating even somewhat less than the transformer full-load current will withstand the inrush currents described above, for typical industrial transformer loading levels.

Current-limiting fuses, in contrast, have inherently steeper (faster) time-current characteristics. As a consequence, manufacturers of current-limiting fuses ordinarily recommend the use of an ampere rating substantially higher than the transformer full-load current in order to prevent the fuse from operating or sustaining damage due to inrush currents. However, the use of a higher ampere rating is undesirable for three reasons: (1) protection for the transformer may be greatly reduced; (2) coordination with the upstream protective device may be jeopardized; and (3) higher-ampere-rated current-limiting fuses (usually above 100 amperes) typically require the use of two or three lower-ampere-rated fuses connected in parallel, resulting in significantly increased cost and space requirements.

Protect Transformer Against Damaging Overcurrents . . .

The most important application principle to be considered when selecting a transformer-primary fuse is that it must protect the transformer against damage from mechanical and thermal stresses resulting from a secondary-side fault that is not promptly interrupted. A properly selected primary fuse will operate to clear such a fault before the magnitude and duration of the overcurrent exceed the short-time loading limits recommended by the transformer manufacturer.

In the absence of specific information applicable to an individual transformer, the primary fuse should be selected in accordance with recognized guidelines for

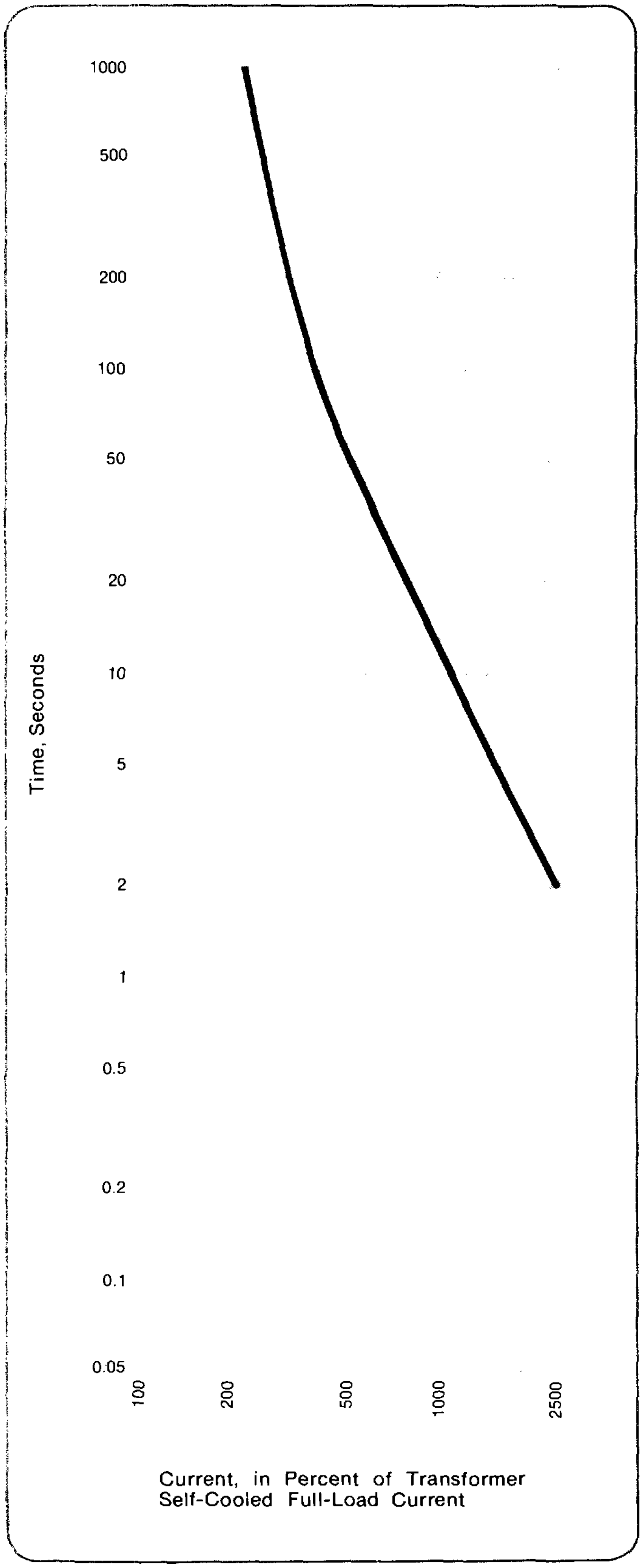
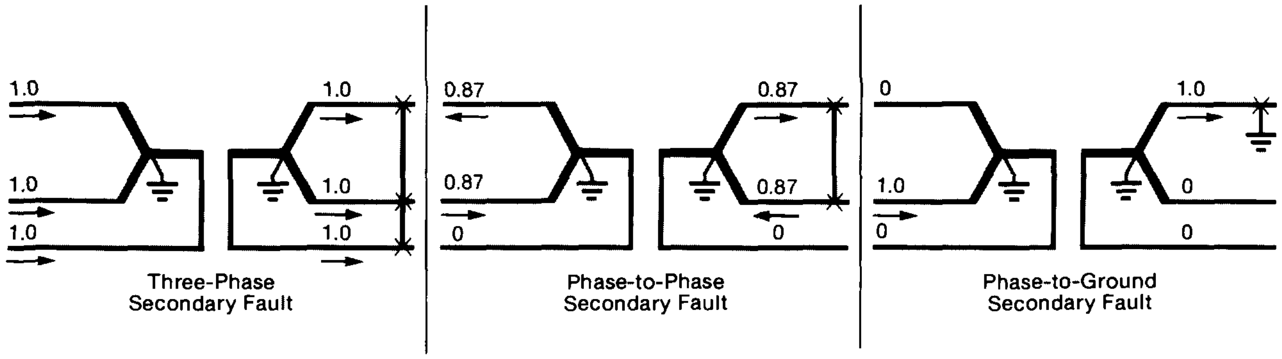


Figure 4. Transformer short-time characteristic curve.

the maximum permissible transformer short-time loading limits. A curve representing these limits (see Figure 4) was introduced in the Appendix to ANSI Standard C57.92-1962, Guide for Loading Oil-Immersed Distribution and Power Transformers. This curve was subsequently incorporated in ANSI Standard C37.91-1972 (R1978), Guide for Protective Relay Applications to Power Transformers, and in NEMA TR-98-1978, Guide for Loading Oil-Immersed Power Transformers. For the purpose of this publication, the curve illustrated in Figure 4 will be referred to as the transformer short-time characteristic curve.

As mentioned before, the most important consideration when selecting a transformer-primary fuse is the degree of protection it provides the transformer against all types of secondary-side faults. The degree of transformer protection provided by the primary fuse should be checked for the level of fault current and type of fault (i.e., three-phase, phase-to-phase, or phase-to-ground) producing the most demanding conditions possible for each particular application, viz., those for which the ratio of the primary-side *line* currents to the transformer *winding* currents is the lowest. For these situations, one or more of the primary fuses will be exposed to a proportionately lower level of current than the windings, and, as a consequence, the primary fuses must be carefully selected to operate fast enough to avoid damage to the transformer windings. Figure 5 illustrates the relationship between the per-unit primary-side and secondary-side line currents and the associated per-unit transformer winding currents for three common transformer connections under a variety of secondary-fault conditions. Table I on page 12 lists the ratio of the per-unit primary-side line currents to the per-unit transformer winding currents for these transformer connections and types of secondary faults.

From Table I, it is clear that a phase-to-phase secondary fault on a delta delta connected transformer and a phase-to-ground secondary fault on a delta grounded-wye connected transformer produce the most demanding conditions possible for those particular transformer connections, since the per-unit primary-side line currents are less than the per-unit transformer winding currents. Accordingly, to ensure proper transformer protection for these two situations, it is necessary to "shift" the basic transformer short-time characteristic curve to the left (in terms of current) by the ratio of the

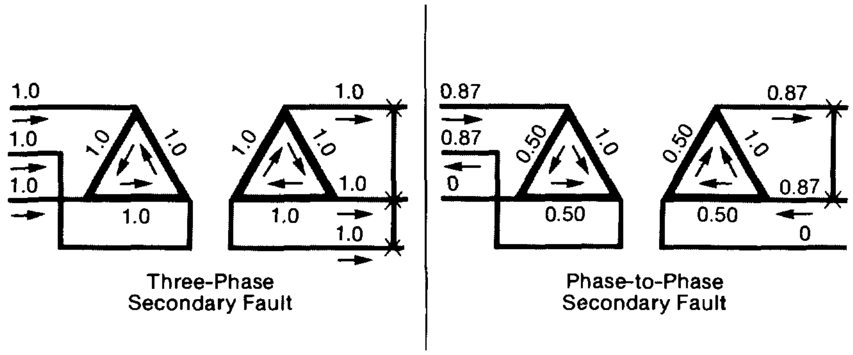


Three-Phase Secondary Fault

Phase-to-Phase Secondary Fault

Phase-to-Ground Secondary Fault

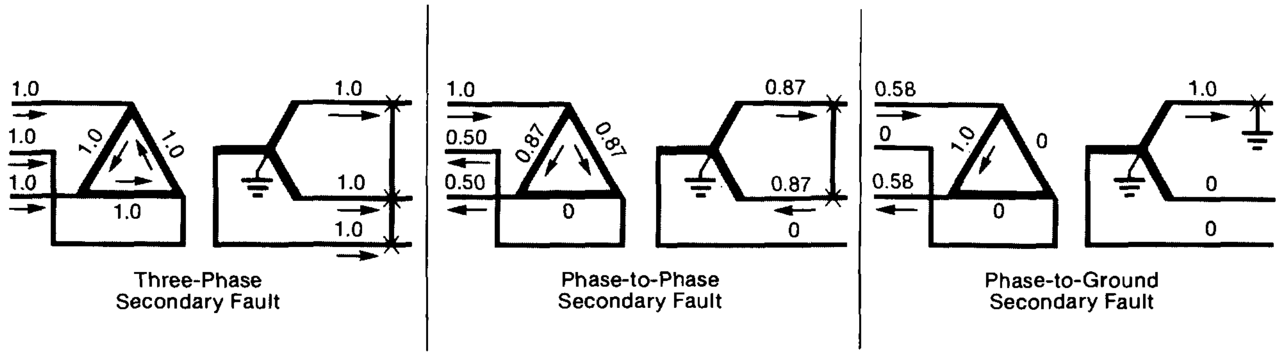
(a) Grounded-Wye Grounded-Wye Connected Transformer



Three-Phase Secondary Fault

Phase-to-Phase Secondary Fault

(b) Delta Delta Connected Transformer



Three-Phase Secondary Fault

Phase-to-Phase Secondary Fault

Phase-to-Ground Secondary Fault

(c) Delta Grounded-Wye Connected Transformer

Figure 5. Relationship between the per-unit primary-side and secondary-side line currents and the associated per-unit transformer winding currents for (a) grounded-wye grounded-wye, (b) delta delta, and (c) delta grounded-wye connected transformers for various types of secondary faults. (Line current and winding current values are expressed in per unit of their respective values for a "bolted" three-phase secondary fault.)

per-unit primary-side line current to the per-unit transformer winding current listed in Table I. The shifted transformer short-time characteristic curve will then be in terms of the primary-side line current and, as such, will be directly comparable with the total clearing time-current characteristic curve of the transformer-primary fuse. For the grounded-wye grounded-wye connected transformer, the per-unit primary-side line currents and the per-unit transformer winding currents are the same, hence the basic transformer short-time characteristic curve applies.

TABLE I—Relationship Between Per-Unit Primary-Side Line Current and Per-Unit Transformer Winding Current for Various Types of Secondary Faults

Transformer Connection ↓	**Ratio of Per-Unit Primary-Side Line Current to Per-Unit Transformer Winding Current①**		
Type of Fault →	**Three-Phase**	**Phase-to-Phase**	**Phase-to-Ground**
⏚Y–⏚Y	1.0	1.0	1.0
Δ–Δ	1.0	0.87	Not Applicable
Δ–⏚Y	1.0	1.15	0.58

① Line current and winding current values are expressed in per unit of their respective values for a "bolted" three-phase secondary fault.

Figure 6 illustrates the basic transformer short-time characteristic curve (Curve Ⓐ), applicable to the grounded-wye grounded-wye connected transformer, as well as short-time characteristic curves adjusted to reflect the two situations discussed above. Curve Ⓑ represents Curve Ⓐ adjusted to reflect the reduced level of current (0.87 per unit) seen by two primary fuses during a phase-to-phase secondary fault on a delta delta connected transformer. Similarly, Curve Ⓒ represents Curve Ⓐ adjusted to reflect the reduced level of current (0.58 per unit) seen by two primary fuses during a phase-to-ground secondary fault on a delta grounded-wye connected transformer.

For a delta wye connected transformer *with its neutral grounded through an impedance*, the ratio of the per-unit line current to the per-unit winding current for a phase-to-ground secondary fault is the same as that discussed above for a delta grounded-wye connected transformer. However, since the impedance in the neutral limits the magnitude of the phase-to-ground fault current to levels well below the level of current which will damage the transformer, the phase-to-ground transformer short-time characteristic curve (Curve Ⓒ) is of no concern and may be ignored. Accordingly, the basic transformer short-time characteristic curve (Curve Ⓐ) applicable to multiphase secondary faults should be used for this transformer.

Although the transformer short-time characteristic curve is only a guide, it is recommended as a criterion against which to measure the degree of transformer protection provided by the transformer-primary fuse. To meet this criterion for high-magnitude secondary-side faults, the total clearing time-current characteristic curve of the primary fuse should pass below the point (commonly called the ANSI Point) on the appropriate transformer short-time characteristic curve at the current level corresponding to the maximum three-phase secondary-fault current as determined solely by the transformer impedance. Based on the design and application of the primary fuse, as described below, the total clearing time-current characteristic curve of the primary fuse will typically cross the transformer short-time characteristic curve at some low level of current.

Another aspect of transformer protection involves low-current overloads. *Low-voltage* current-limiting fuses are designed to provide overload protection for the transformer by operating at currents only slightly larger than their ampere rating. In contrast, *medium-voltage* transformer primary-side protective devices are not intended to provide overload protection. For this reason, the minimum operating current of medium-voltage power fuses is required by ANSI Standards* to be significantly greater than the ampere rating. For example, "E" rated power fuses are required to operate

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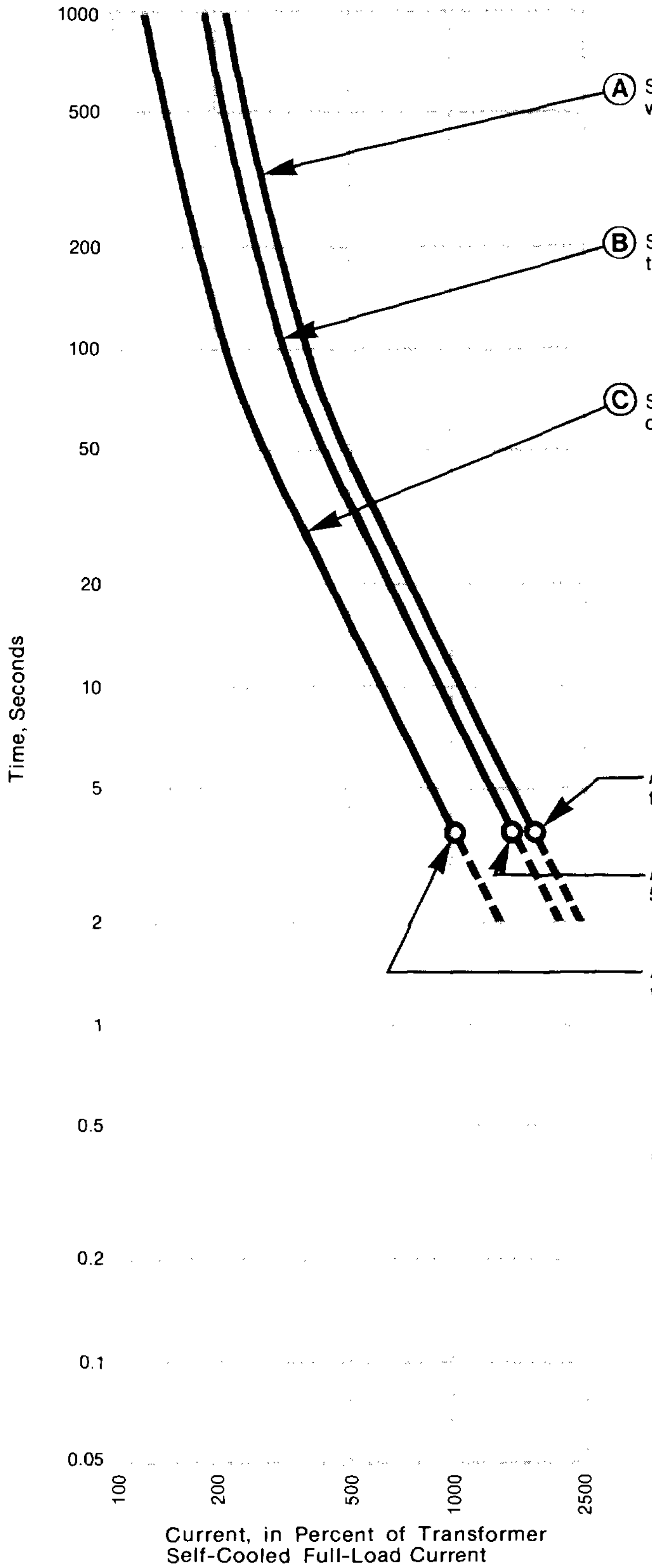
* ANSI Standard C37.46, Specifications for Power Fuses and Fuse Disconnecting Switches.



Ⓐ Short-time characteristic curve for a grounded-wye grounded-wye connected transformer.

Ⓑ Short-time characteristic curve for a delta delta connected transformer.

Ⓒ Short-time characteristic curve for a delta grounded-wye connected transformer.

ANSI Point* for a grounded-wye grounded-wye connected transformer with 5.75% impedance.

ANSI Point* for a delta delta connected transformer with 5.75% impedance.

ANSI Point* for a delta grounded-wye connected transformer with 5.75% impedance.

* The current value for the ANSI Point is determined using the following formula: $\left(\frac{1}{(\%Z)}\right)\left(\begin{matrix}\text{transformer-connection}\\ \text{adjustment factor}\end{matrix}\right)$.

For example, for a delta grounded-wye connected transformer with 5.75% impedance, the current value for the ANSI Point is $\left(\frac{1}{0.0575}\right)$ (0.58), or 1010% of the transformer full-load current.

Figure 6. Transformer short-time characteristic curves.

at not less than 200 or 220 percent of the ampere rating. Accordingly, the total clearing time-current characteristic curve of the transformer-primary fuse will cross the transformer short-time characteristic curve at some low level of current. Because the primary fuse does not provide overload protection for the transformer, this should not be a concern; however, efforts should be made to keep the current value at which the two curves intersect as low as possible, to maximize protection for the transformer against secondary-side faults.

Curve © in Figure 7, which corresponds to the transformer short-time characteristic curve for a delta grounded-wye connected transformer, illustrates these principles. The total clearing curves for primary fuses with a fusing ratio* of 1.0, 1.5, 2.0, or 2.5 all pass below the ANSI Point of the delta grounded-wye connected transformer's short-time characteristic curve. The total clearing curve for a primary fuse with a fusing ratio of 3.0 passes completely above and to the right of the transformer short-time characteristic curve, and thus, as a consequence, would not provide protection for this transformer for a phase-to-ground secondary fault.‡ Since the object of transformer-primary fusing is to provide protection for the transformer for *all* types of secondary faults, a primary fuse with a total clearing curve that passes above the ANSI Point (such as the primary fuse with a fusing ratio of 3.0 in Figure 7) would be considered unacceptable.

The transformer-primary fuse having the *lowest* fusing ratio of the four fuses that pass beneath the ANSI Point would provide the maximum protection for the transformer against secondary faults located between the transformer and the secondary-side overcurrent protective device—as well as maximum backup protection for the transformer in the event the secondary-side overcurrent protective device fails to operate, or operates too slowly due to an incorrect (higher) rating or setting. From Figure 7, it may be seen that a primary fuse with a fusing ratio of 1.0 will provide protection for a delta grounded-wye connected transformer against phase-to-ground secondary faults producing currents as low as 230% of the full-load current of the transformer as reflected on the primary side. When the fusing ratio is 2.5, however, protection for the transformer is provided only when secondary faults produce primary-side currents exceeding 670% of the transformer full-load current.

The results of published studies† referenced below indicate that under arcing conditions, secondary-switchboard and other nearby faults on 480/277Y-volt circuits have magnitudes as low as 40% of the maximum available phase-to-ground fault current at the point of the fault. This corresponds to 290% of the full-load current of the transformer in Figure 7, as seen by the transformer-primary fuse. Hence, a primary fuse with a fusing ratio of 1.0 will provide protection for the transformer against an arcing phase-to-ground fault, since the primary fuse will operate at as low as 230% of the full-load current of the transformer. A primary fuse with a fusing ratio only slightly higher than 1.0, though, may have a total clearing current in excess of 290% of the full-load current of the transformer, and thus may not

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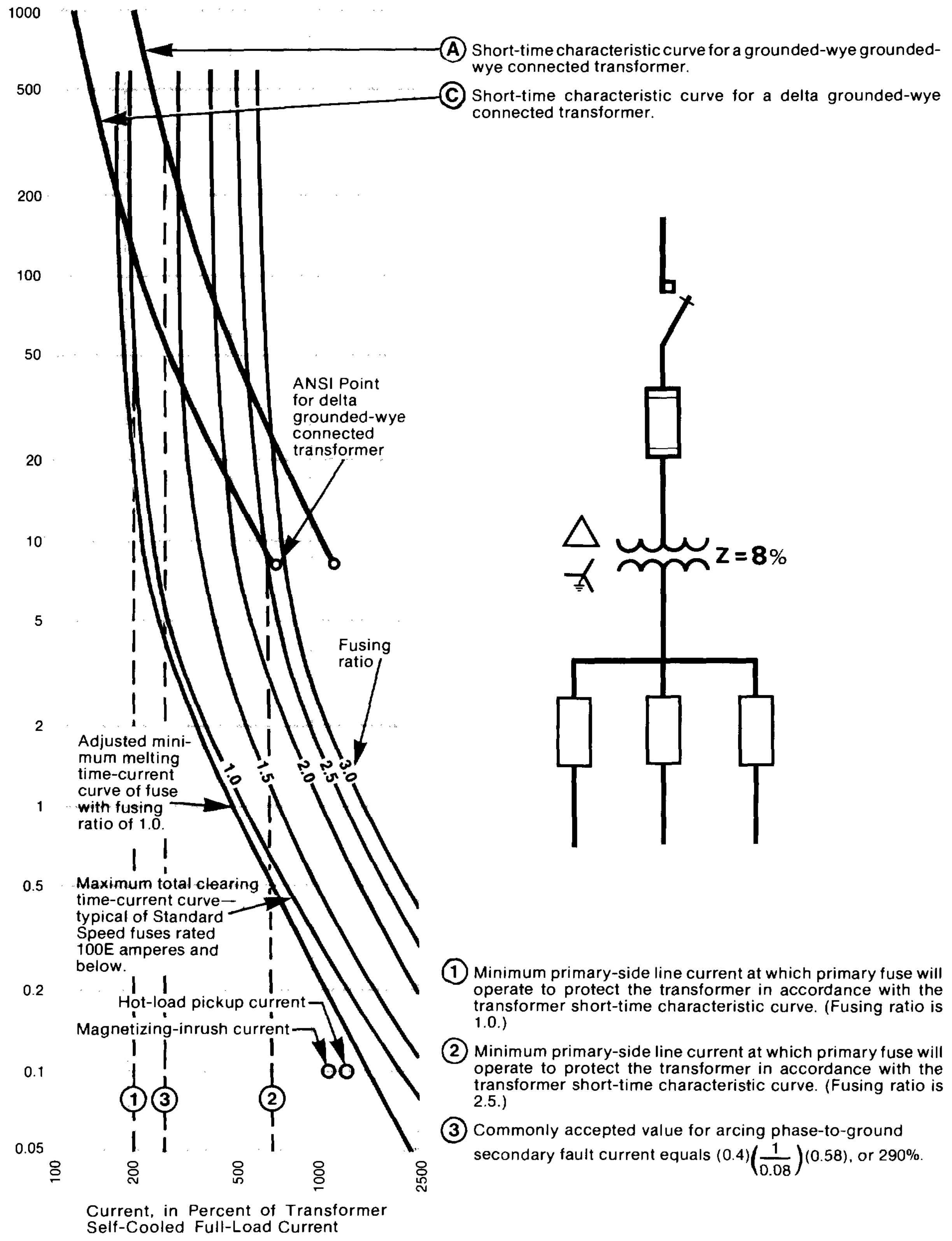
* Fusing ratio is defined as the ratio of the transformer-primary fuse ampere rating to the transformer self-cooled full-load current.

‡ Transformers in industrial, commercial, and institutional power systems typically have impedances less than 8%. For such transformers, the total clearing time-current curve of the slope illustrated for a primary fuse with a fusing ratio of 3.0 would typically pass below and to the left of the ANSI Point. A transformer with 8% impedance was selected for Figure 7 to illustrate the concept of a primary fuse providing inadequate protection.

† The following references are recommended:

1. J. R. Dunki-Jacobs, "The Effects of Arcing Ground Faults on Low-Voltage System Design," Article reprinted from the May/June 1972 issue of IEEE Transactions on Industry and General Applications.
2. J. R. Dunki-Jacobs, "State of the Art of Grounding and Ground Fault Protection," Article reprinted from the 1977 Conference Record of the IEEE 24th Annual Petroleum and Chemical Industry Conference, September 13-14, 1977, Dallas, Texas, Catalog No. 77CH1229-4-1A.
3. L. E. Fisher, "Resistance of Low-Voltage Alternating Current Arcs," IEEE Transactions on Industry and General Applications, Vol. IGA-6, November/December 1970, pages 607-616.



Ⓐ Short-time characteristic curve for a grounded-wye grounded-wye connected transformer.

Ⓒ Short-time characteristic curve for a delta grounded-wye connected transformer.

① Minimum primary-side line current at which primary fuse will operate to protect the transformer in accordance with the transformer short-time characteristic curve. (Fusing ratio is 1.0.)

② Minimum primary-side line current at which primary fuse will operate to protect the transformer in accordance with the transformer short-time characteristic curve. (Fusing ratio is 2.5.)

③ Commonly accepted value for arcing phase-to-ground secondary fault current equals $(0.4)\left(\frac{1}{0.08}\right)(0.58)$, or 290%.

Figure 7. The effect of fusing ratios on the degree of protection provided a delta grounded-wye connected transformer against a phase-to-ground secondary fault.

provide protection for the transformer against a phase-to-ground fault under arcing conditions. A primary fuse with a fusing ratio only slightly higher than 1.0 will, however, adequately protect the transformer against permanent or metallic phase-to-ground secondary faults as well as other types of secondary faults, including arcing phase-to-ground secondary faults that escalate to multiphase secondary faults.

As a second example, consider Curve Ⓑ in Figure 8, which corresponds to the transformer short-time characteristic curve for a delta delta connected transformer. The total clearing curve of a transformer-primary fuse with a fusing ratio as high as 3.0 will pass below the ANSI Point of the transformer short-time characteristic curve, and will thus provide protection for the transformer as discussed before. However, a primary fuse with such a high fusing ratio will not provide protection for the transformer unless the fault current exceeds 735% of the full-load current of the transformer as reflected on the primary side. A primary fuse with a fusing ratio of 1.0 will clearly provide much better protection for the delta delta connected transformer by operating at as low as 230% of the transformer-primary full-load current.

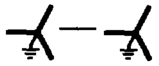
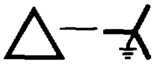
As mentioned before, an effort should be made to select a transformer-primary fuse which will protect the transformer against *all* types of secondary-side faults—including arcing phase-to-ground faults. The primary-side line-current values for various types of secondary-side faults and for various transformer connections and impedances, expressed in percent of the transformer full-load current, are listed in Table II, below. The desired protection is obtained if the current value at which the primary fuse total clearing time-current curve and the transformer short-time characteristic curve intersect is less than the applicable values as shown in Table II.

Coordinate with Other Protective Devices . . .

General

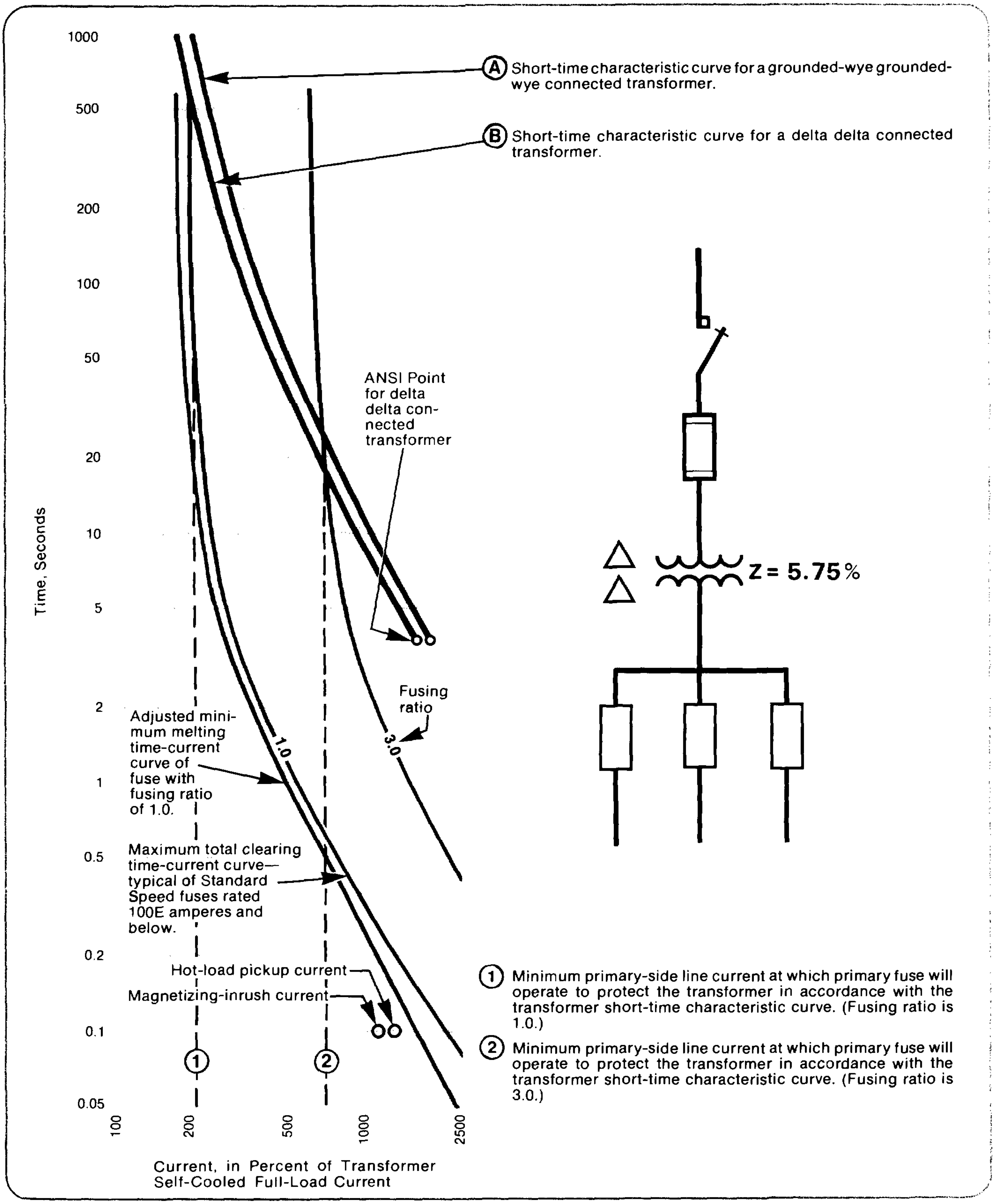
The most important aspect of transformer-primary fusing is, of course, the provision of maximum protection for the transformer. It is also important, however, for the time-current characteristics of the transformer-primary fuse to be coordinated with the time-current characteristics of certain other overcurrent protective devices on both the secondary side and the primary side of the transformer. Coordination is defined as the selective operation of various overcurrent protective devices, and, if properly executed, will result in removal of the

TABLE II—Secondary Fault Currents Reflected to Primary Lines

Transformer Connection	Impedance	Arcing Phase-to-Ground① Fault	Maximum Primary-Side Line Current for Various Types of Secondary Faults, Percent of Transformer Full-Load Current		
			Phase-to-Ground	Phase-to-Phase	Three-Phase
	4%	1000%	2500%	2180%	2500%
	5.5%	■	1820	1580	1820
	5.75%	700	1740	1510	1740
	6.5%	■	1540	1340	1540
	8%	500	1250	1090	1250
	4%	Not Applicable	Not Applicable	2180	2500
	5.5%			1580	1820
	5.75%			1510	1740
	6.5%			1340	1540
	8%			1090	1250
	4%	580	1450	2500	2500
	5.5%	■	1050	1820	1820
	5.75%	400	1010	1740	1740
	6.5%	■	890	1540	1540
	8%	290	730	1250	1250

① Commonly accepted arcing-fault-current values for secondary-switchboard and other nearby faults. See text, page 14.

■ For transformers with medium-voltage secondaries (2.4 kv or 4.16 kv), the entries in the "Phase-to-Ground" column apply.



Ⓐ Short-time characteristic curve for a grounded-wye grounded-wye connected transformer.

Ⓑ Short-time characteristic curve for a delta delta connected transformer.

① Minimum primary-side line current at which primary fuse will operate to protect the transformer in accordance with the transformer short-time characteristic curve. (Fusing ratio is 1.0.)

② Minimum primary-side line current at which primary fuse will operate to protect the transformer in accordance with the transformer short-time characteristic curve. (Fusing ratio is 3.0.)

Figure 8. The effect of fusing ratios on the degree of protection provided a delta delta connected transformer against a phase-to-phase secondary fault.

least possible amount of load by the device clearing the fault, while normal service is maintained on the remainder of the circuit. The following sections describe how proper coordination is achieved both between the transformer-primary fuse and secondary-side protective devices, and between the transformer-primary fuse and upstream protective devices.

Coordination between the transformer-primary fuse and secondary-side protective devices

Figure 9 represents a portion of a simple radial circuit which serves to illustrate the principles of coordination described above. A fault at point Ⓑ on a feeder should be cleared by the feeder protective device ②, before the upstream protective device ① operates. Additionally, a fault at point Ⓐ should be cleared by the protective device ① before another device even farther upstream begins to operate.

Figure 10 represents another simple radial circuit, similar to that in Figure 9 except for the addition of the transformer. The presence of the transformer, however, does not affect the need for coordination between the upstream protective device (transformer-primary fuse, in this example) and the feeder protective devices. As before, a secondary fault at point Ⓒ on a feeder should be cleared by the feeder protective device ②, and a secondary fault at point Ⓑ should be cleared by the transformer-primary fuse ①. Additionally, the transformer-primary fuse will clear a primary fault located at point Ⓐ.

For many applications, a main secondary-side protective device may be considered economically unjustifiable, since as described above, a properly selected primary fuse will provide the same degree of secondary-fault protection for the transformer as would the main secondary protective device. There are applications, though, where a main secondary protective device is commonly used for reasons other than secondary-side fault protection, such as: (1) in circuits with a large number of feeders, where the main secondary protective device serves as a "master" disconnect to permit rapid shutdown of the circuits in an emergency; (2) in circuits where overload protection is desired because the combined load capability of the feeder protective devices exceeds the overload capability of the transformer; and (3) in duplex substations or in situations where the secondaries of two supply transformers are connected through a bus-tie switch or circuit breaker, in order to isolate a faulted transformer from the low-voltage bus.

The use of a main secondary-side protective device does not, however, alter the desirability of providing the maximum degree of protection for the transformer, while obtaining coordination with secondary-side protective devices such that the least possible amount of load is removed in the event of a fault. This is best achieved by coordinating the transformer-primary fuse with the feeder protective device having the highest ampere rating or setting (or in the case of a duplex substation, with the bus-tie switch or circuit breaker). A primary fuse so selected will have a smaller ampere rating than would be possible if the primary fuse were coordinated with the main secondary protective device, thereby providing a higher degree of protection for the transformer against secondary-side faults as well as superior backup protection for the transformer in the event a secondary-side overcurrent protective device fails to operate correctly.

Lack of coordination between the main secondary-side protective device and the transformer-primary fuse is no problem, since the current ranges over which the two devices do not coordinate are very narrow, and even then only apply when (1) a feeder fault is not cleared due

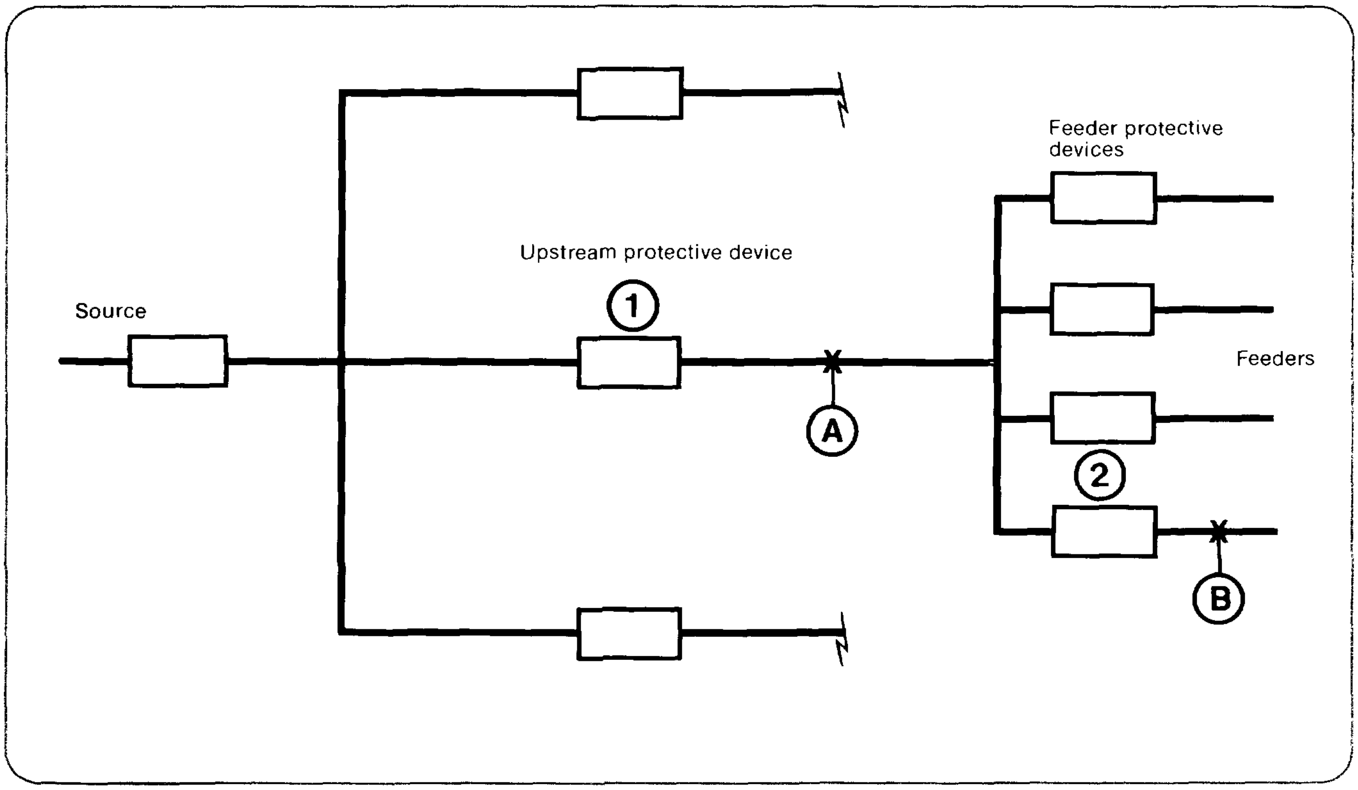


Figure 9. Coordination between an upstream protective device and a feeder protective device. Refer to text.

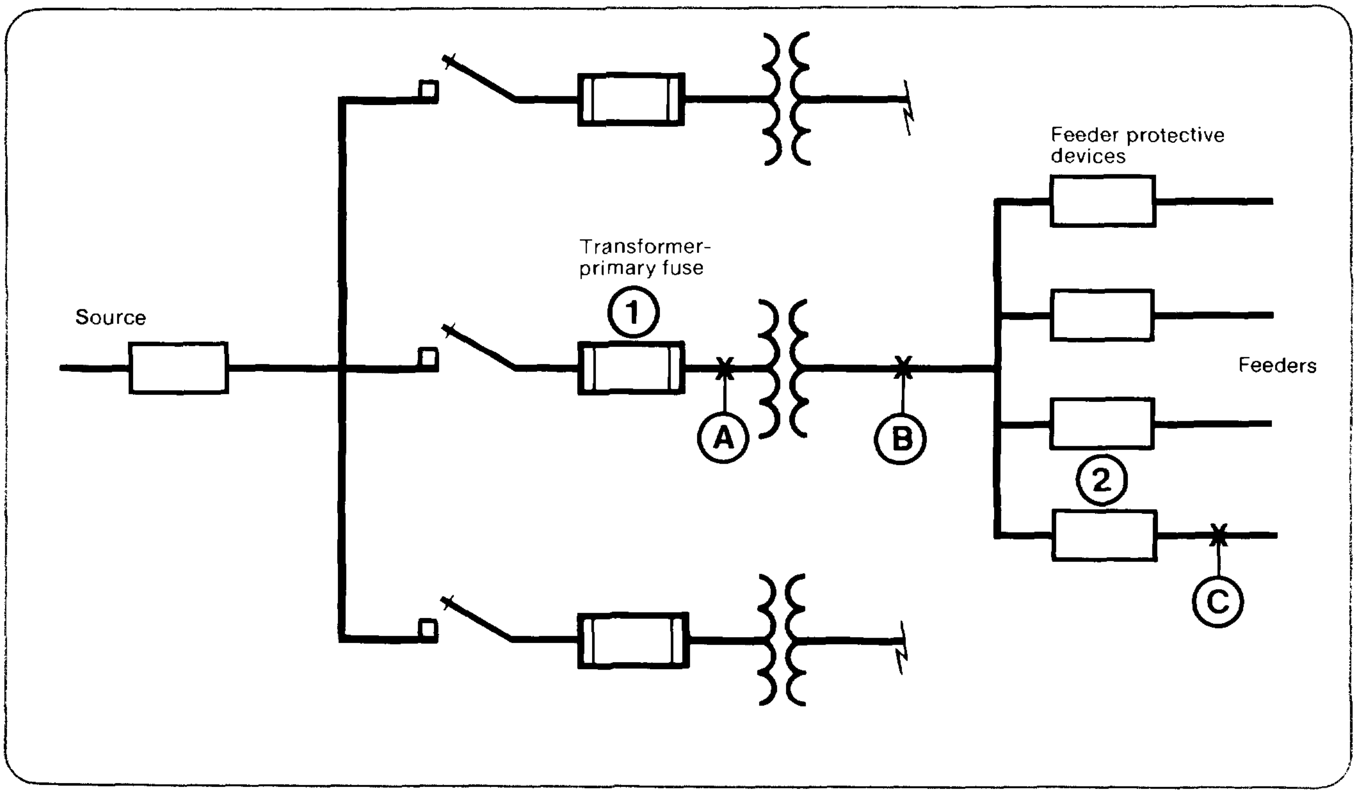


Figure 10. Coordination between a transformer-primary fuse and a feeder protective device. Refer to text.

to failure of a feeder protective device, or (2) there is a secondary bus fault. Either combination of circumstances is so rare that the primary fuse will seldom operate. Even if the primary fuse operates, the result is no different from that which ensues if only the main secondary protective device operates, since in either case the entire output of the transformer will be lost.

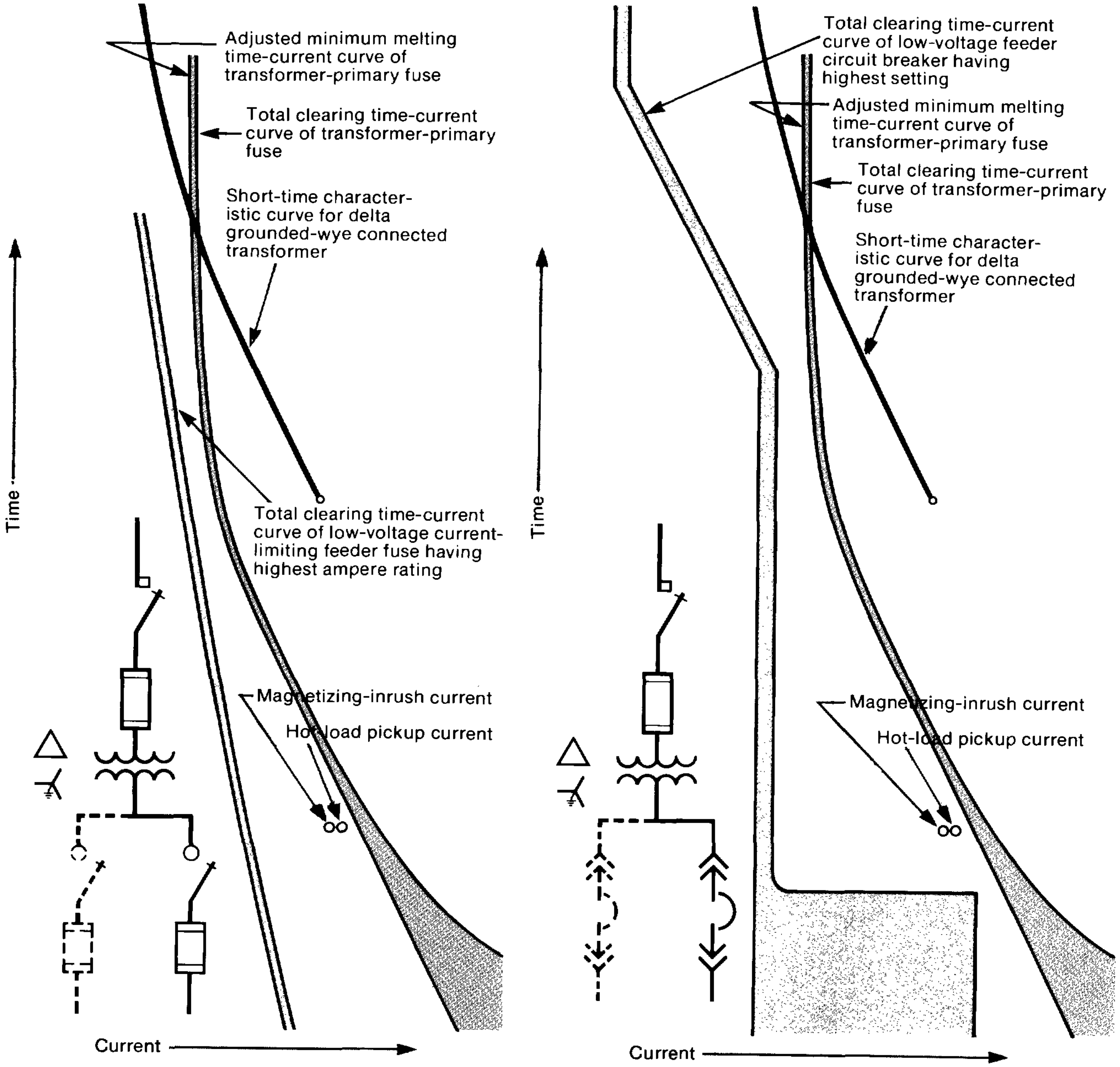
Rapid operation of the transformer-primary fuse will actually improve the degree of protection provided the transformer for the two situations mentioned above, since the time required for the primary fuse to operate will be less than the time required if the primary fuse and the main secondary protective device were fully coordinated. The shorter operating time of the primary fuse results in a lesser accumulation of mechanical and thermal stresses on the transformer, thereby helping to preserve transformer operating life. Additionally, since secondary-switchboard and other nearby faults generally result in significant damage requiring repair before re-energization, the time and cost involved in replacing the inexpensive primary fuse will be insignificant compared to that involved in locating and repairing the fault.

To establish coordination between the transformer-primary fuse and the feeder protective device, it is necessary to examine the relationship between the minimum melting time-current characteristic curve of the primary fuse and the total clearing time-current characteristic curve of the feeder protective device. In so doing, however, the time-current characteristic curves for both devices must be converted to equivalent currents applicable to a common voltage (either primary-side or secondary-side). For this publication, the primary-side voltage has been used.

Complete coordination between the two devices is obtained when the total clearing time-current characteristic curve of the feeder protective device lies below and to the left of the minimum melting time-current characteristic curve of the transformer-primary fuse—for all current levels from overload to the maximum three-phase secondary fault-current level—with proper allowances made for the transformer connection (where applicable) and for the assumed prefault load. Proper coordination between the primary fuse and major types of feeder protective devices is illustrated in Figures 11 and 12.

Transformer-primary fuses should be selected with the lowest possible ampere rating (hence, the lowest possible fusing ratio) that will coordinate with the feeder protective device having the highest ampere rating or setting. It should be remembered that the ampere rating or setting of the feeder protective device has a direct bearing on the ampere rating of the primary fuse, and hence, on the degree of secondary-fault protection provided the transformer. Thus, the ampere rating or setting selected for each feeder protective device should not be higher than is necessary to coordinate with protective devices even farther downstream.

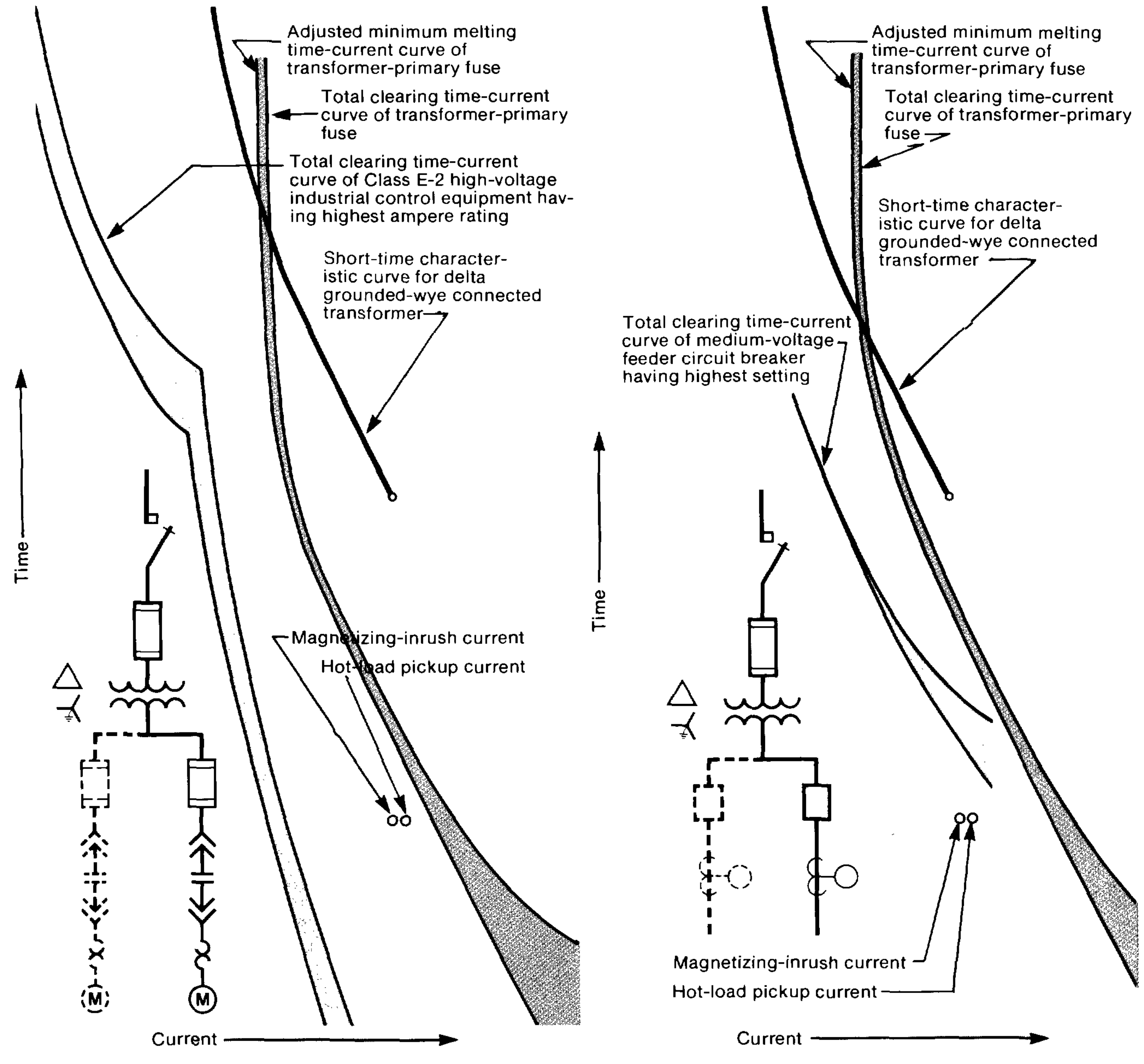
Coordination between the transformer-primary fuse and the feeder protective device is typically checked for the level of fault current and for the type of fault (i.e., three-phase, phase-to-phase, or phase-to-ground) producing the most demanding conditions possible for the transformer in each application. From the standpoint of coordination, the most demanding conditions possible are those where the per-unit line current on the primary side of the transformer is *greater* than the per-unit line current on the secondary side of the transformer. For this situation, the primary fuse carries more current relatively than does the secondary-side overcurrent protective device. Accordingly, an allowance must be made before checking for proper coordination between the two devices. Table III on page 23 lists the ratio of the



(a) Low-voltage current-limiting feeder fuse

(b) Low-voltage feeder circuit breaker

Figure 11. Coordination between transformer-primary fuse and: (a) low-voltage current-limiting feeder fuse, or (b) low-voltage feeder circuit breaker.



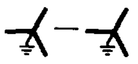
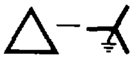
(a) Class E-2 high-voltage industrial control equipment **(b) Medium-voltage feeder circuit breaker**

Figure 12. Coordination between transformer-primary fuse and: (a) Class E-2 high-voltage industrial control equipment, or (b) medium-voltage feeder circuit breaker.

per-unit primary-side line current to the per-unit secondary-side line current for the same transformer connections and types of secondary faults as illustrated in Figure 5 on page 11.

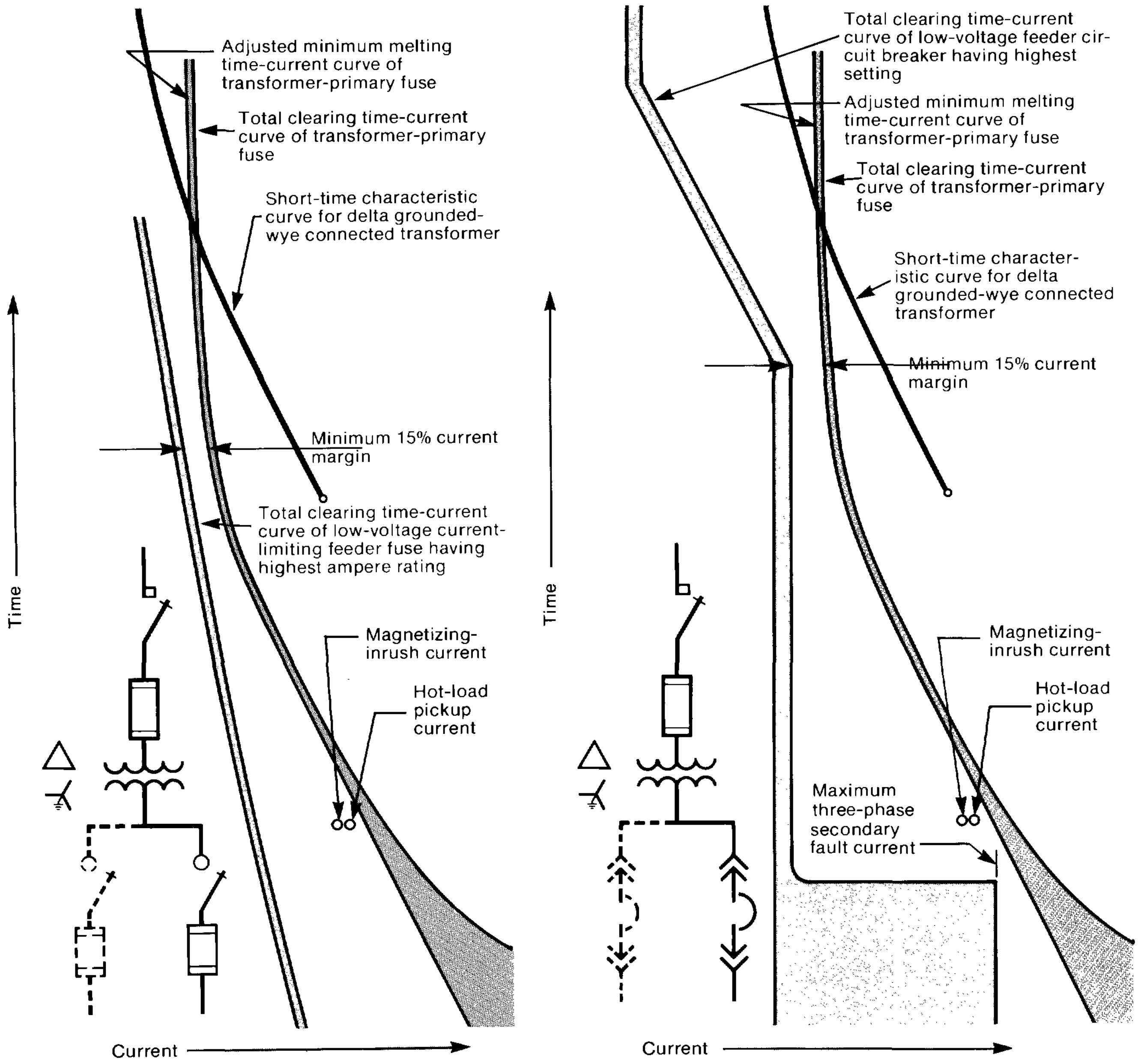
For a phase-to-phase secondary fault not involving ground on a delta grounded-wye connected transformer, the per-unit primary-side line current in one phase is the same as that resulting from a three-phase secondary fault, while the secondary-side line current is only 0.87 per unit of the three-phase secondary fault-current value (hence, the ratio, as listed in Table III, is 1.0 ÷ 0.87, or 1.15). To compensate for the line-current differential inherent to the delta grounded-wye connected transformer, it is generally recommended that a 15% margin in terms of current (or an equivalent margin in terms of time) be maintained between the total clearing time-current characteristic curve of the *feeder* protective device and the minimum melting time-current characteristic curve of the transformer-primary fuse. Refer to Figures 13 and 14. The only exception to this recommendation is Class E-2 high-voltage industrial control equipment, where the 15% current margin is not required since the point of influence of this margin (where the curves for this device and the primary fuse are the closest to each other) occurs at approximately 20 seconds (see Figure 12a), before which time a medium-voltage phase-to-phase ungrounded fault would have propagated to ground. This current margin is therefore not required to ensure proper coordination for faults involving ground in this type of equipment.

TABLE III—Relationship Between Per-Unit Primary-Side Line Current and Per-Unit Secondary-Side Line Current for Various Types of Secondary Faults

Transformer Connection ↓	Ratio of Per-Unit Primary-Side Line Current to Per-Unit Secondary-Side Line Current①		
Type of Fault ⟶	Three-Phase	Phase-to-Phase	Phase-to-Ground
	1.0	1.0	1.0
	1.0	1.0	Not Applicable
	1.0	1.15	0.58

① Primary-side and secondary-side line current values are expressed in per unit of their respective values for a "bolted" three-phase secondary fault.

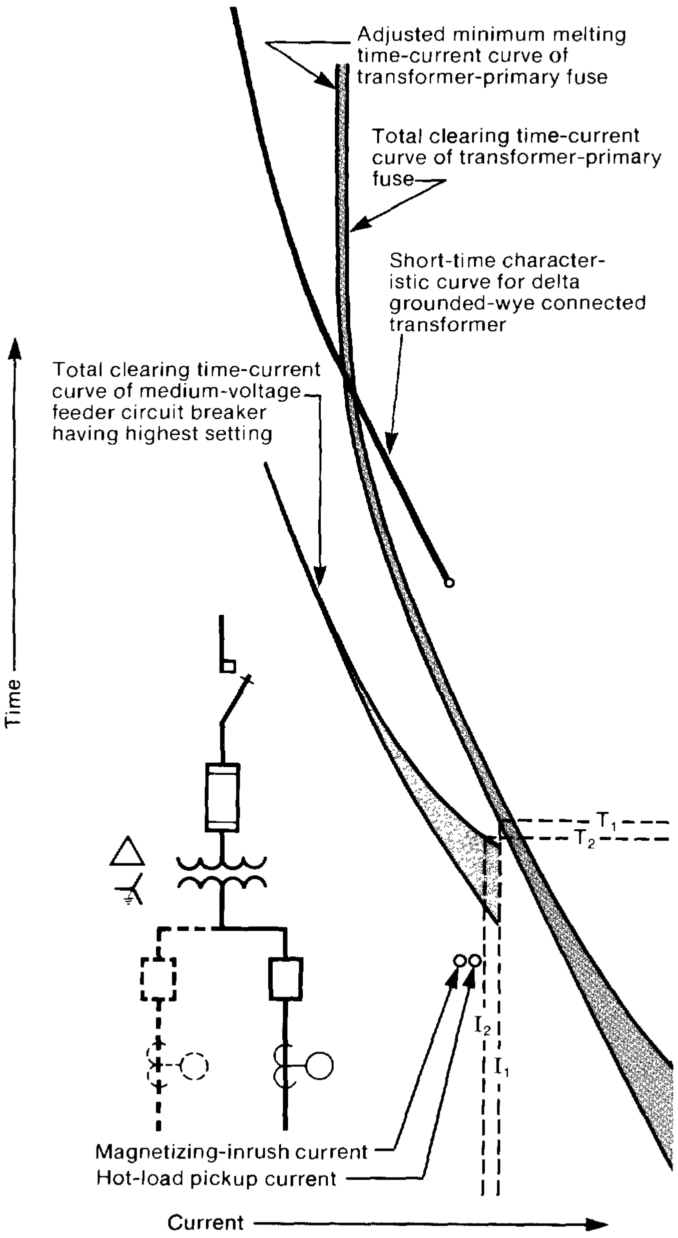
Occasionally, it may be deemed necessary to coordinate the transformer-primary fuse with the *main* secondary-side protective device. In this case, the primary fuse will operate to protect the transformer against a fault located between the transformer and the main secondary protective device, and will further serve as a backup to the main device—operating in the event the main secondary protective device either fails to operate due to a malfunction, or operates too slowly due to incorrect (higher) ratings or settings. The method for establishing coordination between the primary fuse and the main secondary protective device is essentially the same as that described previously for a feeder protective device, except for the handling of the current margin (or equivalent time margin) for the phase-to-phase secondary fault not involving ground on a delta grounded-wye connected transformer. For this particular fault, Figure 13 shows that the point of influence of the 15% current margin (or equivalent time margin) typically occurs at a relatively low current (and long duration) for low-voltage circuit breakers and low-voltage current-limiting fuses. The probability of occurrence of a low-magnitude long-duration phase-to-phase secondary fault not involving ground located between the feeder protective devices and the main secondary protective device is extremely remote. Such low-magnitude long-duration faults typically occur on a feeder some distance from the transformer, and thus are cleared by the



(a) Low-voltage current-limiting feeder fuse

(b) Low-voltage feeder circuit breaker

Figure 13. Application of minimum 15% current margin between time-current curves of transformer-primary fuse and: (a) low-voltage current-limiting feeder fuse, or (b) low-voltage feeder circuit breaker, for delta grounded-wye connected transformers.



I_1 Maximum three-phase secondary fault current.

I_2 87% of maximum three-phase secondary fault current.

T_1 Minimum melting time of transformer-primary fuse at I_1.

T_2 Total operating time of medium-voltage circuit breaker at I_2.

Note: For coordination, T_1 must be greater than T_2.

Figure 14. Application of minimum time margin (equivalent to 15% current margin) between time-current curves of transformer-primary fuse and medium-voltage circuit breaker (feeder or main), for delta grounded-wye connected transformers.

feeder protective device. Accordingly, it is not necessary to maintain the 15% current margin (or equivalent time margin) when coordinating low-voltage *main* secondary circuit breakers and low-voltage *main* secondary current-limiting fuses with the primary fuse. Figure 14 shows that, for medium-voltage circuit breakers, the point of influence of the 15% current margin (or equivalent time margin) occurs at a very high current—on the order of the maximum three-phase secondary fault-current level. Accordingly, this margin must be retained when coordinating medium-voltage *main* secondary circuit breakers with the primary fuse.

Since main secondary-side protective devices typically have high ampere ratings or settings, difficulties are sometimes experienced in simultaneously obtaining protection for the transformer against secondary-side faults in accordance with the transformer short-time characteristic curve, *and* complete coordination between the transformer-primary fuse and the main secondary protective device. If this situation is encountered, it is recommended that the ampere rating or settings of the main secondary protective device be investigated to see if a reduction is possible, rather than accepting a larger than necessary primary-fuse ampere rating, resulting in reduced transformer protection.

This point is illustrated in Figure 15, wherein a transformer-primary fuse, selected to protect the transformer in accordance with the discussion in the previous section, does not coordinate with a low-voltage main secondary circuit breaker over the full range of applicable currents. Coordination between the two devices has not been obtained with the short-time pickup current of the main secondary circuit breaker set at 12,000 amperes (4X), and with the short-time delay setting on "maximum." Clearly, by reducing the short-time pickup setting from 4X to 3X or 2.5X and by reducing the short-time delay setting from "maximum" to "intermediate" or to "minimum," coordination between the main secondary circuit breaker and the primary fuse will be

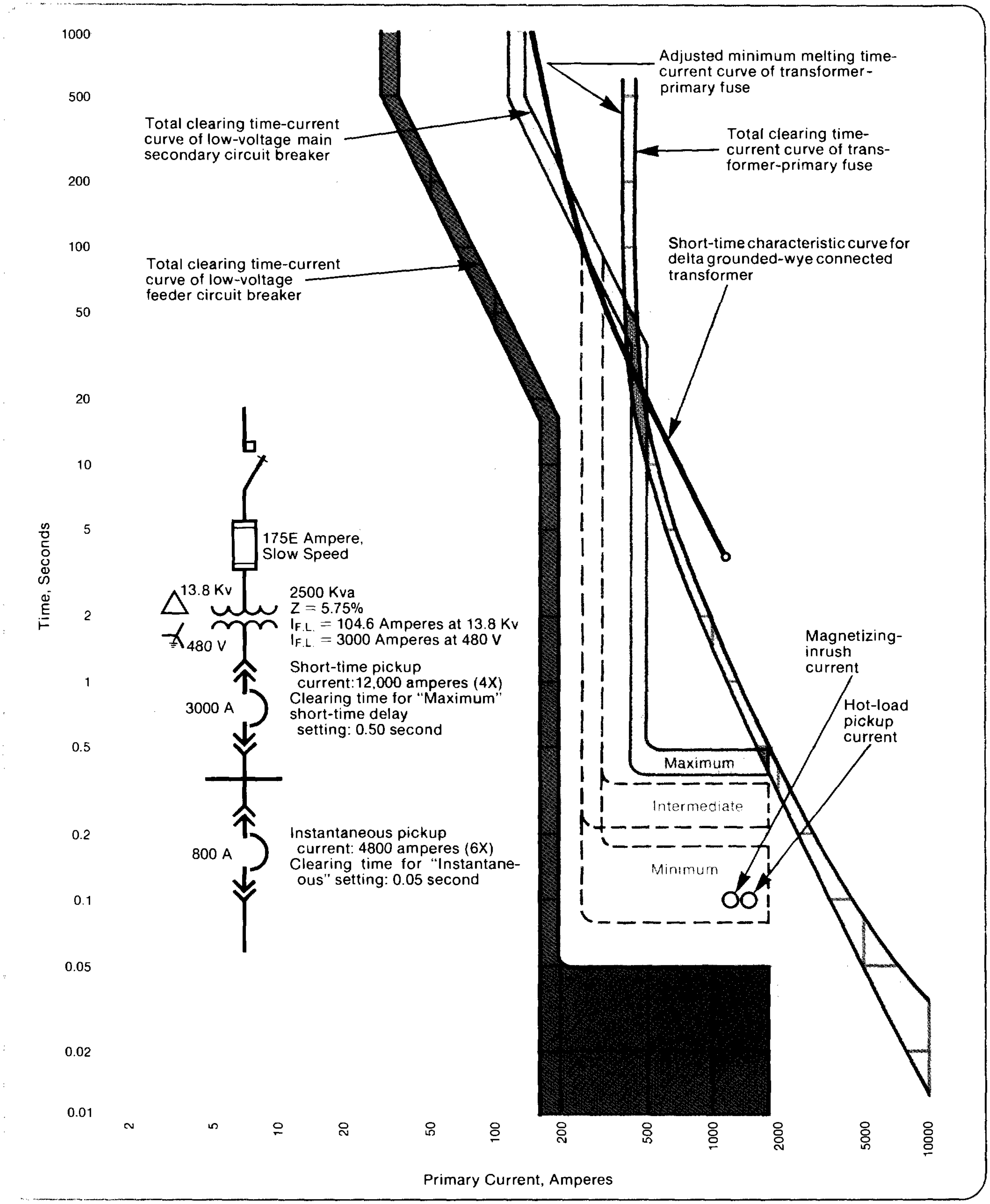


Figure 15. Coordination between a transformer-primary fuse and a low-voltage main secondary circuit breaker can often be obtained by lowering the short-time pickup current and/or the short-time delay setting.

obtained. (The time-current characteristic curve for the main secondary circuit breaker adjusted to reflect lower short-time pickup and short-time delay settings is illustrated by dotted lines.) Lack of complete coordination of the type illustrated in Figure 15 can frequently be corrected by making such adjustments.

If it is not practicable to reduce the ampere rating or settings of the main secondary-side protective device, as discussed in the example above, incomplete coordination between the transformer-primary fuse and the main secondary-side device should be accepted in order to obtain better transformer protection. Even if these rare circumstances are encountered, coordination will typically be given up over only one or two very small ranges of current.

Coordination between the transformer-primary fuse and upstream protective devices

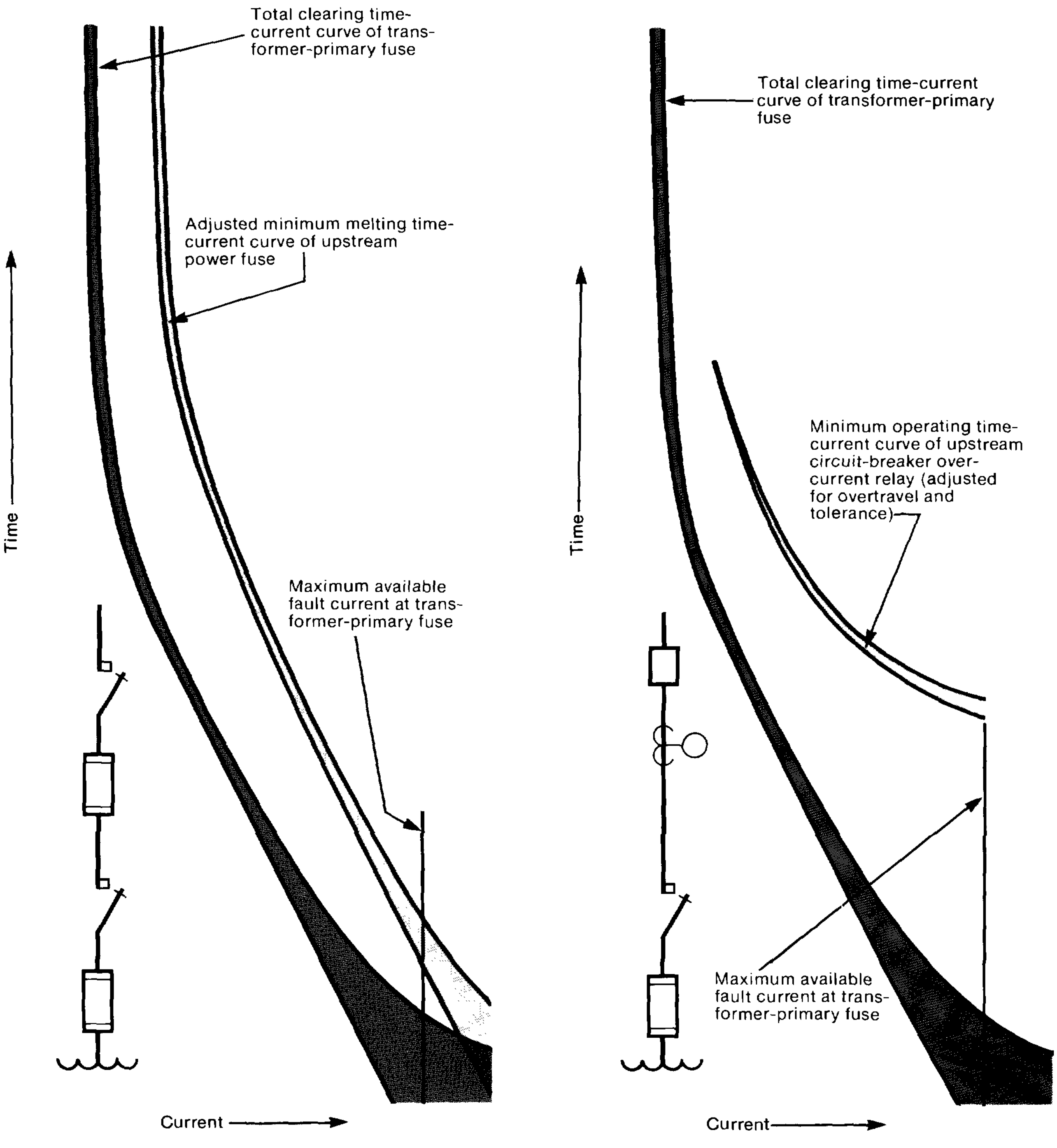
After the transformer-primary fuse has been selected to provide the maximum degree of protection for the transformer and to coordinate with secondary-side protective devices, it is necessary to consider coordination with upstream protective devices. To achieve coordination with an upstream protective device, the total clearing time of the primary fuse must be less than the minimum melting time of the upstream fuse, or the minimum operating time of the relay associated with the upstream circuit breaker, for all currents less than the maximum available fault current at the location of the primary fuse. In establishing such coordination, no adjustment need be made to the total clearing time-current curve of the primary fuse; any prefault load on the fusible element will decrease the total clearing time, and thus increase the time margin.

Certain adjustments, however, must be made to the minimum operating time-current curves of the upstream protective devices. Specifically, the minimum melting time-current characteristic curve of upstream power fuses must be adjusted to reflect the assumed prefault load, and the time-current characteristic curve for upstream relays must be adjusted for any overtravel and tolerance, as recommended by the manufacturer of the device. Refer to Figure 16.

Earlier in this guide, it was recommended that you select the smallest practicable ampere rating of transformer-primary fuse in order to maximize transformer protection. Such a fuse selection will also greatly facilitate coordination with the upstream protective device since the lower total clearing time-current curve associated with this fuse will more easily fit below the time-current curve of the upstream protective device. Often the upstream protective device will be on the system of the serving utility, in which case the utility should be consulted to verify that the primary fuse selected for your application coordinates with the utility's device. Occasionally, the utility's coordination parameters may preclude the use of the primary fuse ampere rating selected. If difficulties in coordination with upstream protective devices (whether on your system or on the utility's) are encountered, the primary fuse application should be restudied to verify that the smallest practicable ampere rating has indeed been selected. This may involve a reconsideration of the ratings and settings of the secondary-side protective devices with which coordination was obtained.

Protect Downstream Conductors Against Damaging Overcurrents . . .

The final application principle to be considered when selecting a transformer-primary fuse is that it must protect the conductors between the primary fuse and the



(a) Upstream power fuse

(b) Upstream circuit breaker

Figure 16. Coordination between transformer-primary fuse and: (a) upstream power fuse, or (b) upstream circuit breaker.

transformer against damage from overheating due to excessive overcurrents. In general, the size of conductor to be used is determined by considering the conductor's ampacity, as well as its behavior under short-circuit current conditions. Selection of the conductor size from the standpoint of continuous current-carrying capability is easily done by reference to the ampacity tables in the National Electrical Code. Similarly, conductor sizes capable of withstanding available short-circuit currents can easily be selected from industry-accepted graphs, such as those contained in The IEEE Buff Book,* or those distributed by the conductor manufacturers. If the size of conductor to be used is selected in this manner, the primary fuses selected in accordance with the recommendations presented in this publication will easily protect the conductors against damage from overheating due to excessive overcurrents. Verification that this is indeed the case for cables can be obtained by referring to S&C Data Bulletin 240-150, "Guide for Power Fuse Protection of Medium-Voltage Cables."

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* IEEE Standard 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

THE FUSE SELECTION TABLES

Introduction to Fuse Selection Tables

As described in the foregoing text, the selection of a transformer-primary fuse ampere rating and speed characteristic involves consideration of all of the following factors:

1. Anticipated normal transformer loading schedule, including daily or repetitive peak loads, and emergency peak loads;
2. Transformer inrush current, including the combined effects of transformer magnetizing-inrush current and the energizing-inrush currents associated with connected loads—particularly following a momentary loss of source voltage;
3. The degree of protection provided to the transformer against damaging overcurrents; and
4. Coordination with secondary-side as well as other primary-side overcurrent protective devices.

In the past, the task of selecting a transformer-primary fuse ampere rating and speed involved complex graphical solutions using time-current characteristic curves published for the various overcurrent protective devices, taking into consideration the many adjustment factors required by the manufacturers of the various protective devices and the particular transformer connection.

The fuse selection tables presented in this publication are based on the consideration of all of the aforementioned factors, and permit the direct selection of the transformer-primary fuse, thereby *eliminating the need to perform graphical coordination studies.* The tables list, for each transformer, primary-fuse ampere ratings and speeds that will accommodate the full range of loading levels normally encountered, and that will withstand the energizing-inrush currents associated with each transformer shown. In addition, for each such fuse, the degree of transformer protection provided by the primary fuse is quantified using S&C's unique "Transformer Protection Index," which indicates the level of secondary-fault current down to which the primary fuse will operate to protect the transformer in accordance with the transformer short-time characteristic curve. Furthermore, each fuse ampere rating and speed listed in the tables has been "precoordinated" with the full spectrum of low-voltage and medium-voltage secondary-side overcurrent protective devices, such as circuit breakers, fuses, and Class E-2 high-voltage industrial control equipment. You need only refer to these tables to select the optimal fuse ampere rating and speed to protect your transformer and coordinate with the appropriate secondary-side overcurrent protective device.

S&C Power Fuses—Types SM, SML, and SMD possess the performance characteristics and quality that make them especially suited for the simultaneous satisfaction of all of the selection criteria. These time-tested fuses are available in a wide variety of ampere ratings and speeds, permitting close fusing for maximum protection and optimum coordination. And their time-current characteristics are precise, with only 10% total tolerance in melting *current,* compared to the 20% (or greater) tolerance of other fuses (20% and 40% respectively, in terms of *time*). Because of these narrow tolerances, S&C Power Fuses can be counted on to respond faster than other fuses of comparable ampere rating and speed, resulting in better and more reliable protection for the transformer. Furthermore, these narrow tolerances allow the upstream protective devices to be set to operate faster for better system protection while still retaining coordination.

Exceptional care in the design and manufacture of S&C Power Fuses guarantees that they are accurate with respect to their minimum melting time-current characteristics not only initially, but also on a sustained basis . . . neither age and vibration, nor surges that heat the element nearly to the severing point, will affect the characteristics of these fuses. S&C Power Fuses possess sufficient load capability to easily accommodate daily or repetitive peak loads in excess of your normal transformer loading schedule. And they have surge capacity which is more than adequate to withstand transformer magnetizing-inrush currents following a momentary loss of source voltage, and which provides operating economies because there is no need to replace unblown companion fuses on suspicion of damage following a fuse operation . . . a performance characteristic not generally found in other types of power fuses.

As a consequence of these performance characteristics, S&C Power Fuses allow you to fuse closer to the transformer full-load current than is possible with other fuses, providing the maximum degree of protection against secondary faults. They are thus better able to protect the transformer against damage due to faults between the transformer and the secondary-side protective device, and furthermore, to supply backup protection in the event of incorrect functioning of the secondary-side protective device. In addition, the ability to fuse closer to the transformer full-load current facilitates coordination with upstream protective devices, by allowing them to have lower ampere ratings and/or settings for faster response.

Once the transformer-primary fuse ampere rating and speed characteristic have been selected as outlined in the section entitled "How to Use the Fuse Selection Tables" on page 76, it is only necessary to determine the appropriate power fuse type based on the voltage rating, short-circuit interrupting rating (considering the maximum anticipated available fault current at the fuse location), and maximum ampere rating required. As can be seen from Table XVIII on page 74, S&C Power Fuses—Type SM, SML, and SMD-20 are offered in a multitude of voltage, short-circuit interrupting, and maximum ampere ratings, allowing you to economically match the power fuse to the load- and fault-current levels of your particular applications.

Moreover, S&C Power Fuses—Types SM, SML, and SMD-20 are offered in a wide variety of styles and mounting configurations to easily accommodate your space and environmental considerations. S&C Power Fuses are designed for installation indoors in suitably designed free-standing or wall-mounted enclosures, or outdoors on station structures or pole tops. They are available in either disconnect or non-disconnect mounting configurations for easy and convenient fuse handling using a variety of fuse-handling tools. Furthermore, certain models having an "SML" designation are equipped with Uni-Rupter™, S&C's integral loadbreak device, for 200-ampere single-pole live switching. Consult your nearest S&C Sales Office for help in making the most economical selection.

Basis for Listings in the Fuse Selection Tables

The fuse selection tables presented in this publication were developed in accordance with the application principles previously discussed. In applying these principles as described, it is necessary to make certain decisions and assumptions, all of which are outlined in detail below. For easy access to this information, it is arranged in the following sections in the same order as it appears in the fuse selection tables.

Transformer self-cooled ratings. Table XX on page 77 serves as an index to the fuse selection tables applicable to transformers having primary voltage ratings between 4.16 kv and 34.5 kv, with either low-voltage (208 v, 240 v, 480 v, or 600 v) or medium-voltage (2.4 kv or 4.16 kv) secondaries. The transformer ratings in Table XX are listed on a self-cooled basis. The fuse selection tables are applicable to all transformers with the listed ratings even if they are equipped with cooling fans, if they have increased temperature capability (e.g., 65°C temperature rise instead of 55°C temperature rise), or if they have both cooling fans *and* increased temperature capability.

The standard transformer impedances listed in Table XX were used in preparing the fuse selection tables. Transformers with special impedances are not within the scope of this publication, and thus have not been considered. In the secondary-side protective-device ratings or settings columns, the transformer protection index columns, and the loading capability columns, actual values may differ slightly from the listed values for different voltages where multiple voltages are involved. In each situation, the "worst-case" values are shown in the fuse selection tables. That is, slightly larger or smaller secondary-side protective device ratings or settings, Transformer Protection Indexes, and loading capability values could apply. The advantages represented by these small differences are so slight that they can be ignored.

Prefault load. As mentioned previously, the time-current characteristic curves for medium-voltage power fuses are determined at 25°C and with no initial load. In practice, every fuse is carrying some load which, in addition to ambient temperatures in excess of 25°C, raises the temperature of the fusible element, and hence reduces the melting time for a given value of current. This is of importance in determining coordination between the transformer-primary fuse and secondary-side protective devices as well as in calculating the hot-load pickup capability of the primary fuse.

For the purpose of the fuse selection tables, a prefault load was assumed based solely on the fusing ratio (the ratio of the fuse ampere rating to the transformer full-load current). Specifically, for a fusing ratio less than 1.0, the transformer is assumed to be loaded to 80% of its full-load current. For a fusing ratio between 1.0 and 2.0 inclusive, the transformer is assumed to be loaded to 100% of its full-load current. Finally, for a fusing ratio greater than 2.0, the transformer is assumed to be loaded to 133% of its full-load current.

Coordination with secondary-side overcurrent protective devices. In general, this section of the fuse selection tables was developed by examining the relationships which exist between the minimum melting time-current characteristic curve of the transformer-primary fuse and the total clearing time-current characteristic curves for the full spectrum of low-voltage and medium-voltage secondary-side overcurrent protective devices. As explained previously, proper coordination between the primary fuse and the secondary-side overcurrent protective device requires the consideration of a number of factors. The assumptions made in considering these factors are outlined below for various types of secondary-side overcurrent protective devices.

1. **Low-voltage molded-case or power circuit breakers equipped with electronic tripping devices (Tables IV through VIII, pages 40 through 49).** Coordination between the transformer-primary fuse and a low-voltage molded-case or power circuit breaker involves comparing the minimum melting time-current characteristic curve of the primary fuse (adjusted to reflect the assumed prefault load as described on page 31) with the total clearing time-current characteristic curve of the low-voltage circuit breaker. For the purpose of the fuse selection tables, it is assumed that the upper limit of the circuit breaker's long-time delay band is a line having a constant I^2t, passing through the point corresponding to a current of 6 times the minimum long-time pickup current of the circuit breaker, and a time of 20 seconds. Refer to Figure 17. This represents a long-time delay band located between the average of the "intermediate" long-time delay bands for a number of makes of low-voltage circuit breakers and the average of the "maximum" long-time delay bands for the same circuit breakers.

   The short-time or instantaneous pickup current of the low-voltage circuit breaker is listed in the fuse selection tables as a percentage of the transformer secondary full-load current. In arriving at these values, the total clearing current of the circuit breaker is assumed to be 10% higher than the short-time or instantaneous pickup current. Refer to Figure 17.

   The maximum three-phase secondary fault-current level used in determining coordination between the transformer-primary fuse and the low-voltage circuit breaker is based on consideration of the source impedance, as well as the more dominant transformer impedance. For the purpose of the fuse selection tables, the source impedance is based on the following levels of available fault current: 37,500 amperes rms symmetrical at 4.16 kv; 34,600 amperes rms symmetrical at 12.0 kv or 12.47 kv, and 13.2 kv or 13.8 kv; 20,000 amperes rms symmetrical at 22.9 kv or 24.9 kv; and 17,500 amperes rms symmetrical at 33.0 kv or 34.5 kv. Additional fault-current contribution by motors or other secondary-side devices has not been considered, thus assuring that coordination between the transformer-primary fuse and the secondary-side protective device will be realized under all circumstances.

   The values listed in the fuse selection tables for low-voltage circuit breakers are based on the coordination requirements of the delta grounded-wye connected transformer. For this transformer, a 15% current margin was maintained between the minimum melting time-current characteristic curve of the transformer-primary fuse (adjusted to reflect the assumed prefault load as described on page 31) and the total clearing time-current characteristic curve of the low-voltage feeder circuit breaker to compensate for the line-current differential resulting from a phase-to-phase secondary fault not involving ground. For those applications involving coordination between a primary fuse and a main secondary circuit breaker, the 15% current margin between their respective time-current characteristic curves was not maintained, for the reason outlined on pages 23 through 25.

   Certain low-voltage circuit breakers may be equipped with a short-time I^2t ramp function to facilitate coordination between the low-voltage circuit breaker and protective devices even farther downstream, such as thermal-magnetic circuit breakers and fuses. Since this function is of no concern when coordinating the low-voltage circuit breaker with the transformer-primary fuse, it was not considered in developing the fuse selection tables.

   For low-voltage *fused* circuit breakers, the current-limiting fuse functions primarily as a "backup" to the circuit breaker in that it operates only for very high levels of fault current. For the purpose of coordination with the transformer-primary fuse, therefore, the fused circuit breaker should be treated in the same manner as a low-voltage circuit breaker with an "instantaneous" setting.

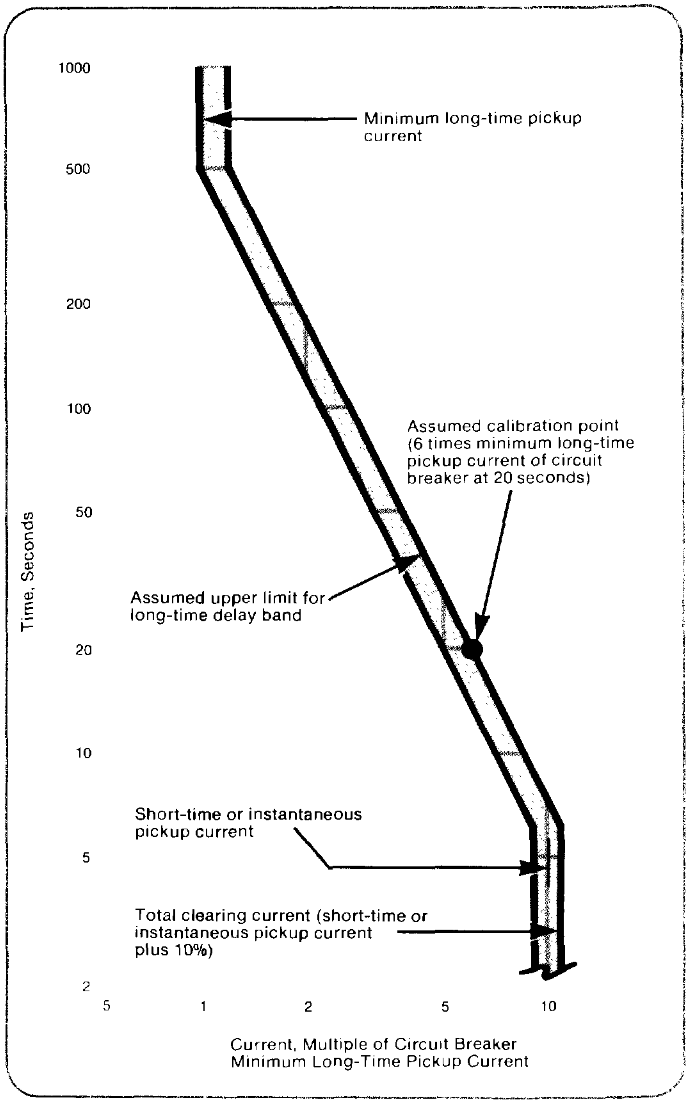


Figure 17. The circuit breaker time-current characteristics shown were used in developing the fuse selection tables.

2. **Low-voltage current-limiting fuses (Tables IX through XIII, pages 50 through 65).** Coordination between the transformer-primary fuse and a low-voltage current-limiting fuse involves comparing the minimum melting time-current characteristic curve of the primary fuse (adjusted to reflect the assumed prefault load as described on page 31) with the total clearing time-current characteristic curve of the current-limiting fuse.

For low-voltage current-limiting fuses rated 601 amperes or larger, UL (Underwriters Laboratories) Class L fuses have been used in preparing the fuse selection tables. For low-voltage current-limiting fuses rated 600 amperes or less, where applicable, the time-current characteristics of fuses having the most time delay (and having a suitable interrupting rating) for each manufacturer have been used. Specifically, Bussmann LOW-PEAK®, UL Class K5 and RK5; General Electric CLF®, UL Class J; Federal Pacific Econ-Limiter®, UL Class K5 and RK5; and Gould Amp-Trap ®, UL Class K5 and RK5 have been used. All other classes of low-voltage current-limiting fuses made by each manufacturer (rated 600 amperes or less) will also coordinate with the transformer-primary fuse with even greater margin, because they have less time delay than the current-limiting fuses used.

The values listed in the fuse selection tables for low-voltage current-limiting fuses are based on the coordination requirements of the delta grounded-wye connected transformer. For this transformer, a 15% current margin was maintained between the minimum melting time-current characteristic curve of the transformer-primary fuse (adjusted to reflect the assumed prefault load as described on page 31) and the total clearing time-current characteristic curve of the low-voltage feeder current-limiting fuse to compensate for the line-current differential resulting from a phase-to-phase secondary fault not involving ground. For those applications involving coordination between a primary fuse and a main secondary fuse, the 15% current margin between their respective time-current characteristic curves was not maintained, for the reason outlined on pages 23 through 25.

3. **Medium-voltage circuit breakers with associated inverse-time overcurrent relays (Tables XIV through XVII, pages 66 through 73).** Coordination between the transformer-primary fuse and a medium-voltage circuit breaker involves comparing the minimum melting time-current characteristic curve of the primary fuse (adjusted to reflect the assumed prefault load as described on page 31) with the total clearing time-current characteristic curve of the medium-voltage circuit breaker. A time margin of 0.15 second was added to the time-current characteristic curve of the relay used with the medium-voltage circuit breaker. This margin consists of a relay time tolerance of 0.07 second (*based on the assumption that the relay operating time is carefully calibrated at maximum three-phase secondary fault current*), plus a 5-cycle circuit breaker interrupting time of 0.08 second. Adjustments to accommodate relay time tolerance values other than 0.07 second can be made by adding or subtracting (as applicable) the difference between the actual tolerance value and the assumed tolerance value to the nominal relay operating time at maximum three-phase secondary fault current *before* entering the fuse selection table as outlined in the section entitled "How to Use the Fuse Selection Tables" on page 76.

The maximum three-phase secondary fault-current level used in determining coordination between the transformer-primary fuse and the medium-voltage circuit breaker is based on consideration of the source impedance, as well as the more dominant transformer impedance. For the purpose of the fuse selection tables, the source impedance is based on the following levels of available fault current: 37,500 amperes rms symmetrical at 4.16 kv; 34,600 amperes rms symmetrical at 12.0 kv or 12.47 kv, and 13.2 kv or 13.8 kv; 20,000 amperes rms symmetrical at 22.9 kv or 24.9 kv; and 17,500 amperes rms symmetrical at 33.0 kv or 34.5 kv. Additional fault-current contribution by motors or other secondary-side devices has not been considered, thus assuring that coordination between the transformer-primary fuse and the secondary-side protective device will be realized under all circumstances.

The values listed in the fuse selection tables for medium-voltage circuit breakers are based on the coordination requirements of the delta grounded-wye connected transformer. For this transformer, a time margin equivalent to the 15% current margin discussed on pages 20 through 25 was added to the total clearing time-current characteristic curve of the circuit breaker/relay combination, to compensate for the line-current differential resulting from a phase-to-phase secondary fault not involving ground.

4. **Class E-2 high-voltage industrial control equipment (Tables XIV through XVII, pages 66 through 73).** Coordination between the transformer-primary fuse and the high-voltage industrial control equipment involves comparing the minimum melting time-current characteristic curve of the primary fuse (adjusted to reflect the assumed prefault load as described on page 31) with the total clearing time-current characteristic curve of the control equipment. A 15% current margin was not maintained between their respective time-current characteristic curves, for the reason outlined on page 23.

The Transformer Protection Index. The Transformer Protection Index is provided in the fuse selection tables to allow you to evaluate the degree of transformer protection provided by the transformer-primary fuse ampere rating selected. As explained in the section entitled, "Protect Transformer Against Damaging Overcurrents . . ." beginning on page 9, there are two objectives that must be achieved in order to obtain a comprehensive level of protection for the transformer. First, the total clearing time-current characteristic curve of the primary fuse should pass below and to the left of the ANSI Point of the appropriate transformer short-time characteristic curve, and second, the point at which the two curves intersect should be at as low a multiple of the transformer primary full-load current as possible. The Transformer Protection Index indicates how well these two objectives are achieved. The presence of an index indicates that the first objective was achieved, whereas the absence of an index signifies that the primary fuse does not provide protection for the transformer, since the total clearing time-current curve of the primary fuse passes above and to the right of the ANSI Point. Accordingly, a smaller primary-fuse ampere rating should be selected. The indexes indicate the percentage of the transformer primary full-load current down to which the primary fuse will operate to protect the transformer in accordance with the transformer short-time characteristic curve.

The indexes are listed in the fuse selection tables for commonly used transformer connections. For delta grounded-wye connected transformers, the indexes are based on a phase-to-ground secondary fault, which is the most demanding type of fault for this transformer connection from a protection standpoint. For delta delta connected transformers, the indexes are based on a phase-to-phase secondary fault, which is the most demanding type of fault for this transformer connection from a protection standpoint. Similarly, for grounded-wye grounded-wye connected transformers, and for delta wye connected transformers with the neutral grounded through an impedance, the indexes should be based on a three-phase secondary fault. However, since the indexes for these transformer connections (based on a three-phase secondary fault) are only slightly smaller (better) than the indexes determined for delta delta connected transformers, for simplicity, indexes for the delta delta connected transformer have been listed in the fuse selection tables.

Loading capability. In general, loading capability refers to the amount of load the transformer-primary fuse can pick up (even after a momentary loss of source voltage) without operating, and carry on a continuous basis. The values listed in the fuse selection tables were determined to be the *minimum* of continuous peak-load, hot-load, and cold-load pickup capabilities for each fuse ampere rating. These three capabilities are discussed below:

1. **Continuous peak-load capability** . . . ability of the transformer-primary fuse to carry on a continuous basis, daily or repetitive peak loads regardless of duration. Continuous peak-load values for S&C Type SM, SML, and SMD-20 Power Fuses can be determined by referring to S&C Data Bulletin 240-190.
2. **Hot-load pickup capability** . . . ability of the transformer-primary fuse that is carrying load, to withstand the combined magnetizing- and load-inrush currents associated with the re-energizing of the transformer following a momentary loss of source voltage. Specifically, hot-load pickup capability is the maximum transformer load current which, when used as the pre-outage load current in adjusting the minimum melting time-current characteristic curve of the primary fuse, results in a fuse curve that passes above and to the right of the point representing the magnitude and duration of the combined magnetizing- and load-inrush currents.
3. **Cold-load pickup capability** . . . ability of the transformer-primary fuse to withstand the combined magnetizing- and load-inrush currents associated with the re-energizing of the transformer following an extended outage (30 minutes or more). Cold-load pickup capability is typically associated with utility distribution transformer loading practices, where the transformers are often sized for the average peak load rather than the maximum expected peak load, thereby exposing the transformers to overcurrent of up to 30 minutes duration following re-energization. In contrast, transformers applied in industrial, commercial, and institutional power systems (including those in high-rise apartment complexes) are usually sized to accommodate maximum peak-load conditions without being overloaded. For this reason, the combined magnetizing- and load-inrush current associated with the energizing of a transformer following an extended outage is no more severe than the inrush current encountered under hot-load pickup conditions—where the primary fuse is loaded to the peak-load capability listed in the fuse selection tables. As a consequence, cold-load pickup capability considerations impose no separate influence on the peak-load capability values listed in the tables.

Ampere ratings. For each transformer kva rating, the fuse selection tables list a choice of fuse ampere ratings in each of two speed characteristics: S&C Standard Speed, TCC No. 153; and S&C Slow Speed, TCC No. 119. The lowest ampere rating listed for each transformer kva rating and for each speed characteristic is the lowest practical ampere rating, based on consideration of the anticipated transformer loading level, transformer magnetizing- and load-inrush currents, and coordination with downstream overcurrent protective devices. The highest ampere rating listed for each transformer kva rating and for each speed characteristic is the highest ampere rating less than or equal to three times the transformer primary full-load current, and thus is within the upper limit specified by the National Electrical Code for transformers provided with secondary-side overcurrent protective devices.

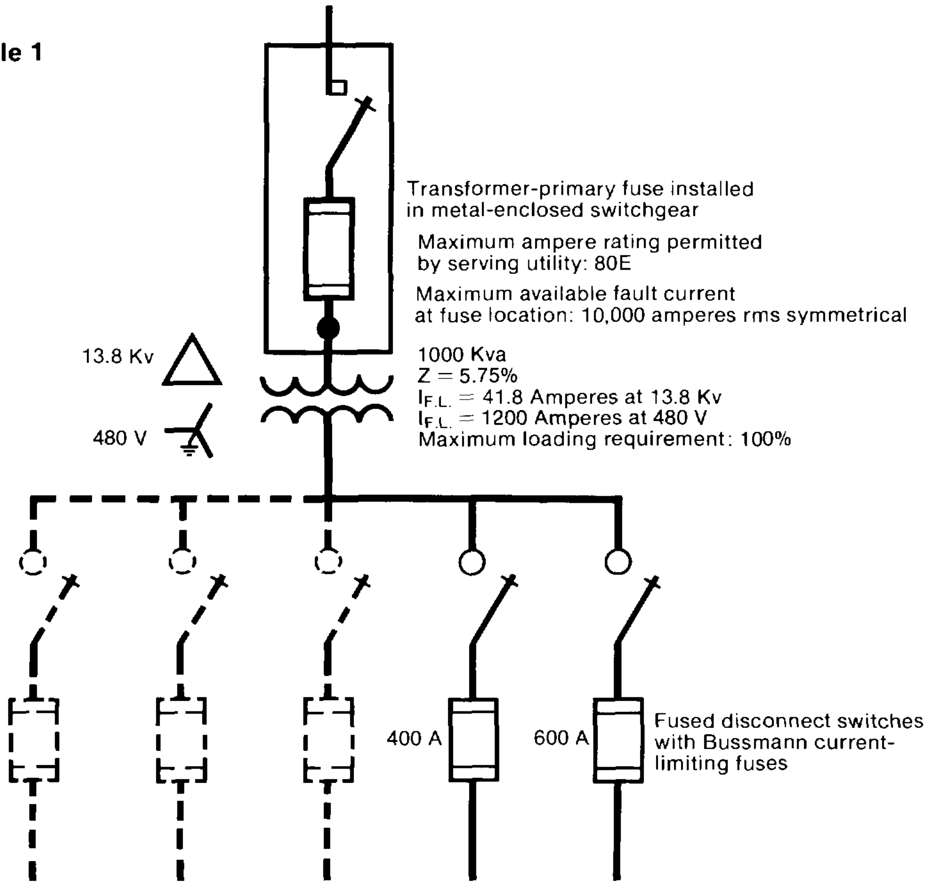
Elevated ambient temperature. An ambient operating temperature not exceeding 45°C is considered to be typical for medium-voltage power fuse installations. The required adjustment (reduction) in melting time for an ambient temperature of 45°C would be very small—on the order of 2% in terms of time, or 1% in terms of current—and thus can be ignored.

Examples

The following examples are provided to illustrate the use of the fuse selection tables for various applications involving the full spectrum of low-voltage and medium-voltage secondary-side overcurrent protective devices.

The steps listed in these examples correspond to those contained in the instructions on "How to Use the Fuse Selection Tables" on page 76 (foldout). For your convenience, the instructions should be left folded out for ready reference while studying these examples.

Example 1



STEP 1. The index on page 77 lists Table XI as applying to transformers rated 13.8 kv three-phase, 1000 kva, 5.75% impedance, with low-voltage secondary current-limiting fuses.

STEP 2. The ratio of the Bussmann current-limiting fuse having the highest ampere rating to the transformer secondary full-load current (at 480 volts) is 600 amperes ÷ 1200 amperes, or 50%.

STEP 3. The appropriate entry in the Bussmann column for the feeder fuse is 72%.

STEP 4. The Transformer Protection Index (TPI) for the transformer in this example is 360%. A comparison of this value with the values listed in Table XIX indicates that the primary fuse associated with this TPI will protect the transformer in accordance with the transformer short-time characteristic curve against all types of secondary faults—even phase-to-ground arcing faults.

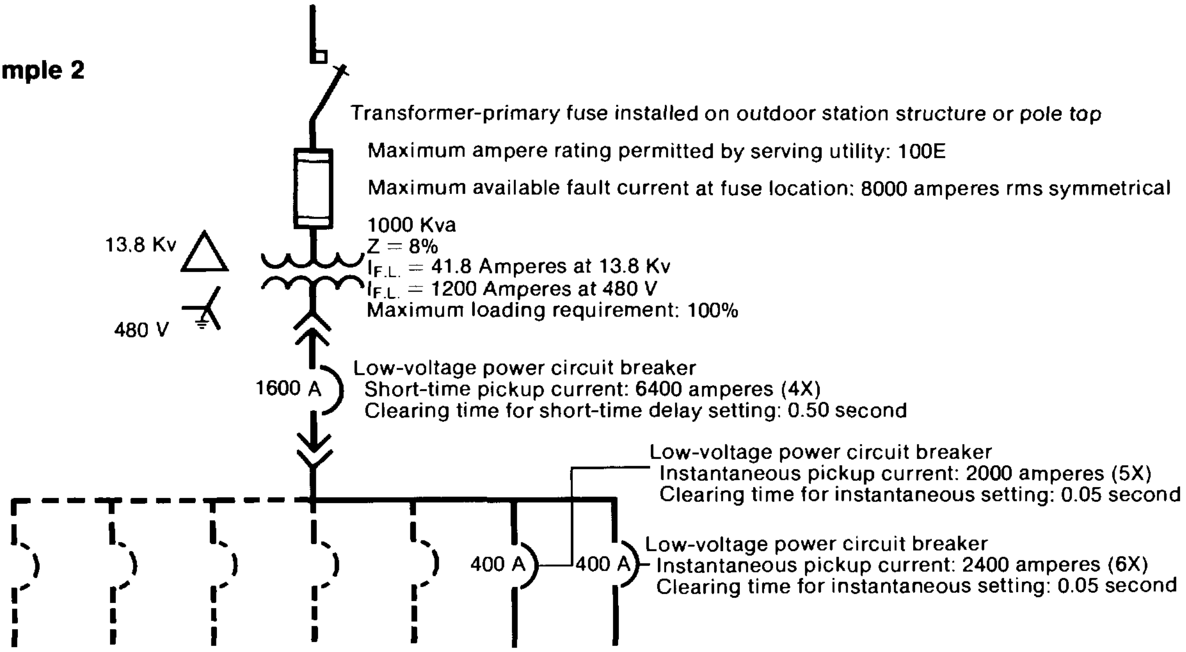
STEP 5. The primary fuse has a loading capability of 205% of the transformer full-load current, which is adequate for the application in this example.

STEP 6. A primary fuse rated 65E amperes, Slow Speed, TCC No. 119, is recommended.

STEP 7. The recommended primary-fuse ampere rating (65E) complies with the serving utility's requirement that the fuse rating not exceed 80E amperes.

STEP 8. From Table XVIII on page 74, S&C Power Fuses—Types SM-4Z, SML-4Z, SM-20, and SML-20 are available in the voltage rating (14.4 kv nominal), maximum ampere rating (200E), and interrupting rating (12,500 amperes rms symmetrical or above), sufficient for the application in this example.

Example 2



STEP 1. The index on page 77 lists Table VI as applying to transformers rated 13.8 kv three-phase, 1000 kva, 8% impedance, with low-voltage secondary circuit breakers.

STEP 2. The ratio of the short-time pickup current of the feeder circuit breaker having the highest setting to the transformer secondary full-load current (at 480 volts) is 2400 amperes ÷ 1200 amperes, or 200%.

STEP 3. The appropriate entry in the column corresponding to clearing time for short-time delay setting of the feeder circuit breaker is 205%.

STEP 4. The Transformer Protection Index (TPI) for the transformer in this example is 270%. A comparison of this value with the values listed in Table XIX indicates that the primary fuse associated with this TPI will protect the transformer in accordance with the transformer short-time characteristic curve against all types of secondary faults—even phase-to-ground arcing faults.

STEP 5. The primary fuse has a loading capability of 160% of the transformer full-load current, which is adequate for the application in this example.

STEP 6. A primary fuse rated 50E amperes, Slow Speed, TCC No. 119, is recommended.

STEP 7. The recommended primary-fuse ampere rating (50E) complies with the serving utility's requirement that the fuse rating not exceed 100E amperes.

STEP 8. From Table XVIII on page 74, S&C Power Fuses—Types SM-4 and SMD-20 are available in the voltage rating (14.4 kv nominal), maximum ampere rating (200E), and interrupting rating (12,500 amperes rms symmetrical or above), sufficient for the application in this example.

◆

If it is deemed necessary for the transformer-primary fuse to coordinate with the main secondary circuit breaker instead of the largest feeder circuit breaker in this example, Steps 2 through 8 would be repeated with these results:

STEP 2. The ratio of the short-time pickup current of the main secondary circuit breaker to the transformer secondary full-load current (at 480 volts) is 6400 amperes ÷ 1200 amperes, or 533%.

STEP 3. The appropriate entry in the column corresponding to the clearing time for short-time delay or instantaneous setting of the main secondary circuit breaker is 570%.

STEP 4. The absence of a Transformer Protection Index (TPI) signifies that the primary fuse does not provide suitable protection for the transformer, and therefore, a smaller primary fuse ampere rating should be selected. This may be accomplished in this example by reducing the short-time pickup current of the main secondary circuit breaker from 6400 amperes (4X) to 4800 amperes (3X). The ratio of the new short-time pickup current to the transformer secondary full-load current is 4800 amperes ÷ 1200 amperes, or 400%, and the appropriate entry in the column corresponding to the clearing time for short-time delay or instantaneous setting is 415%. The TPI for the transformer in this example is 610%. A comparison of this value with the values listed in Table XIX indicates that the primary fuse associated with this TPI will protect the transformer in accordance with the transformer short-time characteristic curve against all types of "bolted" or metallic secondary faults.

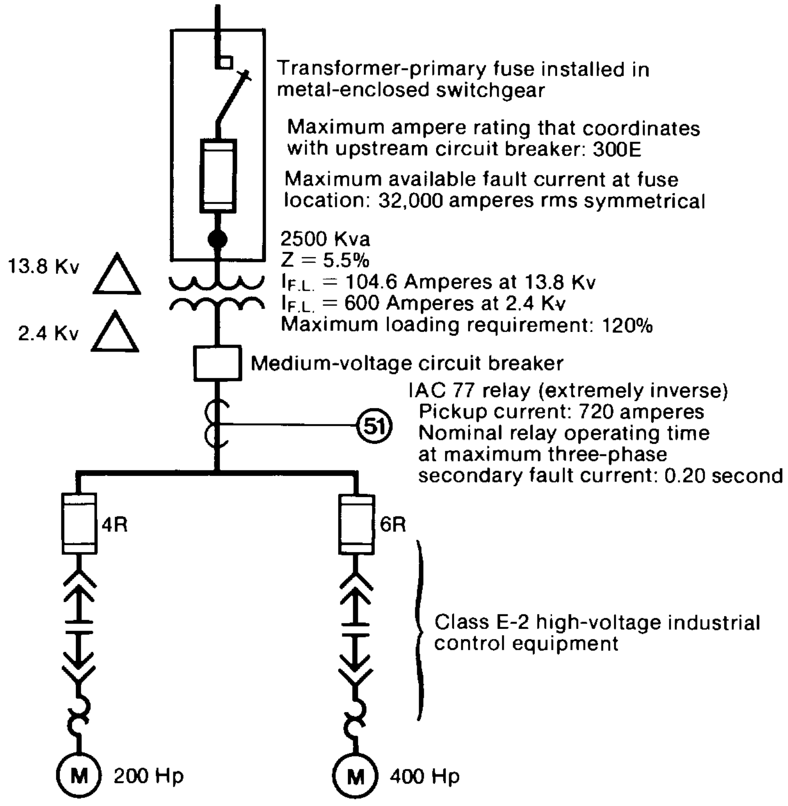
STEP 5. The primary fuse has a loading capability of 270% of the transformer full-load current, which is adequate for the application in this example.

STEP 6. A primary fuse rated 100E amperes, Standard Speed, TCC No. 153, is recommended.

STEP 7. The recommended primary-fuse ampere rating (100E) complies with the serving utility's requirement that the fuse rating not exceed 100E amperes.

STEP 8. From Table XVIII on page 74, S&C Power Fuses—Types SM-4 and SMD-20 are available in the voltage rating (14.4 kv nominal), maximum ampere rating (200E), and interrupting rating (12,500 amperes rms symmetrical or above), sufficient for the application in this example.

Example 3



STEP 1. The index on page 77 lists Table XV as applying to transformers rated 13.8 kv three-phase, 2500 kva, 5.5% impedance, with medium-voltage secondary circuit breakers or Class E-2 industrial control equipment.

STEP 2. Proceed to Step 3.

STEP 3. The appropriate entry in the column corresponding to the secondary voltage of 2.4 kv is the first line containing 6R.

STEP 4. The Transformer Protection Index (TPI) for the transformer in this example is 210%. A comparison of this value with the values listed in Table XIX indicates that the primary fuse associated with this TPI will protect the transformer in accordance with the transformer short-time characteristic curve against all types of secondary faults.

STEP 5. The primary fuse has a loading capability of 105% of the transformer full-load current. Since this is less than the required loading capability of 120%, the next higher value listed in this column, or 125%, should be selected.

STEP 6. A primary fuse rated 125E amperes, Standard Speed, TCC No. 153, is recommended.

STEP 7. The recommended primary-fuse ampere rating (125E) coordinates with the upstream circuit breaker, which can accommodate a primary-fuse ampere rating up through 300E.

STEP 8. From Table XVIII on page 74, an S&C Power Fuse—Type SM-5SS is available in the voltage rating (14.4 kv nominal), maximum ampere rating (400E), and interrupting rating (34,000 amperes rms symmetrical), sufficient for the application in this example.

If it is deemed necessary for the transformer-primary fuse to coordinate with the main secondary circuit breaker instead of the largest Class E-2 high-voltage industrial control equipment in this example, Steps 2 through 8 would be repeated with these results:

STEP 2. The ratio of the overcurrent relay pickup current to the transformer secondary full-load current (at 2.4 kv) is 720 amperes ÷ 600 amperes, or 120%.

STEP 3. The appropriate entry in the column containing the range of pickup currents encompassing the value calculated above, for an extremely inverse relay, is 0.25.

STEP 4. The Transformer Protection Index (TPI) for the transformer in this example is 480%. A comparison of this value with the values listed in Table XIX indicates that the primary fuse associated with this TPI will protect the transformer in accordance with the transformer short-time characteristic curve against all types of secondary faults.

STEP 5. The primary fuse has a loading capability of 180% of the transformer full-load current, which is adequate for the application in this example.

STEP 6. A primary fuse rated 200E amperes, Slow Speed, TCC No. 119, is recommended.

STEP 7. The recommended primary-fuse ampere rating (200E) coordinates with the upstream circuit breaker, which can accommodate a primary-fuse ampere rating up through 300E.

STEP 8. From Table XVIII on page 74, an S&C Power Fuse—Type SM-5SS is available in the voltage rating (14.4 kv nominal), maximum ampere rating (400E), and interrupting rating (34,000 amperes rms symmetrical), sufficient for the application in this example.

THE FUSE SELECTION TABLES

TABLE IV—Transformers Rated 4.16 Kv Three-Phase—with Low-Voltage Secondary Circuit Breakers

Transformer Data (Self Cooled) ↓					Low-Voltage Secondary Circuit Breaker— Upper Limit for Short-Time or Instantaneous Pickup Current, Percent of Transformer Secondary Full-Load Current								S&C Primary Fuse					
Secondary Circuit Breaker Clearing Time for Short-Time Delay or Instantaneous Setting →					Up thru 0.05 Sec. ("Instantaneous" Setting)		0.06 Sec. thru 0.20 Sec. ("Minimum" Setting)		0.21 Sec. thru 0.35 Sec. ("Intermediate" Setting)		0.36 Sec. thru 0.50 Sec. ("Maximum" Setting)		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Character-istic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
			Primary	Secondary														
300	4%	208, 240, 480, or 600	41.6	830 at 208v, 720 at 240v, 360 at 480v, or 290 at 600v	215								260	270	165	50E	Slow	119
					270	280							350	360	215	65E	Std.	153
					270	280							350	370	215	65E	Slow	119
					335	350							440	500	260	80E	Std.	153
					335	350	335	350					460	510	260	80E	Slow	119
					415	435	415	435					550	620	280	100E	Std.	153
					415	435	415	435	415	435			560	780	280	100E	Slow	119
500	4%	208, 240, 480, or 600	69.4	1390 at 208v, 1200 at 240v, 600 at 480v, or 480 at 600v	250	260							310	330	170	100E	Std.	153
					250	260							320	350	170	100E	Slow	119
					335	360							450	490	195	125E	Std.	153
					360	360	360	360					460	530	195	125E	Slow	119
					400	430	400	430					570	610	225	150E	Std.	153
					430	430	430	430	430	430			580	700	225	150E	Slow	119
					465	500	465	500	—	—			650	800	255	175E	Std.	153
					500	500	500	500	500	500			670	900	255	175E	Slow	119
					535	575	535	575	—	—			760	1200	285	200E	Std.	153
					575	575	575	575	575	575	575	575	840	—	285	200E	Slow	119
750	4%	208, 240, 480, or 600	104.1	2080 at 208v, 1800 at 240v, 900 at 480v, 720 at 600v	220								290	300	130	125E	Std.	153
					240								290	310	130	125E	Slow	119
					265	285							350	380	150	150E	Std.	153
					285	285							360	390	150	150E	Slow	119
					310	335							410	440	170	175E	Std.	153
					335	335	335	335					420	450	170	175E	Slow	119
					355	380	—	—					580	600	190	200E	Std.	153
					380	380	380	380					590	660	190	200E	Slow	119
					445	480	445	480					610	670	240	250E	Std.	153
					480	480	480	480	480	480			640	880	240	250E	Slow	119
					535	575	535	575	535	575			730	1050	285	300E	Std.	153
					575	575	575	575	575	575	575	575	960	—	285	300E	Slow	119
	5.75%	208, 240, 480, or 600	104.1	2080 at 208v, 1800 at 240v, 900 at 480v, or 720 at 600v	220								290	300	130	125E	Std.	153
					240		240						290	310	130	125E	Slow	119
					265	285	—						350	380	150	150E	Std.	153
					285	285	285	285					360	390	150	150E	Slow	119
					310	335	310	335					410	440	170	175E	Std.	153
					335	335	335	335	335	335			420	450	170	175E	Slow	119
					355	380	355	380	—	—			580	600	190	200E	Std.	153
					380	380	380	380	380	380	380	380	590	660	190	200E	Slow	119
					445	480	445	480	445	480	—	—	610	670	240	250E	Std.	153
					480	480	480	480	480	480	480	480	640	880	240	250E	Slow	119
					535	575	535	575	535	575	535	575	730	1050	285	300E	Std.	153
					575	575	575	575	575	575	575	575	960	—	285	300E	Slow	119
1000	4%	208, 240, 480, or 600	138.8	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	215								260	280	110	150E	Slow	119
					235	250							310	320	130	175E	Std.	153
					250	250							310	320	130	175E	Slow	119
					265	285							350	370	140	200E	Std.	153
					285	285							360	380	140	200E	Slow	119
					335	360							450	470	180	250E	Std.	153
					360	360	360	360					450	520	180	250E	Slow	119
					400	430	400	430					530	580	215	300E	Std.	153
					430	430	430	430	430	430			590	840	215	300E	Slow	119
					535	575	535	575	—	—			750	930	285	400E	Std.	153
					575	575	575	575	575	575	575	575	980	—	285	400E	Slow	119
	5.75%	208, 240, 480, or 600	138.8	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	200								260	270	110	150E	Std.	153
					215								260	280	110	150E	Slow	119
					235	250							310	320	130	175E	Std.	153
					250	250	250	250					310	320	130	175E	Slow	119
					265	285	—	—					350	370	140	200E	Std.	153
					285	285	285	285					360	380	140	200E	Slow	119
					335	360	335	360					450	470	180	250E	Std.	153
					360	360	360	360	360	360	360	360	450	520	180	250E	Slow	119
					400	430	400	430	400	430	—	—	530	580	215	300E	Std.	153
					430	430	430	430	430	430	430	430	590	840	215	300E	Slow	119
					535	575	535	575	535	575	535	575	750	930	285	400E	Std.	153
					575	575	575	575	575	575	575	575	980	—	285	400E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

TABLE CONTINUED ⟶

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE IV—Transformers Rated 4.16 Kv Three-Phase—with Low-Voltage Secondary Circuit Breakers—Continued

Transformer Data (Self Cooled) ↓					Low-Voltage Secondary Circuit Breaker—Upper Limit for Short-Time or Instantaneous Pickup Current, Percent of Transformer Secondary Full-Load Current								S&C Primary Fuse					
Secondary Circuit Breaker Clearing Time for Short-Time Delay or Instantaneous Setting →					Up thru 0.05 Sec. ("Instantaneous" Setting)		0.06 Sec. thru 0.20 Sec. ("Minimum" Setting)		0.21 Sec. thru 0.35 Sec. ("Intermediate" Setting)		0.36 Sec. thru 0.50 Sec. ("Maximum" Setting)		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
			Primary	Secondary														
1000	8%	208, 240, 480, or 600	138.8	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	200		200						260	270	110	150E	Std.	153
					215		215						260	280	110	150E	Slow	119
					235	250	235	250					310	320	130	175E	Std.	153
					250	250	250	250	250	250			310	320	130	175E	Slow	119
					265	285	265	285	—	—			350	370	140	200E	Std.	153
					285	285	285	285	285	285	285	285	360	380	140	200E	Slow	119
					335	360	335	360	335	360	—	—	450	470	180	250E	Std.	153
					360	360	360	360	360	360	360	360	450	520	180	250E	Slow	119
					400	430	400	430	400	430	400	430	530	580	215	300E	Std.	153
					430	430	430	430	430	430	430	430	590	—	215	300E	Slow	119
					535	575	535	575	535	575	535	575	750	—	285	400E	Std.	153
					575	575	575	575	575	575	575	575	980	—	285	400E	Slow	119
1500	4%	208, 240, 480, or 600	208.2	4160 at 208v, 3610 at 240v, 1800 at 480v, or 1440 at 600v	220								290	300	120	250E	Std.	153
					240								290	300	120	250E	Slow	119
					265	285							350	350	140	300E	Std.	153
					285	285	285	285					350	400	140	300E	Slow	119
					355	380	—	—					480	500	190	400E	Std.	153
					380	380	380	380					540	650	190	400E	Slow	119
					400	430	400	430					620	680	215	2-250E	Std.	153
					430	430	430	430	430	430			640	900	215	2-250E	Slow	119
					480	515	480	515	—	—			750	1000	255	2-300E	Std.	153
					515	515	515	515	515	515	515	515	970	—	255	2-300E	Slow	119
	5.75%	208, 240, 480, or 600	208.2	4160 at 208v, 3610 at 240v, 1800 at 480v, or 1440 at 600v	220								290	300	120	250E	Std.	153
					240		240						290	300	120	250E	Slow	119
					265	285	265	285					350	350	140	300E	Std.	153
					285	285	285	285	285	285			350	400	140	300E	Slow	119
					355	385	355	385	—	—			480	500	190	400E	Std.	153
					380	380	380	380	380	380	380	380	540	650	190	400E	Slow	119
					400	430	400	430	400	430	—	—	620	680	215	2-250E	Std.	153
					430	430	430	430	430	430	430	430	640	900	215	2-250E	Slow	119
					480	515	480	515	480	515	480	515	750	1000	255	2-300E	Std.	153
					515	515	515	515	515	515	515	515	970	—	255	2-300E	Slow	119
2000	5.75%	480 or 600	277.6	2410 at 480v or 1930 at 600v	200								260	260	105	300E	Std.	153
					215								260	260	105	300E	Slow	119
					265	285							350	360	140	400E	Std.	153
					285	285	285	285	285	285			370	420	140	400E	Slow	119
					300	320	300	320	—	—			440	470	160	2-250E	Std.	153
					320	320	320	320	320	320			450	500	160	2-250E	Slow	119
					360	385	360	385	360	385			540	570	195	2-300E	Std.	153
					385	385	385	385	385	385	385	385	580	860	195	2-300E	Slow	119
					480	515	480	515	480	515	480	515	730	820	255	2-400E	Std.	153
					515	515	515	515	515	515	515	515	940	—	255	2-400E	Slow	119
2500	5.75%	480 or 600	347.0	3010 at 480v or 2410 at 600v	215								280	290	115	400E	Std.	153
					230		230						290	310	115	400E	Slow	119
					240	255	—						350	370	130	2-250E	Std.	153
					255	255	255	255					350	370	130	2-250E	Slow	119
					290	310	290	310					430	450	155	2-300E	Std.	153
					310	310	310	310	310	310			440	520	155	2-300E	Slow	119
					385	415	385	415	385	415			580	610	205	2-400E	Std.	153
					415	415	415	415	415	415	415	415	690	—	205	2-400E	Slow	119
3750	5.75%	480 or 600	520.4	4510 at 480v or 3610 at 600v	190								280	280	100	2-300E	Std.	153
					205		205						280	290	100	2-300E	Slow	119
					255	275	—						370	380	135	2-400E	Std.	153
					275	275	275	275	275	275			410	460	135	2-400E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

THE FUSE SELECTION TABLES

TABLE V—Transformers Rated 12.0 Kv or 12.47 Kv Three-Phase—with Low-Voltage Secondary Circuit Breakers

Transformer Data (Self Cooled) ↓					Low-Voltage Secondary Circuit Breaker— Upper Limit for Short-Time or Instantaneous Pickup Current, Percent of Transformer Secondary Full-Load Current								S&C Primary Fuse					
Secondary Circuit Breaker Clearing Time for Short-Time Delay or Instantaneous Setting →					Up thru 0.05 Sec. ("Instantaneous" Setting)		0.06 Sec. thru 0.20 Sec. ("Minimum" Setting)		0.21 Sec. thru 0.35 Sec. ("Intermediate" Setting)		0.36 Sec. thru 0.50 Sec. ("Maximum" Setting)		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes															
			Primary	Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
300	4%	208, 240, 480, or 600	14.4 at 12.0 kv or 13.9 at 12.47 kv	830 at 208v, 720 at 240v, 360 at 480v, or 290 at 600v	240	250							320	330	195	20E	Std.	153
					250	250							330	330	205	20E	Slow	119
					300	315							390	420	260	25E	Std.	153
					315	315							400	420	260	25E	Slow	119
					360	375							490	530	310	30E	Std.	153
					375	375	375	375					490	570	310	30E	Slow	119
					480	500	480	500					680	760	395	40E	Std.	153
					500	500	500	500	500	500	500	500	760	—	395	40E	Slow	119
500	4%	208, 240, 480, or 600	24.1 at 12.0 kv or 23.1 at 12.47 kv	1390 at 208v, 1200 at 240v, 600 at 480v, or 480 at 600v	215								280	280	185	30E	Std.	153
					225								280	290	185	30E	Slow	119
					285	300							380	390	235	40E	Std.	153
					300	300							380	430	235	40E	Slow	119
					360	380							480	520	290	50E	Std.	153
					380	380	380	380					490	660	290	50E	Slow	119
					470	490	470	490					660	770	370	65E	Std.	153
					470	490	470	490	470	490			680	1300	370	65E	Slow	119
750	4%	208, 240, 480 or 600	36.1 at 12.0 kv or 34.7 at 12.47 kv	2080 at 208v, 1800 at 240v, 900 at 480v, or 720 at 600v	200								250	260	155	40E	Slow	119
					240	250							310	320	190	50E	Std.	153
					250	250							320	340	190	50E	Slow	119
					310	325							420	450	245	65E	Std.	153
					310	325	310	325					420	470	245	65E	Slow	119
					385	400	—	—					540	620	305	80E	Std.	153
					385	400	385	400					550	760	305	80E	Slow	119
					480	505	480	505					700	800	325	100E	Std.	153
					480	505	480	505	480	505	480	505	710	—	325	100E	Slow	119
	5.75%	208, 240, 480, or 600	36.1 at 12.0 kv or 34.7 at 12.47 kv	2080 at 208v, 1800 at 240v, 900 at 480v, or 720 at 600v	190								250	250	135	40E	Std.	153
					200								250	260	155	40E	Slow	119
					240	250							310	320	190	50E	Std.	153
					250	250	250	250					320	340	190	50E	Slow	119
					310	325	310	325					420	450	245	65E	Std.	153
					310	325	310	325	310	325			420	470	245	65E	Slow	119
					385	400	385	400	385	400			540	620	305	80E	Std.	153
					385	400	385	400	385	400	385	400	550	760	305	80E	Slow	119
					480	500	480	500	480	500	480	500	700	800	325	100E	Std.	153
					480	500	480	500	480	500	480	500	710	—	325	100E	Slow	119
1000	4%	208, 240, 480, or 600	48.1 at 12.0 kv or 46.3 at 12.47 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	185								240	240	145	50E	Slow	119
					235								310	320	185	65E	Std.	153
					235								310	320	185	65E	Slow	119
					285	300							380	420	225	80E	Std.	153
					285	300							400	420	225	80E	Slow	119
					360	375							490	540	245	100E	Std.	153
					360	375	360	375					500	600	245	100E	Slow	119
					480	520	480	520					700	790	285	125E	Std.	153
					520	520	520	520	520	520	520	520	790	—	285	125E	Slow	119
	5.75%	208, 240, 480, or 600	48.1 at 12.0 kv or 46.3 at 12.47 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	180								240	240	110	50E	Std.	153
					185								240	240	145	50E	Slow	119
					235								310	320	185	65E	Std.	153
					235		235						310	320	185	65E	Slow	119
					285	300	285	300					380	420	225	80E	Std.	153
					285	300	285	300	285	300			400	420	225	80E	Slow	119
					360	375	360	375	—	—			490	540	245	100E	Std.	153
					360	375	360	375	360	375	360	375	500	600	245	100E	Slow	119
					480	520	480	520	480	520	480	520	700	790	285	125E	Std.	153
					520	520	520	520	520	520	520	520	790	—	285	125E	Slow	119
	8%	208, 240, 480, or 600	48.1 at 12.0 kv or 46.3 12.47 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	180								240	240	110	50E	Std.	153
					185		185						240	240	145	50E	Slow	119
					235		235						310	320	185	65E	Std.	153
					235		235		235				310	320	185	65E	Slow	119
					285	300	285	300	285	300			380	420	225	80E	Std.	153
					285	300	285	300	285	300	285	300	400	420	225	80E	Slow	119
					360	375	360	375	360	375	360	375	490	540	245	100E	Std.	153
					360	375	360	375	360	375	360	375	500	600	245	100E	Slow	119
					480	520	480	520	480	520	480	520	700	—	285	125E	Std.	153
					520	520	520	520	520	520	520	520	790	—	285	125E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

TABLE CONTINUED →

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE V—Transformers Rated 12.0 Kv or 12.47 Kv Three-Phase—with Low-Voltage Secondary Circuit Breakers—Continued

Transformer Data (Self Cooled) ↓					Low-Voltage Secondary Circuit Breaker—Upper Limit for Short-Time or Instantaneous Pickup Current, Percent of Transformer Secondary Full-Load Current								S&C Primary Fuse					
Secondary Circuit Breaker Clearing Time for Short-Time Delay or Instantaneous Setting →					Up thru 0.05 Sec. ("Instantaneous" Setting)		0.06 Sec. thru 0.20 Sec. ("Minimum" Setting)		0.21 Sec. thru 0.35 Sec. ("Intermediate" Setting)		0.36 Sec. thru 0.50 Sec. ("Maximum" Setting)		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
			Primary	Secondary														
1500	4%	208, 240, 480, or 600	72.2 at 12.0 kv or 69.4 at 12.47 kv	4160 at 208v, 3610 at 240v, 1800 at 480v, or 1440 at 600v	190								260	270	150	80E	Slow	119
					240	250							320	330	160	100E	Std.	153
					240	250							330	340	160	100E	Slow	119
					320	345							450	470	190	125E	Std.	153
					345	345	345	345					470	530	190	125E	Slow	119
					385	415	385	415					560	610	215	150E	Std.	153
					415	415	415	415	415	415			580	700	215	150E	Slow	119
					450	485	450	485	—	—			650	800	245	175E	Std.	153
					485	485	485	485	485	485			680	860	245	175E	Slow	119
					515	550	515	550	—	—			750	1190	275	200E	Std.	153
					550	550	550	550	550	550	550	550	870	—	275	200E	Slow	119
	5.75%	208, 240, 480, or 600	72.2 at 12.0 kv or 69.4 at 12.47 kv	4160 at 208v, 3610 at 240v, 1800 at 480v, or 1440 at 600v	155								210	210	125	65E	Slow	119
					190								250	260	135	80E	Std.	153
					190								260	270	150	80E	Slow	119
					240	250							320	330	160	100E	Std.	153
					240	250	240	250					330	340	160	100E	Slow	119
					320	345	320	345					450	470	190	125E	Std.	153
					345	345	345	345	345	345			470	530	190	125E	Slow	119
					385	415	385	415	385	415			560	610	215	150E	Std.	153
					415	415	415	415	415	415	415	415	580	700	215	150E	Slow	119
					450	485	450	485	450	485	—	—	650	800	245	175E	Std.	153
					485	485	485	485	485	485	485	485	680	860	245	175E	Slow	119
					515	550	515	550	515	550	515	550	750	—	275	200E	Std.	153
					550	550	550	550	550	550	550	550	870	—	275	200E	Slow	119
2000	5.75%	480 or 600	96.2 at 12.0 kv or 92.6 at 12.47 kv	2410 at 480v or 1930 at 600v	145								190	190	105	80E	Slow	119
					180								230	240	115	100E	Std.	153
					180								240	240	120	100E	Slow	119
					240	260							320	340	140	125E	Std.	153
					260	260	260	260					330	350	140	125E	Slow	119
					290	310	290	310					400	430	160	150E	Std.	153
					310	310	310	310	310	310			410	450	160	150E	Slow	119
					335	360	335	360	—	—			460	500	185	175E	Std.	153
					360	360	360	360	360	360			470	530	185	175E	Slow	119
					385	415	385	415	—	—			540	580	205	200E	Std.	153
					415	415	415	415	415	415	415	415	550	700	205	200E	Slow	119
					480	520	480	520	480	520	480	520	690	780	260	250E	Std.	153
					520	520	520	520	520	520	520	520	740	—	260	250E	Slow	119
2500	5.75%	480 or 600	120.3 at 12.0 kv or 115.7 at 12.47 kv	3010 at 480v or 2410 at 600v	145								190	190	95	100E	Slow	119
					190								260	270	110	125E	Std.	153
					205								260	270	110	125E	Slow	119
					230	245							310	330	130	150E	Std.	153
					245	245	245	245					320	340	130	150E	Slow	119
					270	290	—	—					360	380	150	175E	Std.	153
					290	290	290	290					370	390	150	175E	Slow	119
					305	330	305	330					420	430	165	200E	Std.	153
					330	330	330	330	330	330			440	470	165	200E	Slow	119
					385	415	385	415	—	—			540	590	205	250E	Std.	153
					415	415	415	415	415	415	415	415	580	640	205	250E	Slow	119
					460	495	460	495	460	495	460	495	640	740	245	300E	Std.	153
					495	495	495	495	495	495	495	495	760	—	245	300E	Slow	119
3750	5.75%	480 or 600	180.4 at 12.0 kv or 173.6 at 12.47 kv	4510 at 480v or 3610 at 600v	180								240	240	100	175E	Std.	153
					190								250	250	100	175E	Slow	119
					205								270	280	110	200E	Std.	153
					220								280	290	110	200E	Slow	119
					255	275							340	360	135	250E	Std.	153
					275	275	275	275					350	370	135	250E	Slow	119
					305	330	305	330					400	420	165	300E	Std.	153
					330	330	330	330	330	330			440	520	165	300E	Slow	119
					410	440	410	440	410	440			560	610	220	400E	Std.	153
					440	440	440	440	440	440	440	440	690	850	220	400E	Slow	119
					460	495	460	495	460	495	460	495	750	960	245	2-250E	Std.	153
					495	495	495	495	495	495	495	495	850	—	245	2-250E	Slow	119
					555	595	555	595	555	595	555	595	910	—	295	2-300E	Std.	153

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE VI—Transformers Rated 13.2 Kv or 13.8 Kv Three-Phase—with Low-Voltage Secondary Circuit Breakers

Transformer Data (Self Cooled) ↓					Low-Voltage Secondary Circuit Breaker—Upper Limit for Short-Time or Instantaneous Pickup Current, Percent of Transformer Secondary Full-Load Current								S&C Primary Fuse					
Secondary Circuit Breaker Clearing Time for Short-Time Delay or Instantaneous Setting →					Up thru 0.05 Sec. ("Instantaneous" Setting)		0.06 Sec. thru 0.20 Sec. ("Minimum" Setting)		0.21 Sec. thru 0.35 Sec. ("Intermediate" Setting)		0.36 Sec. thru 0.50 Sec. ("Maximum" Setting)		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
			Primary	Secondary														
300	4%	208, 240, 480, or 600	13.1 at 13.2 kv or 12.6 at 13.8 kv	830 at 208v, 720 at 240v, 360 at 480v, or 290 at 600v	205								260	270	170	15E	Slow	119
					265	275							350	350	225	20E	Std.	153
					275	275							350	370	225	20E	Slow	119
					330	345							440	460	285	25E	Std.	153
					345	345							440	480	285	25E	Slow	119
					395	415	395	415					540	600	340	30E	Std.	153
					415	415	415	415					560	670	340	30E	Slow	119
500	4%	208, 240, 480, or 600	21.9 at 13.2 kv or 20.9 at 13.8 kv	1390 at 208v, 1200 at 240v, 600 at 480v, or 480 at 600v	205								260	260	160	25E	Slow	119
					235	245							310	320	205	30E	Std.	153
					245	245							310	330	205	30E	Slow	119
					315	330							420	440	260	40E	Std.	153
					330	330	330	330					440	510	260	40E	Slow	119
					395	415	—	—					540	600	320	50E	Std.	153
					415	415	415	415	415	415			580	950	320	50E	Slow	119
					515	540	515	540	—	—			750	960	410	65E	Std.	153
					515	540	515	540	515	540	515	540	820	—	410	65E	Slow	119
750	4%	208, 240, 480, or 600	32.8 at 13.2 kv or 31.4 at 13.8 kv	2080 at 208v, 1800 at 240v, 900 at 480v, or 720 at 600v	220								280	290	170	40E	Slow	119
					265	275							350	360	210	50E	Std.	153
					275	275							360	390	210	50E	Slow	119
					345	360							460	500	270	65E	Std.	153
					345	360	345	360					480	550	270	65E	Slow	119
					420	440	420	440					610	690	335	80E	Std.	153
					420	440	420	440	420	440			620	1040	335	80E	Slow	119
	5.75%	208, 240, 480, or 600	32.8 at 13.2 kv or 31.4 at 13.8 kv	2080 at 208v, 1800 at 240v, 900 at 480v, or 720 at 600v	155								210	210	95	30E	Std.	153
					165								210	210	125	30E	Slow	119
					210								280	280	165	40E	Std.	153
					220								280	290	170	40E	Slow	119
					265	275							350	360	210	50E	Std.	153
					275	275	275	275					360	390	210	50E	Slow	119
					340	360	340	360					460	500	270	65E	Std.	153
					340	360	340	360	340	360			480	550	270	65E	Slow	119
					420	440	420	440	420	440			610	690	335	80E	Std.	153
					420	440	420	440	420	440	420	440	620	—	335	80E	Slow	119
1000	4%	208, 240, 480, or 600	43.7 at 13.2 kv or 41.8 at 13.8 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	155								210	210	130	40E	Slow	119
					205								260	270	160	50E	Slow	119
					255	270							340	350	205	65E	Std.	153
					255	270							340	360	205	65E	Slow	119
					315	330							420	480	250	80E	Std.	153
					315	330	315	330					450	490	250	80E	Slow	119
					395	415	395	415					550	610	270	100E	Std.	153
					395	415	395	415	395	415			560	760	270	100E	Slow	119
					530	570	530	570	530	570			800	920	310	125E	Std.	153
					570	570	570	570	570	570	570	570	920	—	310	125E	Slow	119
	5.75%	208, 240, 480, or 600	43.7 at 13.2 kv or 41.8 at 13.8 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	165								210	210	130	40E	Slow	119
					195								260	260	140	50E	Std.	153
					205								260	270	160	50E	Slow	119
					255	270							340	350	205	65E	Std.	153
					255	270	255	270					340	360	205	65E	Slow	119
					315	330	315	330					420	480	250	80E	Std.	153
					315	330	315	330	315	330			450	490	250	80E	Slow	119
					395	415	395	415	395	415			550	610	270	100E	Std.	153
					395	415	395	415	395	415	395	415	560	760	270	100E	Slow	119
					530	570	530	570	530	570	530	570	800	920	310	125E	Std.	153
					570	570	570	570	570	570	570	570	920	—	310	125E	Slow	119
	8%	208, 240, 480, or 600	43.7 at 13.2 kv or 41.8 at 13.8 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, 960 at 600v	165		165						210	210	130	40E	Slow	119
					195		—						260	260	140	50E	Std.	153
					205		205						260	270	160	50E	Slow	119
					255	270	255	270					340	350	205	65E	Std.	153
					255	270	255	270	255	270	255	270	340	360	205	65E	Slow	119
					315	330	315	330	315	330	—	—	420	480	250	80E	Std.	153
					315	330	315	330	315	330	315	330	450	490	250	80E	Slow	119
					395	415	395	415	395	415	395	415	550	610	270	100E	Std.	153
					395	415	395	415	395	415	395	415	560	—	270	100E	Slow	119
					530	570	530	570	530	570	530	570	800	—	310	125E	Std.	153
					570	570	570	570	570	570	570	570	920	—	310	125E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

TABLE CONTINUED →

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE VI—Transformers Rated 13.2 Kv or 13.8 Kv Three-Phase—with Low-Voltage Secondary Circuit Breakers—Continued

Transformer Data (Self Cooled) ↓					Low-Voltage Secondary Circuit Breaker—Upper Limit for Short-Time or Instantaneous Pickup Current, Percent of Transformer Secondary Full-Load Current								S&C Primary Fuse					
Secondary Circuit Breaker Clearing Time for Short-Time Delay or Instantaneous Setting →					Up thru 0.05 Sec. ("Instantaneous" Setting)		0.06 Sec. thru 0.20 Sec. ("Minimum" Setting)		0.21 Sec. thru 0.35 Sec. ("Intermediate" Setting)		0.36 Sec. thru 0.50 Sec. ("Maximum" Setting)		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
			Primary	Secondary														
1500	4%	208, 240, 480, or 600	65.6 at 13.2 kv or 62.8 at 13.8 kv	4160 at 208v, 3610 at 240v, 1800 at 480v, or 1440 at 600v	170								230	230	135	65E	Slow	119
					210								280	290	165	80E	Slow	119
					265	275							350	360	180	100E	Std.	153
					265	275							360	380	180	100E	Slow	119
					350	380							490	520	205	125E	Std.	153
					380	380	380	380					520	620	205	125E	Slow	119
					425	455	425	455					620	670	240	150E	Std.	153
					455	455	455	455	455	455			650	800	240	150E	Slow	119
					495	530	495	530	—	—			720	1060	270	175E	Std.	153
					530	530	530	530	530	530	530	530	780	—	270	175E	Slow	119
	5.75%	208, 240, 480, or 600	65.6 at 13.2 kv or 62.8 at 13.8 kv	4160 at 208v, 3610 at 240v, 1800 at 480v, or 1440 at 600v	135								210	210	95	50E	Slow	119
					170								220	230	105	65E	Std.	153
					170								230	230	135	65E	Slow	119
					210								270	280	165	80E	Std.	153
					210								280	290	165	80E	Slow	119
					265	275							350	360	180	100E	Std.	153
					265	275	265	275					360	380	180	100E	Slow	119
					355	380	355	380					490	520	205	125E	Std.	153
					380	380	380	380	380	380	380	380	520	620	205	125E	Slow	119
					425	455	425	455	425	455	—	—	620	670	240	150E	Std.	153
					455	455	455	455	455	455	455	455	650	800	240	150E	Slow	119
					495	530	495	530	495	530	495	530	720	—	270	175E	Std.	153
					530	530	530	530	530	530	530	530	780	—	270	175E	Slow	119
2000	5.75%	480 or 600	87.5 13.2 kv or 83.7 at 13.8 kv	2410 at 480v or 1930 at 600v	155								210	210	125	80E	Slow	119
					195								260	260	135	100E	Std.	153
					195								260	270	135	100E	Slow	119
					265	285							360	370	155	125E	Std.	153
					285	285	285	285					370	400	155	125E	Slow	119
					315	340	315	340					450	470	180	150E	Std.	153
					340	340	340	340	340	340			450	530	180	150E	Slow	119
					370	400	370	400	—	—			510	550	205	175E	Std.	153
					400	400	400	400	400	400	400	400	520	640	205	175E	Slow	119
					425	455	425	455	425	455	—	—	590	650	225	200E	Std.	153
					455	455	455	455	455	455	455	455	620	900	225	200E	Slow	119
					530	570	530	570	530	570	530	570	770	920	285	250E	Std.	153
					570	570	570	570	570	570	570	570	910	—	285	250E	Slow	119
2500	5.75%	480 or 600	109.3 at 13.2 kv or 104.6 at 13.8 kv	3010 at 480v or 2410 at 600v	155								210	210	105	100E	Slow	119
					210								290	290	125	125E	Std.	153
					225								290	300	125	125E	Slow	119
					255	270							350	370	140	150E	Std.	153
					270	270	270	270					350	390	140	150E	Slow	119
					295	320	295	320					410	430	165	175E	Std.	153
					320	320	320	320	320	320			410	440	165	175E	Slow	119
					340	365	340	365	—	—			470	500	180	200E	Std.	153
					365	365	365	365	365	365			480	560	180	200E	Slow	119
					425	455	425	455	425	455			600	660	225	250E	Std.	153
					455	455	455	455	455	455	455	455	630	880	225	250E	Slow	119
					510	545	510	545	510	545	510	545	720	960	270	300E	Std.	153
					545	545	545	545	545	545	545	545	930	—	270	300E	Slow	119
3750	5.75%	480 or 600	164.0 at 13.2 kv or 156.9 at 13.8 kv	4510 at 480v or 3610 at 600v	140								230	230	95	150E	Std.	153
					150								230	240	95	150E	Slow	119
					170								270	270	110	175E	Std.	153
					180								270	280	110	175E	Slow	119
					195								310	320	120	200E	Std.	153
					210		210						310	320	120	200E	Slow	119
					225	240	—						380	400	150	250E	Std.	153
					240	240	240	240	240	240			390	420	150	250E	Slow	119
					280	305	280	305	—	—			460	480	180	300E	Std.	153
					305	305	305	305	305	305	305	305	500	620	180	300E	Slow	119
					450	485	450	485	450	485	—	—	640	700	240	400E	Std.	153
					485	485	485	485	485	485	485	485	780	—	240	400E	Slow	119
					510	545	510	545	510	545	510	545	850	—	270	2-250E	Std.	153
					545	545	545	545	545	545	545	545	1020	—	270	2-250E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

THE FUSE SELECTION TABLES

TABLE VII—Transformers Rated 22.9 Kv or 24.9 Kv Three-Phase—with Low-Voltage Secondary Circuit Breakers

Transformer Data (Self Cooled) ↓					Low-Voltage Secondary Circuit Breaker—Upper Limit for Short-Time or Instantaneous Pickup Current, Percent of Transformer Secondary Full-Load Current								S&C Primary Fuse					
Secondary Circuit Breaker Clearing Time for Short-Time Delay or Instantaneous Setting →					Up thru 0.05 Sec. ("Instantaneous" Setting)		0.06 Sec. thru 0.20 Sec. ("Minimum" Setting)		0.21 Sec. thru 0.35 Sec. ("Intermediate" Setting)		0.36 Sec. thru 0.50 Sec. ("Maximum" Setting)		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
			Primary	Secondary														
300	4%	208, 240, 480, or 600	7.6 at 22.9 kv or 7.0 at 24.9 kv	830 at 208v, 720 at 240v, 360 at 480v, 290 at 600v	230								310	320	185	10E	Std.	153
					295	310							400	410	255	13E	Std.	153
					345	360							480	510	295	15E	Std.	153
					360	360	360	360					500	590	295	15E	Slow	119
					460	480	460	480					640	710	395	20E	Std.	153
					480	480	480	480	480	480			690	1300	395	20E	Slow	119
500	4%	208, 240, 480, or 600	12.6 at 22.9 kv or 11.6 at 24.9 kv	1390 at 208v, 1200 at 240v, 600 at 480v, or 480 at 600v	215								290	300	175	15E	Slow	119
					275	285							370	390	235	20E	Std.	153
					285	285							380	400	235	20E	Slow	119
					345	360							480	520	295	25E	Std.	153
					360	360	360	360					490	540	295	25E	Slow	119
					410	430	410	430					590	660	355	30E	Std.	153
					430	430	430	430					620	850	355	30E	Slow	119
750	4%	208, 240, 480, or 600	18.9 at 22.9 kv or 17.4 at 24.9 kv	2080 at 208v, 1800 at 240v, 900 at 480v, or 720 at 600v	230								310	320	185	25E	Std.	153
					240								310	320	195	25E	Slow	119
					275	285	275	285					370	390	235	30E	Std.	153
					285	285	285	285					380	410	235	30E	Slow	119
					365	385	365	385					510	540	300	40E	Std.	153
					385	385	385	385	385	385	385	385	540	740	300	40E	Slow	119
					460	480	460	480	460	480	—	—	670	780	370	50E	Std.	153
					480	480	480	480	480	480	480	480	760	—	370	50E	Slow	119
	5.75%	208, 240, 480, or 600	18.9 at 22.9 kv or 17.4 at 24.9 kv	2080 at 208v, 1800 at 240v, 900 at 480v, or 720 at 600v	180								250	250	110	20E	Std.	153
					185								250	250	145	20E	Slow	119
					230								310	320	185	25E	Std.	153
					240								310	320	195	25E	Slow	119
					275	285	275	285					370	390	235	30E	Std.	153
					285	285	285	285					380	410	235	30E	Slow	119
					365	385	365	385					510	540	300	40E	Std.	153
					385	385	385	385	385	385	385	385	540	740	300	40E	Slow	119
					460	480	460	480	460	480	—	—	670	780	370	50E	Std.	153
					480	480	480	480	480	480	480	480	760	—	370	50E	Slow	119
1000	4%	208, 240, 480, or 600	25.2 at 22.9 kv or 23.2 at 24.9 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	205								280	280	170	30E	Std.	153
					215								290	290	175	30E	Slow	119
					275	285							370	390	225	40E	Std.	153
					285	285							390	430	225	40E	Slow	119
					345	360							480	520	275	50E	Std.	153
					360	360	360	360					500	670	275	50E	Slow	119
					445	465	445	465					660	780	355	65E	Std.	153
					445	465	445	465	445	465			700	1300	355	65E	Slow	119
	5.75%	208, 240, 480, or 600	25.2 at 22.9 kv or 23.2 at 24.9 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	170								230	240	95	25E	Std.	153
					180								240	240	120	25E	Slow	119
					205								280	280	170	30E	Std.	153
					215								290	290	175	30E	Slow	119
					275	285	275	285					370	390	225	40E	Std.	153
					285	285	285	285	285	285			390	430	225	40E	Slow	119
					345	360	345	360	—	—			480	520	275	50E	Std.	153
					360	360	360	360	360	360	360	360	500	670	275	50E	Slow	119
					445	465	445	465	445	465	445	465	660	780	355	65E	Std.	153
					445	465	445	465	445	465	445	465	700	—	355	65E	Slow	119
	8%	208, 240, 480, or 600	25.2 at 22.9 kv or 23.2 at 24.9 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	170								230	240	95	25E	Std.	153
					180								240	240	120	25E	Slow	119
					205		205						280	280	170	30E	Std.	153
					215		215						290	290	175	30E	Slow	119
					275	285	275	285	275	285			370	390	225	40E	Std.	153
					285	285	285	285	285	285	285	285	390	430	225	40E	Slow	119
					345	360	345	360	345	360	345	360	480	520	275	50E	Std.	153
					360	360	360	360	360	360	360	360	500	670	275	50E	Slow	119
					445	465	445	465	445	465	445	465	660	—	355	65E	Std.	153
					445	465	445	465	445	465	445	465	700	—	355	65E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

TABLE CONTINUED ⟶

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE VII—Transformers Rated 22.9 Kv or 24.9 Kv Three-Phase—with Low-Voltage Secondary Circuit Breakers—Continued

Transformer Data (Self Cooled) ↓					Low-Voltage Secondary Circuit Breaker—Upper Limit for Short-Time or Instantaneous Pickup Current, Percent of Transformer Secondary Full-Load Current								S&C Primary Fuse					
Secondary Circuit Breaker Clearing Time for Short-Time Delay or Instantaneous Setting →					Up thru 0.05 Sec. ("Instantaneous" Setting)		0.06 Sec. thru 0.20 Sec. ("Minimum" Setting)		0.21 Sec. thru 0.35 Sec. ("Intermediate" Setting)		0.36 Sec. thru 0.50 Sec. ("Maximum" Setting)		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
			Primary	Secondary														
1500	4%	208, 240, 480, or 600	37.8 at 22.9 kv or 34.8 at 24.9 kv	4160 at 208v, 3610 at 240v, 1800 at 480v, or 1440 at 600v	190								250	260	150	40E	Slow	119
					230								310	320	185	50E	Std.	153
					240								310	330	185	50E	Slow	119
					295	310							420	440	235	65E	Std.	153
					295	310							420	460	235	65E	Slow	119
					365	385							530	600	290	80E	Std.	153
					365	385	365	385					550	710	290	80E	Slow	119
					460	480	460	480					690	800	310	100E	Std.	153
					460	480	460	480	460	480			700	—	310	100E	Slow	119
	5.75%	208, 240, 480, or 600	37.8 at 22.9 kv or 34.8 at 24.9 kv	4160 at 208v, 3610 at 240v, 1800 at 480v, or 1440 at 600v	180								250	250	120	40E	Std.	153
					190								250	260	150	40E	Slow	119
					230								310	320	185	50E	Std.	153
					240		240						310	330	185	50E	Slow	119
					295	310	295	310					420	440	235	65E	Std.	153
					295	310	295	310	295	310			420	460	235	65E	Slow	119
					365	385	365	385	365	385			530	600	290	80E	Std.	153
					365	385	365	385	365	385	365	385	550	710	290	80E	Slow	119
					460	480	460	480	460	480	460	480	690	800	310	100E	Std.	153
					460	480	460	480	460	480	460	480	700	—	310	100E	Slow	119
2000	5.75%	480 or 600	50.4 at 22.9 kv or 46.4 at 24.9 kv	2410 at 480v or 1930 at 600v	140								190	190	95	40E	Slow	119
					170								230	240	95	50E	Std.	153
					180								230	240	135	50E	Slow	119
					220								300	320	175	65E	Std.	153
					220		220						310	320	175	65E	Slow	119
					275	285	275	285					380	410	215	80E	Std.	153
					275	285	275	285	275	285			400	420	215	80E	Slow	119
					345	360	345	360	—	—			470	540	230	100E	Std.	153
					345	360	345	360	345	360	345	360	500	600	230	100E	Slow	119
					460	495	460	495	460	495	460	495	710	800	270	125E	Std.	153
					495	495	495	495	495	495	495	495	760	—	270	125E	Slow	119
					550	595	550	595	550	595	550	595	900	—	310	150E	Std.	153
					595	595	595	595	595	595	595	595	1120	—	310	150E	Slow	119
2500	5.75%	480 or 600	63.0 at 22.9 kv or 58.0 at 24.9 kv	3010 at 480v or 2410 at 600v	140								190	190	105	50E	Slow	119
					175								250	250	120	65E	Std.	153
					175								250	250	140	65E	Slow	119
					220								300	310	175	80E	Std.	153
					220		220						310	330	175	80E	Slow	119
					275	285	275	285					370	400	185	100E	Std.	153
					275	285	275	285	275	285			400	420	185	100E	Slow	119
					365	395	365	395	365	395			550	600	215	125E	Std.	153
					395	395	395	395	395	395	395	395	560	730	215	125E	Slow	119
					440	475	440	475	440	475	440	475	700	760	250	150E	Std.	153
					475	475	475	475	475	475	475	475	720	—	250	150E	Slow	119
					515	555	515	555	515	555	515	555	800	950	285	175E	Std.	153
					555	555	555	555	555	555	555	555	880	—	285	175E	Slow	119
3750	5.75%	480 or 600	94.5 at 22.9 kv or 87.0 at 24.9 kv	4510 at 480v or 3610 at 600v	145								210	210	110	80E	Slow	119
					180								250	250	120	100E	Std.	153
					180								260	260	125	100E	Slow	119
					245	260							360	370	145	125E	Std.	153
					260	260	260	260					360	380	145	125E	Slow	119
					295	315	295	315					430	460	165	150E	Std.	153
					315	315	315	315	315	315			440	500	165	150E	Slow	119
					340	370	340	370	—	—			500	540	190	175E	Std.	153
					370	370	370	370	370	370	370	370	510	620	190	175E	Slow	119
					390	420	390	420	390	420	—	—	580	630	210	200E	Std.	153
					420	420	420	420	420	420	420	420	610	860	210	200E	Slow	119
					490	525	490	525	490	525	490	525	750	870	260	250E	Std.	153
					525	525	525	525	525	525	525	525	840	—	260	250E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

THE FUSE SELECTION TABLES

TABLE VIII —Transformers Rated 33.0 Kv or 34.5 Kv Three-Phase—with Low-Voltage Secondary Circuit Breakers

Transformer Data (Self Cooled) ↓					Low-Voltage Secondary Circuit Breaker— Upper Limit for Short-Time or Instantaneous Pickup Current, Percent of Transformer Secondary Full-Load Current								S&C Primary Fuse					
Secondary Circuit Breaker Clearing Time for Short-Time Delay or Instantaneous Setting →					Up thru 0.05 Sec. ("Instantaneous" Setting)		0.06 Sec. thru 0.20 Sec. ("Minimum" Setting)		0.21 Sec. thru 0.35 Sec. ("Intermediate" Setting)		0.36 Sec. thru 0.50 Sec. ("Maximum" Setting)		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
			Primary	Secondary														
300	4%	208, 240, 480, or 600	5.2 at 33.0 kv or 5.0 at 34.5 kv	830 at 208v, 720 at 240v, 360 at 480v, or 290 at 600v	230								310	310	195	7E	Std.	153
					330	345							440	480	285	10E	Std.	153
					430	450	430	450					580	640	370	13E	Std.	153
					495	520	495	520					720	870	425	15E	Std.	153
					520	520	520	520	520	520			780	—	425	15E	Slow	119
500	4%	208, 240, 480, or 600	8.7 at 33.0 kv or 8.4 at 34.5 kv	1390 at 208v, 1200 at 240v, 600 at 480v, or 480 at 600v	255	270							340	340	220	13E	Std.	153
					295	310							390	420	255	15E	Std.	153
					310	310							400	450	255	15E	Slow	119
					395	415							530	570	340	20E	Std.	153
					415	415	415	415					540	700	340	20E	Slow	119
					495	520	495	520	495	520			700	850	425	25E	Std.	153
					520	520	520	520	520	520			710	—	425	25E	Slow	119
750	4%	208, 240, 480, or 600	13.1 at 33.0 kv or 12.6 at 34.5 kv	2080 at 208v, 1800 at 240v, 900 at 480v, or 720 at 600v	205								270	280	170	15E	Slow	119
					265	275							350	360	225	20E	Std.	153
					275	275							360	370	225	20E	Slow	119
					330	345							440	480	285	25E	Std.	153
					345	345							450	490	285	25E	Slow	119
					395	415	395	415					550	600	340	30E	Std.	153
					415	415	415	415					560	720	340	30E	Slow	119
	5.75%	208, 240, 480, or 600	13.1 at 33.0 kv or 12.6 at 34.5 kv	2080 at 208v, 1800 at 240v, 900 at 480v, or 720 at 600v	170								230	230	90	13E	Std.	153
					195								260	260	140	15E	Std.	153
					205								270	280	170	15E	Slow	119
					265	275							350	360	225	20E	Std.	153
					275	275	275	275					360	370	225	20E	Slow	119
					330	345	330	345					440	480	285	25E	Std.	153
					345	345	345	345	345	345			450	490	285	25E	Slow	119
					395	415	395	415	395	415			550	600	340	30E	Std.	153
					415	415	415	415	415	415	415	415	560	720	340	30E	Slow	119
1000	4%	208, 240, 480, or 600	17.5 at 33.0 kv or 16.7 at 34.5 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	205								260	260	165	20E	Slow	119
					245	260							330	340	210	25E	Std.	153
					260	260							330	340	210	25E	Slow	119
					295	310							400	420	255	30E	Std.	153
					310	310	310	310					400	440	255	30E	Slow	119
					395	415	395	415					540	590	325	40E	Std.	153
					415	415	415	415	415	415			570	830	325	40E	Slow	119
					495	520	495	520	—	—			710	870	400	50E	Std.	153
					520	520	520	520	520	520	520	520	850	—	400	50E	Slow	119
	5.75%	208, 240, 480, or 600	17.5 at 33.0 kv or 16.7 at 34.5 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, 960 at 600v	195								260	260	135	20E	Std.	153
					205								260	260	165	20E	Slow	119
					245	260							330	340	210	25E	Std.	153
					260	260	260	260					330	340	210	25E	Slow	119
					295	310	295	310					400	420	255	30E	Std.	153
					310	310	310	310	310	310			400	440	255	30E	Slow	119
					395	415	395	415	395	415			540	590	325	40E	Std.	153
					415	415	415	415	415	415			570	830	325	40E	Slow	119
					495	520	495	520	495	520	495	520	710	870	400	50E	Std.	153
					520	520	520	520	520	520	520	520	850	—	400	50E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

TABLE CONTINUED ⟶

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE VIII—Transformers Rated 33.0 Kv or 34.5 Kv Three-Phase—with Low-Voltage Secondary Circuit Breakers— Continued

Transformer Data (Self Cooled) ↓					Low-Voltage Secondary Circuit Breaker— Upper Limit for Short-Time or Instantaneous Pickup Current, Percent of Transformer Secondary Full-Load Current								S&C Primary Fuse					
Secondary Circuit Breaker Clearing Time for Short-Time Delay or Instantaneous Setting →					Up thru 0.05 Sec. ("Instantaneous" Setting)		0.06 Sec. thru 0.20 Sec. ("Minimum" Setting)		0.21 Sec. thru 0.35 Sec. ("Intermediate" Setting)		0.36 Sec. thru 0.50 Sec. ("Maximum" Setting)		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes Primary	Full-Load Current, Amperes Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
1000	8%	208, 240, 480, or 600	17.5 at 33.0 kv or 16.7 at 34.5 kv	2780 at 208v, 2410 at 240v, 1200 at 480v, or 960 at 600v	195								260	260	135	20E	Std.	153
					205		205						260	260	165	20E	Slow	119
					245	260	245	260					330	340	210	25E	Std.	153
					260	260	260	260	260	260			330	340	210	25E	Slow	119
					295	310	295	310	295	310			400	420	255	30E	Std.	153
					310	310	310	310	310	310	310	310	400	440	255	30E	Slow	119
					395	415	395	415	395	415	395	415	540	590	325	40E	Std.	153
					415	415	415	415	415	415	415	415	570	—	325	40E	Slow	119
					495	520	495	520	495	520	495	520	710	—	400	50E	Std.	153
					520	520	520	520	520	520	520	520	850	—	400	50E	Slow	119
1500	4%	208, 240, 480, or 600	26.2 at 33.0 kv or 25.1 at 34.5 kv	4160 at 208v, 3610 at 240v, 1800 at 480v, or 1440 at 600v	205								270	270	170	30E	Slow	119
					265	275							350	360	215	40E	Std.	153
					275	275							350	380	215	40E	Slow	119
					330	345							450	480	265	50E	Std.	153
					345	345	345	345					460	550	265	50E	Slow	119
					430	450	430	450					600	690	340	65E	Std.	153
					430	450	430	450	430	450			620	820	340	65E	Slow	119
	5.75%	208, 240, 480, or 600	26.2 at 33.0 kv or 25.1 at 34.5 kv	4160 at 208v, 3610 at 240v, 1800 at 480v, or 1440 at 600v	170								220	220	110	25E	Slow	119
					195								260	260	160	30E	Std.	153
					205								270	270	170	30E	Slow	119
					265	275							350	360	215	40E	Std.	153
					275	275	275	275					350	380	215	40E	Slow	119
					330	345	330	345					450	480	265	50E	Std.	153
					345	345	345	345	345	345	345	345	460	550	265	50E	Slow	119
					430	450	430	450	430	450	—	—	600	690	340	65E	Std.	153
					430	450	430	450	430	450	430	450	620	820	340	65E	Slow	119
2000	5.75%	480 or 600	35.0 at 33.0 kv or 33.5 at 34.5 kv	2410 at 480v or 1930 at 600v	155								200	200	110	30E	Slow	119
					195								260	260	145	40E	Std.	153
					205								260	270	160	40E	Slow	119
					245	260							330	340	200	50E	Std.	153
					260	260	260	260					330	340	200	50E	Slow	119
					320	335	320	335					440	470	255	65E	Std.	153
					320	335	320	335	320	335			440	500	255	65E	Slow	119
					395	415	395	415	395	415			560	650	310	80E	Std.	153
					395	415	395	415	395	415	395	415	580	820	310	80E	Slow	119
					495	520	495	520	495	520	495	520	740	860	335	100E	Std.	153
					495	520	495	520	495	520	495	520	750	—	335	100E	Slow	119
2500	5.75%	480 or 600	43.7 at 33.0 kv or 41.8 at 34.5 kv	3010 at 480v or 2410 at 600v	165								210	210	130	40E	Slow	119
					195								260	260	140	50E	Std.	153
					205								260	270	160	50E	Slow	119
					255	270							340	350	205	65E	Std.	153
					255	270	255	270					340	360	205	65E	Slow	119
					315	330	315	330					420	470	250	80E	Std.	153
					315	330	315	330	315	330			440	490	250	80E	Slow	119
					395	415	395	415	395	415			540	610	270	100E	Std.	153
					395	415	395	415	395	415	395	415	570	770	270	100E	Slow	119
					530	570	530	570	530	570	530	570	800	920	310	125E	Std.	153
					570	570	570	570	570	570	570	570	950	—	310	125E	Slow	119
3750	5.75%	480 or 600	65.6 at 33.0 kv or 62.8 at 34.5 kv	4510 at 480v or 3610 at 600v	170								230	230	105	65E	Std.	153
					170								230	230	135	65E	Slow	119
					210								280	280	165	80E	Std.	153
					210		210						280	300	165	80E	Slow	119
					265	275	265	275					350	360	180	100E	Std.	153
					265	275	265	275					360	380	180	100E	Slow	119
					355	380	355	380	355	380			500	540	205	125E	Std.	153
					380	380	380	380	380	380			510	630	205	125E	Slow	119
					425	455	425	455	425	455			640	690	240	150E	Std.	153
					455	455	455	455	455	455	455	455	660	—	240	150E	Slow	119
					495	530	495	530	495	530	495	530	720	830	270	175E	Std.	153
					530	530	530	530	530	530	530	530	780	—	270	175E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

S&C Power Fuses — Types SM, SML, and SMD-20

Indoor and Outdoor Distribution (4.16 kv through 34.5 kv)

THE FUSE SELECTION TABLES

TABLE IX—Transformers Rated 4.16 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes																	
			Primary	Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
300	Up thru 4%	208 or 240	41.6	830 at 208v or 720 at 240v	23		25		50		30				210	210	90	40E	Std.	153
					29		34		59	67	38				210	210	135	40E	Slow	119
					29		33		64	74	38				260	270	155	50E	Std.	153
					38		43		73	96	47				260	270	165	50E	Slow	119
					41		47		104	121	51	84			350	360	215	65E	Std.	153
					49	89	54	92	112	124	77	88			350	370	215	65E	Slow	119
					52	94	89	103	126	138	91	104		104■	440	500	260	80E	Std.	153
					97	108	100	113	132	146	95	110		109■	460	510	260	80E	Slow	119
					100	118	107	121	143	160	110	130	108■	124	550	620	280	100E	Std.	153
					114	129	120	137	155	176	117	136	115	132	560	780	280	100E	Slow	119
		480 or 600	41.6	360 at 480v or 290 at 600v	27		26		57	61	29				210	210	90	40E	Std.	153
					33		34		62	69	38				210	210	135	40E	Slow	119
					33		33		65	73	38				260	270	155	50E	Std.	153
					39		42		77	85	48				260	270	165	50E	Slow	119
					41		44		84	99	52	60			350	360	215	65E	Std.	153
					47		52	60	99	111	60	69			350	370	215	65E	Slow	119
					49		55	63	108	123	64	73			440	500	260	80E	Std.	153
					59	68	66	76	119	133	76	86			460	510	260	80E	Slow	119
					60	71	67	79	128	148	78	89			550	620	280	100E	Std.	153
					73	86	83	97	141	163	93	107			560	780	280	100E	Slow	119
500	Up thru 4%	208 or 240	69.4	1390 at 208v or 1200 at 240v	24		27		59	72	30				210	210	90	65E	Std.	153
					28		31		66	74	39				210	210	130	65E	Slow	119
					30		52	61	75	82	54	62		61■	250	250	145	80E	Std.	153
					57	64	58	66	78	85	56	65		64■	260	260	155	80E	Slow	119
					59	70	64	72	85	95	66	77	64■	74	310	330	170	100E	Std.	153
					68	76	71	81	92	104	69	81	68	79	320	350	170	100E	Slow	119
					83	92	81	93	109	123	89	102	87	101	450	490	195	125E	Std.	153
					91	101	96	108	125	140	99	115	101	115	460	530	195	125E	Slow	119
					96	109	97	112	129	145	110	127	106	120	570	610	225	150E	Std.	153
					106	119	114	129	146	159	123	141	121	135	580	700	225	150E	Slow	119
					108	121	113	126	145	158	126	145	120	135	650	800	255	175E	Std.	153
					117	130	128	144	157	171	138	161	133	151	670	900	255	175E	Slow	119
					119	131	123	137	155	170	142	165	132	149	760	1200	285	200E	Std.	153
					131	146	143	163	172	195	162	186	152	175	840	—	285	200E	Slow	119
		480 or 600	69.4	600 at 480v or 480 at 600v	24		26		50		31				210	210	90	65E	Std.	153
					27		30		58	66	35				210	210	130	65E	Slow	119
					29		32		63	72	37				250	250	145	80E	Std.	153
					34		38		70	78	44				260	260	155	80E	Slow	119
					36		40		76	88	46				310	330	170	100E	Std.	153
					43		49		83	97	55	63			320	350	170	100E	Slow	119
					48		55	64	102	121	61	70			450	490	195	125E	Std.	153
					62	72	68	79	126	164	75	101			460	530	195	125E	Slow	119
					59	70	67	78	138	174	74	125			570	610	225	150E	Std.	153
					123	139	125	143	171	188	120	137		140●	580	700	225	150E	Slow	119
					70	82	79	136	173	190	125	144		137●	650	800	255	175E	Std.	153
					137	153	142	161	185	206	134	155	137●	156●	670	900	255	175E	Slow	119
					80	142	133	150	187	206	141	161	—	155●	760	1200	285	200E	Std.	153
					154	172	160	181	207	235	156	180	157●	182	840	—	285	200E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

■ Applicable at 208 v only.

● Applicable at 480 v only.

TABLE CONTINUED →

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE IX—Transformers Rated 4.16 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes Primary	Full-Load Current, Amperes Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
750	Up thru 5.75%	208 or 240	104.1	2080 at 208v or 1800 at 240v	39		42		57	63	43		43■		210	210	90	100E	Std.	153
					45		47		61	69	46		45		210	210	110	100E	Slow	119
					54	60	53	60	72	81	58	66	57	66	290	300	130	125E	Std.	153
					59	67	63	70	82	92	65	76	66	75	290	310	130	125E	Slow	119
					64	72	64	74	86	97	73	84	70	79	350	380	150	150E	Std.	153
					71	79	76	85	97	106	81	94	80	90	360	390	150	150E	Slow	119
					72	80	75	84	96	105	84	97	80	90	410	440	170	175E	Std.	153
					78	87	85	96	105	114	92	107	88	101	420	450	170	175E	Slow	119
					79	87	82	91	103	113	94	110	88	99	580	600	190	200E	Std.	153
					87	97	95	108	114	129	107	123	101	116	590	660	190	200E	Slow	119
					93	104	98	113	121	139	119	136	109	128	610	670	240	250E	Std.	153
					104	116	117	134	141	164	135	157	130	152	640	880	240	250E	Slow	119
					111	125	120	138	150	171	144	168	138	158	730	1050	285	300E	Std.	153
					130	149	148	169	182	208	172	196	164	182	960	—	285	300E	Slow	119
		480 or 600	104.1	900 at 480v or 720 at 600v	23		26		50		30				210	210	90	100E	Std.	153
					28		32		55	64	36				210	210	110	100E	Slow	119
					31		36		67	78	40				290	300	130	125E	Std.	153
					40		44		81	108	48				290	310	130	125E	Slow	119
					39		45		90	115	49	83			350	380	150	150E	Std.	153
					82		83	95	114	125	80	91		93●	360	390	150	150E	Slow	119
					47	55	52	90	115	126	83	96		91●	410	440	170	175E	Std.	153
					91	102	94	107	123	137	89	103	91●	104●	420	450	170	175E	Slow	119
					53	94	88	99	124	137	94	107	—	103●	580	600	190	200E	Std.	153
					102	115	106	121	137	156	104	120	104●	121	590	660	190	200E	Slow	119
					106	124	108	122	148	166	118	133	112	130	610	670	240	250E	Std.	153
					124	139	131	147	170	192	132	153	132	153	640	880	240	250E	Slow	119
					136	147	130	151	175	198	142	162	141	163	730	1050	285	300E	Std.	153
					151	169	161	182	209	231	169	198	170	192	960	—	285	300E	Slow	119
1000	Up thru 8%	208 or 240	138.8	2780 at 208v or 2410 at 240v	44		47		61	69	48		49		220	220	95	125E	Slow	119
					47		47		63	72	54	62	51		260	270	110	150E	Std.	153
					52		56	63	72	78	60	69	59	66	260	280	110	150E	Slow	119
					53	60	55	62	72	78	62	71	59	66	310	320	130	175E	Std.	153
					58	64	63	71	78	85	68	79	66	74	310	320	130	175E	Slow	119
					59	65	61	68	77	84	70	82	65	73	350	370	140	200E	Std.	153
					65	72	71	80	85	96	80	91	75	86	360	360	140	200E	Slow	119
					70	78	74	84	91	104	89	102	82	96	450	470	180	250E	Std.	153
					78	87	88	100	106	123	101	118	97	114	450	520	180	250E	Slow	119
					82	93	89	102	111	127	107	125	103	117	530	580	215	300E	Std.	153
					96	111	110	125	135	155	128	146	122	136	590	840◆	215	300E	Slow	119
					103	117	112	127	140	160	141	163	125	138	750	930◆	285	400E	Std.	153
					127	142	146	165	184	212	174	202	156	175	980	—	285	400E	Slow	119
		480 or 600	138.8	1200 at 480v or 960 at 600v	30		33		60	80	36				220	220	95	125E	Slow	119
					29		33		62	85	36				260	270	110	150E	Std.	153
					37	68	41	70	84	92	59	67		68●	260	280	110	150E	Slow	119
					34	40	39	67	85	94	42	71		67●	310	320	130	175E	Std.	153
					67	75	70	79	92	101	66	76	68●	77●	310	320	130	175E	Slow	119
					39	69	65	74	93	102	70	80	—	76●	350	370	140	200E	Std.	153
					76	85	79	89	102	116	77	89	78●	90	360	380	140	200E	Slow	119
					80	93	81	92	111	124	88	100	84	98	450	470	180	250E	Std.	153
					93	104	98	110	128	144	99	115	99	115	450	520	180	250E	Slow	119
					101	110	97	112	131	147	106	121	104	121	530	580	215	300E	Std.	153
					113	126	120	135	156	172	126	147	127	143	590	840◆	215	300E	Slow	119
					120	135	122	139	161	177	139	160	132	148	750	930◆	285	400E	Std.	153
					144	160	155	175	191	209	173	201	164	192	980	—	285	400E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

■ Applicable at 208 v only.

● Applicable at 480 v only.

◆ Applicable to transformers through 5.75% impedance.

TABLE CONTINUED →

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

THE FUSE SELECTION TABLES

TABLE IX—Transformers Rated 4.16 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
			Full-Load Current, Amperes		Bussmann		Federal Pacific		General Electric		Gould		Westing-house		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Primary	Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
1500	Up thru 5.75%	208 or 240	208.2	4160 at 208v or 3610 at 240v	43		46		56	63	53	60	49		230	230	95	200E	Slow	119
					46		48		59	68	58	67	54	62	290	300	120	250E	Std.	153
					51		57	65	69	81	66	77	63	75	290	300	120	250E	Slow	119
					55	62	59	68	74	84	71	83	68	78	350	350	140	300E	Std.	153
					64	73	73	83	90	103	85	97	81	90	350	400	140	300E	Slow	119
					69	78	74	85	93	106	94	108	83	92	480	500	190	400E	Std.	153
					85	95	97	109	122	141	116	134	104	117	540	650	190	400E	Slow	119
					78	88	84	95	107	123	108	127	91	102	620	680	215	2-250E	Std.	153
					88	99	102	116	129	148	124	141	108	122	640	900	215	2-250E	Slow	119
					92	104	104	117	131	151	131	147	112	127	750	1000	255	2-300E	Std.	153
					108	121	126	137	165	190	156	180	135	154	970	—	255	2-300E	Slow	119
		480 or 600	208.2	1800 at 480v or 1440 600v	50		52		67	77	51		51●		230	230	95	200E	Slow	119
					51	60	53	60	73	82	58	66	56●	64	290	300	120	250E	Std.	153
					61	68	64	72	83	94	65	75	65	75	290	300	120	250E	Slow	119
					67	73	64	74	87	98	70	80	69	80	350	350	140	300E	Std.	153
					75	84	79	90	103	114	83	97	84	95	350	400	140	300E	Slow	119
					80	90	81	93	107	118	92	106	88	99	480	500	190	400E	Std.	153
					96	107	103	116	127	139	115	134	109	128	540	650	190	400E	Slow	119
					90	99	92	102	118	129	106	123	98	110	620	680	215	2-250E	Std.	153
					100	111	109	123	131	148	122	141	116	133	640	900	215	2-250E	Slow	119
					104	116	111	126	135	154	130	150	124	141	750	1000	255	2-300E	Std.	153
					120	135	137	156	167	190	157	181	149	175	970	—	255	2-300E	Slow	119
2000	Up thru 5.75%	480 or 600	277.6	2410 at 480v or 1930 at 600v	46		48		62	70	48		48		210	220	90	250E	Slow	119
					48		47		64	72	51		51		260	260	105	300E	Std.	153
					55	62	58	66	76	85	61	71	62	70	260	260	105	300E	Slow	119
					59	67	60	69	80	88	68	79	65	73	350	360	140	400E	Std.	153
					71	79	76	86	95	103	85	99	81	95	370	420	140	400E	Slow	119
					68	75	69	77	89	97	80	93	73	82	440	470	160	2-250E	Std.	153
					75	83	81	92	98	111	92	106	87	100	450	500	160	2-250E	Slow	119
					78	87	83	95	101	116	97	113	93	106	540	570	195	2-300E	Std.	153
					90	101	103	117	125	142	118	136	111	131	580	860	195	2-300E	Slow	119
					95	108	103	118	128	147	126	147	117	135	730	820	255	2-400E	Std.	153
					123	139	136	156	171	197	162	187	152	169	940	—	255	2-400E	Slow	119
2500	Up thru 5.75%	480 or 600	347.0	3010 at 480v or 2410 at 600v	47		48		63	70	54	63	51		280	290	115	400E	Std.	153
					56	63	60	68	75	82	67	78	64	75	290	310	115	400E	Slow	119
					54	59	55	61	71	77	63	73	58	65	350	370	130	2-250E	Std.	153
					59	66	64	73	78	88	72	84	69	79	350	370	130	2-250E	Slow	119
					62	69	66	75	80	92	77	90	74	84	430	450	155	2-300E	Std.	153
					72	80	81	93	99	113	94	108	88	104	440	520	155	2-300E	Slow	119
					76	86	82	93	102	117	100	117	92	108	580	610	205	2-400E	Std.	153
					97	110	108	123	136	157	128	149	121	134	690	—	205	2-400E	Slow	119
3750	Up thru 5.75%	480 or 600	520.4	4510 at 480v or 3610 at 600v	41		43		53	60	51		47		280	280	100	2-300E	Std.	153
					47		53	60	64	73	61	70	57	67	280	290	100	2-300E	Slow	119
					50		54	62	68	77	67	78	61	71	370	380	135	2-400E	Std.	153
					65	73	71	82	90	104	85	99	80	89	410	460	135	2-400E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

● Applicable at 480 v only.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE X—Transformers Rated 12.0 Kv or 12.47 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westing-house		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes: Primary	Full-Load Current, Amperes: Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
300	Up thru 4%	208 or 240	14.4 at 12.0 kv or 13.9 at 12.47 kv	830 at 208v or 720 at 240v	25		28		55	62	33				230	240	110	15E	Std.	153
					29		34		60	69	38				240	240	140	15E	Slow	119
					34		38		69	89	42				320	330	195	20E	Std.	153
					41		46		84	111	50	71			330	330	205	20E	Slow	119
					46		52	88	114	126	80	91			390	420	260	25E	Std.	153
					84	96	87	98	119	130	82	94			400	420	260	25E	Slow	119
					88	104	94	107	131	143	95	109		109■	490	530	310	30E	Std.	153
					100	112	104	118	136	151	103	118	102■	116	490	570	310	30E	Slow	119
					115	133	117	132	156	175	125	142	119	137	680	760	395	40E	Std.	153
					136	153	145	164	187	210	145	166	140	167	760	—	395	40E	Slow	119
		480 or 600	14.4 at 12.0 kv or 13.9 at 12.47 kv	360 at 480v or 290 at 600v	29		29		60	64	33				230	240	110	15E	Std.	153
					33		34		63	73	37				240	240	140	15E	Slow	119
					36		37		69	82	43				320	330	195	20E	Std.	153
					41		45		82	98	51				330	330	205	20E	Slow	119
					45		49		93	109	58	66			390	420	260	25E	Std.	153
					49		55	64	106	117	64	73			400	420	260	25E	Slow	119
					52	60	59	67	114	129	68	78			490	530	310	30E	Std.	153
					59	68	68	78	123	137	77	88			490	570	310	30E	Slow	119
					67	78	76	89	144	165	87	100			680	760	395	40E	Std.	153
					90	105	102	118	173	219	113	129			760	—	395	40E	Slow	119
500	Up thru 4%	208 or 240	24.1 at 12.0 kv or 23.1 at 12.47 kv	1390 at 208v or 1200 at 240v	26		30		67	74	32				230	230	110	25E	Std.	153
					30		51		69	76	48				230	230	135	25E	Slow	119
					51	61	56	64	78	85	56	65		64■	280	280	185	30E	Std.	153
					60	67	61	70	81	90	61	70	60■	69	280	290	185	30E	Slow	119
					68	79	70	79	93	104	75	85	71	82	380	390	235	40E	Std.	153
					81	91	87	98	111	126	86	99	84	100	380	430	235	40E	Slow	119
					88	99	89	102	117	133	96	112	98	111	480	520	290	50E	Std.	153
					96	107	103	116	132	147	108	125	107	121	490	660	290	50E	Slow	119
					111	124	118	130	149	162	130	150	127	144	660	770	370	65E	Std.	153
					116	128	125	140	155	169	137	159	130	147	680	1300	370	65E	Slow	119
		480 or 600	24.1 at 12.0 kv or 23.1 at 12.47 kv	600 at 480v or 480 at 600v	26		28		53	63	33				230	230	110	25E	Std.	153
					28		32		62	69	37				230	230	135	25E	Slow	119
					31		35		67	76	40				280	280	185	30E	Std.	153
					35		40		73	81	46				280	290	185	30E	Slow	119
					40		45		85	98	52				380	390	235	40E	Std.	153
					53	62	60	70	103	128	66	77			380	430	235	40E	Slow	119
					53	62	60	70	115	159	66	76			480	520	290	50E	Std.	153
					70	124	77	128	152	172	88	121			490	660	290	50E	Slow	119
					74	133	83	145	177	194	126	146		146●	660	770	370	65E	Std.	153
					134	150	138	157	183	202	132	153		151●	680	1300	370	65E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

■ Applicable at 208 v only.

● Applicable at 480 v only.

TABLE CONTINUED →

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE X—Transformers Rated 12.0 Kv or 12.47 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes																	
			Primary	Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
750	Up thru 5.75%	208 or 240	36.1 at 12.0 kv or 34.7 at 12.47 kv	2080 at 208v or 1800 at 240v	39		40		53		40		40■		190	190	100	30E	Slow	119
					43		46		61	68	49		47E		250	250	135	40E	Stc.	153
					53	60	56	64	73	82	56	65	55	65	250	260	155	40E	Slow	119
					58	66	59	68	78	88	64	75	65	74	310	320	190	50E	Std.	153
					63	71	68	77	88	98	71	83	71	80	320	340	190	50E	Slow	119
					74	82	78	86	99	108	86	100	84	96	420	450	245	65E	Std.	153
					77	85	83	93	103	112	91	106	87	98	420	470	245	65E	Slow	119
					87	96	91	102	113	126	108	125	102	117	540	620	305	80E	Std.	153
					91	101	100	114	118	136	114	131	107	124	550	760	305	80E	Slow	119
					103	116	108	125	134	155	133	153	124	143	700	800	325	100E	Std.	153
					107	120	123	141	147	170	140	160	133	153	710	—	325	100E	Slow	119
		480 or 600	36.1 at 12.0 kv or 34.7 at 12.47 kv	900 at 480v or 720 at 600v	23		26		48		30				190	190	100	30E	Slow	119
					26		29		55	64	33				250	250	135	40E	Std.	153
					34		39		67	81	43				250	260	155	40E	Slow	119
					35		40		76	106	44				310	320	190	50E	Std.	153
					46	82	51	85	100	114	55	80			320	340	190	50E	Slow	119
					49	88	55	96	118	129	84	97		97●	420	450	245	65E	Std.	153
					89	100	92	104	122	134	88	102		100●	420	470	245	65E	Slow	119
					94	111	102	114	135	152	104	122	103●	119	540	620	305	80E	Std.	153
					107	120	112	128	144	164	110	128	108●	125	550	760	305	80E	Slow	119
					119	136	120	136	159	179	129	150	125	144	700	800	325	100E	Std.	153
					128	143	136	153	176	197	137	158	133	158	710	—	325	100E	Slow	119
1000	Up thru 8%	208 or 240	48.1 at 12.0 kv or 46.3 at 12.47 kv	2780 at 208v or 2410 at 240v	40		42		54	61	42		41		190	190	110	40E	Slow	119
					44		43		57	65	47		47		240	240	110	50E	Std.	153
					47		50		64	72	52	61	52		240	240	145	50E	Slow	119
					55	61	58	64	74	80	64	74	63	71	310	320	185	65E	Std.	153
					57	63	62	69	77	84	67	79	64	72	310	320	185	65E	Slow	119
					65	72	68	77	84	94	81	94	76	88	380	420	225	80E	Std.	153
					68	76	75	86	89	102	86	99	80	93	400	420	225	80E	Slow	119
					77	87	81	93	100	115	99	114	92	106	490	540	245	100E	Std.	153
					80	89	91	105	109	126	104	119	99	114	500	600	245	100E	Slow	119
					97	111	107	121	132	151	132	152	121	133	700	790◆	285	125E	Std.	153
					110	124	124	142	154	177	145	167	135	151	790	—	285	125E	Slow	119
		480 or 600	48.1 at 12.0 kv or 46.3 at 12.47 kv	1200 at 480v or 960 at 600v	25		29		50	60	32				190	190	110	40E	Slow	119
					25		29		55	75	32				240	240	110	50E	Std.	153
					33		37	62	70	84	40				240	240	145	50E	Slow	119
					36	64	40	71	88	96	63	72		72●	310	320	185	65E	Std.	153
					66	74	68	77	90	99	65	76		75●	310	320	185	65E	Slow	119
					70	83	76	86	101	114	78	91	77●	89	380	420	225	80E	Std.	153
					80	90	84	96	108	123	82	96	81●	94	400	420	225	80E	Slow	119
					88	101	89	101	118	133	96	112	93	107	490	540	245	100E	Std.	153
					95	106	101	114	131	147	102	117	99	118	500	600	245	100E	Slow	119
					114	129	117	134	153	171	128	151	126	142	700	790◆	285	125E	Std.	153
					126	140	134	151	172	187	146	167	142	159	790	—	285	125E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

■ Applicable at 208 v only.

● Applicable at 480 v only.

◆ Applicable to transformers through 5.75% impedance.

TABLE CONTINUED ⟶

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE X—Transformers Rated 12.0 Kv or 12.47 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westing-house		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes																	
			Primary	Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
1500	Up thru 5.75%	208 or 240	72.2 at 12.0 kv or 69.4 at 12.47 kv	4160 at 208v or 3610 at 240v	38		41		51		44		43		210	210	125	65E	Slow	119
					43		45		55	61	53	61	50		250	260	135	80E	Std.	153
					44		49		58	67	56	64	52	60	260	270	150	80E	Slow	119
					51		53	61	66	76	66	75	61	70	320	330	160	100E	Std.	153
					53		61	69	72	84	69	79	66	76	330	340	160	100E	Slow	119
					65	74	71	81	88	100	88	101	80	88	450	470	190	125E	Std.	153
					73	82	83	94	102	118	96	111	90	100	470	530	190	125E	Slow	119
					77	87	84	96	106	122	107	126	91	102	560	610	215	150E	Std.	153
					86	96	100	113	125	144	118	137	105	119	580	700	215	150E	Slow	119
					86	97	96	108	121	139	125	140	103	116	650	800	245	175E	Std.	153
					95	106	112	125	141	162	135	154	117	132	680	860	245	175E	Slow	119
					95	107	106	119	136	157	137	156	113	129	750	1190▲	275	200E	Std.	153
					107	120	124	136	163	187	155	178	133	152	870	—	275	200E	Slow	119
		480 or 600	72.2 at 12.0 kv or 69.4 at 12.47 kv	1800 at 480v or 1440 at 600v	44		45		60	66	43				210	210	125	65E	Slow	119
					45		50		66	74	51	60	50●		250	260	135	80E	Std.	153
					52		55	62	70	80	54	63	53●	61	260	270	150	80E	Slow	119
					58	67	59	67	78	88	64	74	62	71	320	330	160	100E	Std.	153
					63	71	67	76	87	97	68	78	66	78	330	340	160	100E	Slow	119
					76	85	78	89	102	114	85	100	84	95	450	470	190	125E	Std.	153
					83	93	89	100	114	124	97	111	95	106	470	530	190	125E	Slow	119
					90	99	92	102	118	128	106	122	98	110	560	610	215	150E	Std.	153
					97	108	106	120	129	142	118	136	111	130	580	700	215	150E	Slow	119
					98	109	103	115	128	141	121	140	111	129	650	800	245	175E	Std.	153
					107	119	120	136	139	163	134	154	128	145	680	860	245	175E	Slow	119
					107	119	112	128	138	160	137	158	126	143	750	1190▲	275	200E	Std.	153
					119	133	135	154	164	187	155	179	146	173	870	—	275	200E	Slow	119
2000	Up thru 5.75%	480 or 600	96.2 at 12.0 kv or 92.6 at 12.47 kv	2410 at 480v or 1930 at 600v	39		41		53	60	40		40●		190	190	105	80E	Slow	119
					42		44		58	65	47		46		230	240	115	100E	Std.	153
					46		49		64	72	50		48		240	240	120	100E	Slow	119
					56	63	57	66	75	85	63	74	62	70	320	340	140	125E	Std.	153
					62	69	66	74	85	92	72	82	70	79	330	350	140	125E	Slow	119
					67	74	69	77	88	96	79	92	74	83	400	430	160	150E	Std.	153
					73	81	80	90	96	107	88	102	83	97	410	450	160	150E	Slow	119
					74	82	77	86	96	106	91	105	83	97	460	500	185	175E	Std.	153
					80	89	90	102	104	123	100	116	96	109	470	530	185	175E	Slow	119
					80	89	83	95	103	119	102	118	94	106	540	580	205	200E	Std.	153
					89	99	100	114	122	139	115	132	109	128	550	700	205	200E	Slow	119
					97	110	106	121	131	150	129	150	121	138	690	780	260	250E	Std.	153
					110	126	125	143	155	177	147	167	140	156	740	—	260	250E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

● Applicable at 480 v only.

▲ Applicable to transformers through 4% impedance.

TABLE CONTINUED ——→

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

THE FUSE SELECTION TABLES

TABLE X—Transformers Rated 12.0 Kv or 12.47 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ–Δ ⅄–⅄	Δ–⅄ ①			Speed	TCC No.
			Primary	Secondary																
2500	Up thru 5.75%	480 or 600	120.3 at 12.0 kv or 115.7 at 12.47 kv	3010 at 480v or 2410 at 600v	37		40		51		40		39		190	190	95	100E	Slow	119
					44		45		59	67	50		49		260	270	110	125E	Std.	153
					49		52		67	73	56	65	55	62	260	270	110	125E	Slow	119
					53		55	61	70	76	63	72	58	65	310	330	130	150E	Std.	153
					58	64	63	71	77	84	70	81	66	77	320	340	130	150E	Slow	119
					59	65	61	68	76	84	72	83	66	77	360	380	150	175E	Std.	153
					64	71	71	81	83	97	80	92	76	86	370	390	150	175E	Slow	119
					64	71	67	76	82	96	82	95	75	85	420	430	165	200E	Std.	153
					71	80	80	92	98	111	93	106	87	103	440	470	165	200E	Slow	119
					77	88	84	96	104	119	102	119	96	110	540	590	205	250E	Std.	153
					87	100	99	113	123	141	116	132	111	124	580	640	205	250E	Slow	119
					94	106	103	117	127	146	125	145	115	127	640	740	245	300E	Std.	153
					110	123	126	143	156	180	148	169	134	151	760	—	245	300E	Slow	119
3750	Up thru 5.75%	480 or 600	180.4 at 12.0 kv or 173.6 at 12.47 kv	4510 at 480v or 3610 at 600v	39		40		51		48		44		240	240	100	175E	Std.	153
					42		47		55	64	53	61	50		250	250	100	175E	Slow	119
					42		44		54	62	54	62	49		270	280	110	200E	Std.	153
					47		52		64	72	60	69	56	67	280	290	110	200E	Slow	119
					51		56	64	69	79	68	79	63	73	340	360	135	250E	Std.	153
					58	66	66	75	81	93	77	88	74	82	350	370	135	250E	Slow	119
					62	71	68	78	84	97	83	96	76	84	400	420	165	300E	Std.	153
					73	82	84	95	104	119	99	112	89	100	440	520	165	300E	Slow	119
					76	86	84	95	106	122	108	124	90	101	560	610	220	400E	Std.	153
					93	105	108	119	140	161	133	153	115	131	690	850	220	400E	Slow	119
					87	98	95	107	124	143	125	142	102	115	750	960	245	2-250E	Std.	153
					98	110	114	125	150	172	142	163	122	140	850	—	245	2-250E	Slow	119
					103	116	115	126	152	175	148	171	128	147	910	—	295	2-300E	Std.	153

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XI—Transformers Rated 13.2 Kv or 13.8 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes																	
			Primary	Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
300	Up thru 4%	208 or 240	13.1 at 13.2 kv or 12.6 at 13.8 kv	830 at 208v or 720 at 240v	23		26		50		30				220	220	90	13E	Std.	153
					28		32		59	68	36				260	260	140	15E	Std.	153
					33		38		67	81	42				260	270	170	15E	Slow	119
					38		43		81	111	47				350	350	225	20E	Std.	153
					46	86	51	88	107	120	55	86			350	370	225	20E	Slow	119
					52	94	84	99	123	135	87	100		100■	440	460	285	25E	Std.	153
					92	103	95	107	127	139	90	104		103■	440	480	285	25E	Slow	119
					99	116	104	117	139	155	105	123	105■	119	540	600	340	30E	Std.	153
					109	122	113	129	146	165	113	132	112	128	560	670	340	30E	Slow	119
		480 or 600	13.1 at 13.2 kv or 12.6 at 13.8 kv	360 at 480v or 290 at 600v	28		26		57	61	30				220	220	90	13E	Std.	153
					32		32		62	68	36				260	260	140	15E	Std.	153
					36		37		69	80	42				260	270	170	15E	Slow	119
					39		41		79	88	48				350	350	225	20E	Std.	153
					45		49		91	107	57	65			350	370	225	20E	Slow	119
					49		54	62	105	120	63	72			440	460	285	25E	Std.	153
					53	62	61	70	114	127	70	80			440	480	285	25E	Slow	119
					57	66	65	75	125	140	75	86			540	600	340	30E	Std.	153
					66	76	75	87	133	155	85	97			560	670	340	30E	Slow	119
500	Up thru 4%	208 or 240	21.9 at 13.2 kv or 20.9 at 13.8 kv	1390 at 208v or 1200 at 240v	27		30		63	71	32				210	210	105	20E	Slow	119
					30		45		73	80	51				260	260	140	25E	Std.	153
					54	61	55	63	75	82	53	61		61■	260	260	160	25E	Slow	119
					58	69	62	70	83	92	63	73	62■	71	310	320	205	30E	Std.	153
					65	72	67	76	87	98	67	79	66	76	310	330	205	30E	Slow	119
					76	88	76	86	101	113	82	94	79	93	420	440	260	40E	Std.	153
					88	99	94	106	121	136	95	111	96	109	440	510	260	40E	Slow	119
					95	108	98	113	128	145	107	124	107	121	540	600	320	50E	Std.	153
					104	116	112	126	144	156	120	138	117	131	580	950	320	50E	Slow	119
					120	133	126	139	158	173	143	166	138	159	750	960	410	65E	Std.	153
					124	138	135	153	165	180	152	175	141	162	820	—	410	65E	Slow	119
		480 or 600	21.9 at 13.2 kv or 20.9 at 13.8 kv	600 at 480v or 480 at 600v	26		29		53	63	33				210	210	105	20E	Slow	119
					28		31		61	70	37				260	260	140	25E	Std.	153
					31		35		67	74	41				260	260	160	25E	Slow	119
					34		38		74	83	45				310	320	205	30E	Std.	153
					39		44		79	92	50				310	330	205	30E	Slow	119
					44		51		95	109	57	65			420	440	260	40E	Std.	153
					60	70	67	78	119	160	74	94			440	510	260	40E	Slow	119
					59	70	67	78	145	171	73	121			540	600	320	50E	Std.	153
					78	135	123	139	168	184	117	133			580	950	320	50E	Slow	119
					127	150	138	157	189	209	140	160	140●	159●	750	960	410	65E	Std.	153
					145	163	151	172	195	221	147	168	145●	166	820	—	410	65E	Slow	119
750	Up thru 5.75%	208 or 240	32.8 at 13.2 kv or 31.4 at 13.8 kv	2080 at 208v or 1800 at 240v	38		41		55	61	41		41■		210	210	95	30E	Std.	153
					43		44		57	65	44		44■		210	210	125	30E	Slow	119
					49		50		66	74	54	62	52	61	280	280	165	40E	Std.	153
					58	65	62	70	80	89	62	72	63	72	280	290	170	40E	Slow	119
					63	71	65	75	85	96	71	83	71	81	350	360	210	50E	Std.	153
					69	77	74	83	95	104	79	91	78	87	360	390	210	50E	Slow	119
					80	88	84	93	105	115	95	111	92	105	460	500	270	65E	Std.	153
					83	92	90	102	110	120	101	116	94	108	480	550	270	65E	Slow	119
					93	105	98	112	120	138	120	137	112	129	610	690	335	80E	Std.	153
					98	109	110	126	131	151	126	145	118	139	620	1040▲	335	80E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

■ Applicable at 208 v only.

● Applicable at 480 v only.

▲ Applicable to transformers through 4% impedance.

TABLE CONTINUED ⟶

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XI—Transformers Rated 13.2 Kv or 13.8 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
			Primary	Secondary																
750	Up thru 5.75%	480 or 600	32.8 at 13.2 kv or 31.4 at 13.8 kv	900 at 480v or 720 at 600v	22		25		49		29				210	210	95	30E	Std.	153
					25		29		52	61	33				210	210	125	30E	Slow	119
					28		33		63	70	37				280	280	165	40E	Std.	153
					38		43		77	105	48				280	290	170	40E	Slow	119
					39		44		95	114	49	75			350	360	210	50E	Std.	153
					51	90	82	93	111	122	77	88			360	390	210	50E	Slow	119
					84	99	92	104	126	139	93	107	93●	106●	460	500	270	65E	Std.	153
					97	108	100	114	130	147	98	112	96●	110	480	550	270	65E	Slow	119
					106	123	110	124	146	164	116	132	113	130	610	690	335	80E	Std.	153
					116	130	123	139	158	179	122	143	120	137	620	1040▲	335	80E	Slow	119
1000	Up thru 8%	208 or 240	43.7 at 13.2 kv or 41.8 at 13.8 kv	2780 at 208v or 2410 at 240v	43		46		59	67	47		47		130	210	130	40E	Slow	119
					47		48		63	71	52	61	52	60	260	260	140	50E	Std.	153
					51		55	62	70	77	59	67	58	64	260	260	160	50E	Slow	119
					59	66	63	69	78	86	71	82	69	78	340	350	205	65E	Std.	153
					61	68	67	75	82	89	75	86	70	80	340	360	205	65E	Slow	119
					70	79	73	84	90	104	90	103	84	97	420	480	250	80E	Std.	153
					73	82	82	94	98	113	95	109	88	104	450	490	250	80E	Slow	119
					84	95	89	103	109	126	109	125	102	116	550	610	270	100E	Std.	153
					86	99	101	114	122	139	115	131	111	123	560	760◆	270	100E	Slow	119
					107	120	117	133	145	166	145	167	129	142	800	920◆	310	125E	Std.	153
					120	134	137	155	170	195	160	187	146	164	920	—	310	125E	Slow	119
		480 or 600	43.7 at 13.2 kv or 41.8 at 13.8 kv	1200 at 480v or 960 at 600v	29		32		57	78	36				210	210	130	40E	Slow	119
					29		32		67	85	36				260	260	140	50E	Std.	153
					37	66	41	68	82	90	57	65			260	260	160	50E	Slow	119
					40	73	68	78	94	103	69	79	69●	79●	340	350	205	65E	Std.	153
					72	80	75	85	97	109	73	83	72●	82●	340	360	205	65E	Slow	119
					79	92	83	93	110	123	87	99	85	98	420	480	250	80E	Std.	153
					87	98	92	104	118	135	92	107	90	103	450	490	250	80E	Slow	119
					98	110	97	111	128	145	107	121	102	121	550	610	270	100E	Std.	153
					103	115	110	124	142	160	113	131	111	129	560	760◆	270	100E	Slow	119
					124	138	128	144	166	181	143	163	138	154	800	920◆	310	125E	Std.	153
					136	151	146	165	182	198	161	185	154	176	920	–	310	125E	Slow	119
1500	Up thru 5.75%	208 or 240	65.6 at 13.2 kv or 62.8 at 13.8 kv	4160 at 208v or 3610 at 240v	39		41		52		47		45		230	230	105	65E	Std.	153
					41		44		54		50		46		230	230	135	65E	Slow	119
					46		48		59	68	59	68	55	63	270	280	165	80E	Std.	153
					48		54	62	64	74	62	71	58	68	280	290	165	80E	Slow	119
					55	63	59	68	73	84	72	83	68	77	350	360	180	100E	Std.	153
					57	66	67	76	81	92	76	87	74	82	360	380	180	100E	Slow	119
					71	80	78	88	96	110	97	111	86	95	490	520	205	125E	Std.	153
					80	89	91	103	113	130	107	124	97	109	520	620	205	125E	Slow	119
					84	94	92	104	117	135	120	136	98	111	620	670	240	150E	Std.	153
					93	104	109	123	138	158	132	150	115	130	650	800	240	150E	Slow	119
					94	105	105	118	134	154	135	153	112	128	720	1060▲	270	175E	Std.	153
					103	115	122	133	155	179	147	170	127	145	780	—	270	175E	Slow	119
		480 or 600	65.6 at 13.2 kv or 62.8 at 13.8 kv	1800 at 480v or 1440 at 600v	27		45		62	68	46		46●		230	230	105	65E	Std.	153
					47		49		64	72	48		47●		230	230	135	65E	Slow	119
					51	60	54	61	72	81	57	65	55	64	270	280	165	80E	Std.	153
					57	64	60	68	77	88	60	70	59	68	280	290	165	80E	Slow	119
					65	73	65	74	85	96	71	81	68	81	350	360	180	100E	Std.	153
					68	77	73	83	94	106	75	86	74	86	360	380	180	100E	Slow	119
					82	92	85	96	111	121	95	109	91	102	490	520	205	125E	Std.	153
					90	100	97	109	121	132	107	123	102	117	520	620	205	125E	Slow	119
					96	106	99	110	125	137	116	135	107	124	620	670	240	150E	Std.	153
					105	117	116	132	137	159	131	151	125	142	650	800	240	150E	Slow	119
					105	118	111	127	136	157	134	155	125	141	720	1060▲	270	175E	Std.	153
					115	128	131	149	156	177	148	170	138	163	780	—	270	175E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

● Applicable at 480 v only.

▲ Applicable to transformers through 4% impedance.

◆ Applicable to transformers through 5.75% impedance.

TABLE CONTINUED ⟶

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XI—Transformers Rated 13.2 Kv or 13.8 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
			Primary	Secondary																
2000	Up thru 5.75%	480 or 600	87.5 at 13.2 kv or 83.7 at 13.8 kv	2410 at 480v or 1930 at 600v	43		45		58	66	45		44		210	210	125	80E	Slow	119
					47		48		63	71	52	60	50	60	260	260	135	100E	Std.	153
					51		54	61	70	78	55	64	54	63	260	270	135	100E	Slow	119
					61	69	63	71	82	90	71	81	68	76	360	370	155	125E	Std.	153
					67	75	72	81	90	98	79	91	76	86	370	400	155	125E	Slow	119
					72	79	74	83	94	103	87	101	80	93	450	470	180	150E	Std.	153
					79	88	87	99	103	120	98	113	94	106	450	530	180	150E	Slow	119
					78	87	82	94	102	117	100	116	92	105	510	550	205	175E	Std.	153
					86	95	97	110	116	131	110	126	103	121	520	640	205	175E	Slow	119
					86	97	92	105	114	130	114	129	102	119	590	650	225	200E	Std.	153
					96	109	110	125	132	154	127	146	122	139	620	900	225	200E	Slow	119
					106	122	116	133	144	164	144	165	134	147	770	920	285	250E	Std.	153
					122	138	138	157	170	195	160	186	151	168	910	—	285	250E	Slow	119
2500	Up thru 5.75%	480 or 600	109.3 at 13.2 kv or 104.6 at 13.8 kv	3010 at 480v or 2410 at 600v	40		43		56	63	44		43		210	210	105	100E	Slow	119
					48		50		65	71	56	64	54	60	290	290	125	125E	Std.	153
					53		57	64	72	78	63	72	60	68	290	300	125	125E	Slow	119
					57	63	59	66	75	82	69	80	63	73	350	370	140	150E	Std.	153
					62	70	69	78	82	95	78	90	74	84	350	390	140	150E	Slow	119
					63	70	66	75	81	94	80	93	74	84	410	430	165	175E	Std.	153
					69	77	78	89	93	105	88	101	83	97	410	440	165	175E	Slow	119
					69	77	73	84	91	104	91	104	82	96	470	500	180	200E	Std.	153
					77	88	88	101	106	123	102	117	98	112	480	560	180	200E	Slow	119
					84	97	92	106	115	131	114	131	107	117	600	660	225	250E	Std.	153
					97	110	109	125	135	155	127	148	120	134	630	880	225	250E	Slow	119
					103	115	113	128	140	160	138	159	123	137	720	960	270	300E	Std.	153
					119	133	138	156	172	198	162	189	146	164	930	—	270	300E	Slow	119
3750	Up thru 5.75%	480 or 600	164.0 at 13.2 kv or 156.9 at 13.8 kv	4510 at 480v or 3610 at 600v	38		39		49		45		42		230	230	95	150E	Std.	153
					41		45		54	62	51		49		230	240	95	150E	Slow	119
					41		43		53	61	52	61	48		270	270	110	175E	Std.	153
					45		50		60	69	57	66	54	63	270	280	110	175E	Slow	119
					45		48		60	69	60	68	54	62	310	320	120	200E	Std.	153
					51		57	65	69	81	67	77	64	73	310	320	120	200E	Slow	119
					56	64	61	70	76	87	76	87	71	78	380	400	150	250E	Std.	153
					64	73	72	83	90	103	85	98	80	89	390	420	150	250E	Slow	119
					68	77	75	85	93	107	92	105	82	91	460	480	180	300E	Std.	153
					79	88	92	104	115	132	108	126	97	109	500	620	180	300E	Slow	119
					83	93	91	103	117	135	120	135	98	111	640	700	240	400E	Std.	153
					101	114	116	127	155	178	147	169	126	145	780	—	240	400E	Slow	119
					94	106	103	114	137	157	136	156	111	127	850	—	270	2-250E	Std.	153
					106	120	121	133	165	190	156	180	134	154	1020	—	270	2-250E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XII—Transformers Rated 22.9 Kv or 24.9 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes Primary	Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
300	Up thru 4%	208 or 240	7.6 at 22.9 kv or 7.0 at 24.9 kv	830 at 208v or 720 at 240v	33		38		68	85	42				310	320	185	10E	Std.	153
					43		49	84	108	121	53	86			400	410	255	13E	Std.	153
					54	98	88	103	126	138	90	104		104■	480	510	295	15E	Std.	153
					100	112	104	118	136	152	104	120	103■	118	500	590	295	15E	Slow	119
					113	131	113	127	150	168	112	131	114	131	640	710	395	20E	Std.	153
					122	137	129	147	166	189	132	152	128	151	690	1300	395	20E	Slow	119
		480 or 600	7.6 at 22.9 kv or 7.0 at 24.9 kv	360 at 480v or 290 at 600v	36		37		69	81	42				310	320	185	10E	Std.	153
					43		46		85	101	54	62			400	410	255	13E	Std.	153
					51		57	65	110	125	66	75			480	510	295	15E	Std.	153
					59	67	67	77	123	137	76	87			500	590	295	15E	Slow	119
					64	73	72	85	135	158	83	95			640	710	395	20E	Std.	153
					77	91	88	102	156	175	98	113			690	1300	395	20E	Slow	119
500	Up thru 4%	208 or 240	12.6 at 22.9 kv or 11.6 at 24.9 kv	1390 at 208v or 1200 at 240v	25		28		58	71	30				240	240	105	13E	Std.	153
					31		52	61	75	82	53	61		61■	280	290	150	15E	Std.	153
					59	66	61	69	80	89	61	71	61■	69	290	300	175	15E	Slow	119
					67	78	67	76	89	100	67	78	68	78	370	390	235	20E	Std.	153
					73	82	77	87	99	112	79	91	76	90	380	400	235	20E	Slow	119
					89	93	85	97	112	126	92	106	91	106	480	520	295	25E	Std.	153
					87	98	93	105	120	135	96	111	97	110	490	540	295	25E	Slow	119
					97	109	102	117	132	148	112	129	111	126	590	660	355	30E	Std.	153
					103	115	111	124	142	155	121	140	118	132	620	850	355	30E	Slow	119
		480 or 600	12.6 at 22.9 kv or 11.6 at 24.9 kv	600 at 480v or 480 at 600v	25		26		50		31				240	240	105	13E	Std.	153
					30		33		64	73	38				280	290	150	15E	Std.	153
					34		39		72	81	44				290	300	175	15E	Slow	119
					38		43		80	94	49				370	390	235	20E	Std.	153
					46		52	60	93	104	58	66			380	400	235	20E	Slow	119
					51	60	58	68	106	140	64	74			480	520	295	25E	Std.	153
					58	68	65	76	117	158	72	82			490	540	295	25E	Slow	119
					63	74	71	83	159	176	77	126			590	660	355	30E	Std.	153
					73	134	81	138	166	182	118	135		135●	620	850	355	30E	Slow	119
750	Up thru 5.75%	208 or 240	18.9 at 22.9 kv or 17.4 at 24.9 kv	2080 at 208v or 1800 at 240v	42		44		59	66	44		44		250	250	110	20E	Std.	153
					47		50		64	73	51		50		250	250	145	20E	Slow	119
					58	61	56	64	74	83	60	69	59	69	310	320	185	25E	Std.	153
					57	64	61	69	79	89	63	73	63	72	310	320	195	25E	Slow	119
					64	72	68	78	88	98	75	86	74	83	370	390	235	30E	Std.	153
					68	76	73	82	94	103	81	93	79	88	380	410	235	30E	Slow	119
					79	88	83	92	104	114	96	111	91	104	510	540	300	40E	Std.	153
					90	101	100	114	118	136	112	129	105	121	540	740	300	40E	Slow	119
					99	112	105	120	130	149	127	145	120	138	670	780	370	50E	Std.	153
					106	119	122	140	146	169	140	160	133	153	760	—	370	50E	Slow	119
		480 or 600	18.9 at 22.9 kv or 17.4 at 24.9 kv	900 at 480v or 720 at 600v	25		27		52	61	32				250	250	110	20E	Std.	153
					29		33		60	68	37				250	250	145	20E	Slow	119
					33		38		69	87	42				310	320	185	25E	Std.	153
					38		42		76	104	47				310	320	195	25E	Slow	119
					42		47		105	117	51	84			370	390	235	30E	Std.	153
					49	89	53	91	110	121	77	90		90●	380	410	235	30E	Slow	119
					55	97	90	103	124	137	94	107	92●	104●	510	540	300	40E	Std.	153
					106	120	112	127	144	163	107	125	106●	123	540	740	300	40E	Slow	119
					117	135	117	132	154	174	124	143	122	138	670	780	370	50E	Std.	153
					127	142	136	153	175	196	137	158	133	158	760	—	370	50E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.
■ Applicable at 208 v only.
● Applicable at 480 v only.

TABLE CONTINUED →

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XII—Transformers Rated 22.9 Kv or 24.9 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westing-house		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes																	
			Primary	Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
1000	Up thru 8%	208 or 240	25.2 at 22.9 kv or 23.2 at 24.9 kv	2780 at 208v or 2410 at 240v	43		42		55	62	45		44		230	240	95	25E	Std.	153
					43		46		59	66	47		47		240	240	120	25E	Slow	119
					48		50		65	73	55	64	54	62	280	280	170	30E	Std.	153
					50		54	61	70	76	60	69	58	65	290	290	175	30E	Slow	119
					60	66	62	69	78	85	72	83	68	78	370	390	225	40E	Std.	153
					68	75	75	85	89	102	84	96	78	91	390	430	225	40E	Slow	119
					74	84	79	90	97	112	95	109	90	103	480	520	275	50E	Std.	153
					80	89	92	105	109	127	105	120	100	115	500	670	275	50E	Slow	119
					94	108	105	118	129	147	125	144	118	130	660	780◆	355	65E	Std.	153
					98	113	113	127	137	157	131	150	122	136	700	1300▲	355	65E	Slow	119
		480 or 600	25.2 at 22.9 kv or 23.2 at 24.9 kv	1200 at 480v or 960 at 600v	25		28		51	65	31				230	240	95	25E	Std.	153
					28		32		57	77	35				240	240	120	25E	Slow	119
					31		35		75	87	38	62			280	280	170	30E	Std.	153
					35	66	39	68	82	90	49	66			290	290	175	30E	Slow	119
					41	73	68	77	93	103	70	80	69●	78●	370	390	225	40E	Std.	153
					80	90	84	95	108	123	81	94	80●	92	390	430	225	40E	Slow	119
					88	102	87	99	116	130	93	107	91	103	480	520	275	50E	Std.	153
					95	107	102	114	131	147	103	118	100	119	500	670	275	50E	Slow	119
					109	123	114	131	147	167	121	143	123	140	660	780◆	355	65E	Std.	153
					114	128	123	138	157	174	129	150	128	144	700	1300▲	355	65E	Slow	119
1500	Up thru 5.75%	208 or 240	37.8 at 22.9 kv or 34.8 at 24.9 kv	4160 at 208v or 3610 at 240v	39		41		51		47		44		250	250	120	40E	Std.	153
					44		48		58	66	55	63	51		250	260	150	40E	Slow	119
					49		52		64	73	63	72	59	68	310	320	185	50E	Std.	153
					52		60	69	71	83	69	79	66	76	310	330	185	50E	Slow	119
					62	71	69	79	85	97	83	96	78	86	420	440	235	65E	Std.	153
					65	75	75	85	91	104	87	100	81	90	420	460	235	65E	Slow	119
					76	85	83	93	104	119	103	120	90	101	530	600	290	80E	Std.	153
					80	89	91	103	113	130	108	125	96	108	550	710	290	80E	Slow	119
					91	102	98	113	126	145	128	145	106	121	690	800	310	100E	Std.	153
					95	106	110	123	140	161	132	150	114	131	700	—	310	100E	Slow	119
		480 or 600	37.8 at 22.9 kv or 34.8 at 24.9 kv	1800 at 480v or 1440 at 600v	26		44		61	67	46		45●		250	250	120	40E	Std.	153
					52		54	62	70	80	53	61	52●	60	250	260	150	40E	Slow	119
					57	66	58	65	76	86	61	70	60	68	310	320	185	50E	Std.	153
					63	70	67	75	86	97	68	78	65	78	310	330	185	50E	Slow	119
					72	82	75	87	98	111	81	95	82	93	420	440	235	65E	Std.	153
					76	85	81	92	105	116	86	100	85	96	420	460	235	65E	Slow	119
					87	96	91	101	115	126	103	117	98	112	530	600	290	80E	Std.	153
					90	100	98	110	121	132	108	125	102	117	550	710	290	80E	Slow	119
					102	114	105	118	130	146	126	146	118	136	690	800	310	100E	Std.	153
					106	119	118	135	139	163	133	153	126	142	700	—	310	100E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

● Applicable at 480 v only.

◆ Applicable to transformers through 5.75% impedance.

▲ Applicable to transformers through 4% impedance.

TABLE CONTINUED ⟶

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XII—Transformers Rated 22.9 Kv or 24.9 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
			Primary	Secondary																
2000	Up thru 5.75%	480 or 600	50.4 at 22.9 kv or 46.4 at 24.9 kv	2410 at 480v or 1930 at 600v	42		43		57	64	46		45		230	240	95	50E	Std.	153
					47		50		64	72	51		49		230	240	135	50E	Slow	119
					54	61	56	64	73	82	60	70	61	69	300	320	175	65E	Std.	153
					56	63	60	68	78	86	64	74	63	71	310	320	175	65E	Slow	119
					65	72	68	75	86	94	77	88	74	84	380	410	215	80E	Std.	153
					68	75	73	82	91	99	81	94	77	88	400	420	215	80E	Slow	119
					77	85	79	89	98	110	94	109	89	102	470	540	230	100E	Std.	153
					80	89	88	101	104	122	100	115	94	107	500	600	230	100E	Slow	119
					94	107	102	117	128	145	125	145	116	135	710	800	270	125E	Std.	153
					104	121	120	137	148	169	140	159	135	150	760	—	270	125E	Slow	119
					114	130	124	141	154	176	155	180	140	154	900	—	310	150E	Std.	153
					128	145	147	168	181	208	170	196	158	177	1120	—	310	150E	Slow	119
2500	Up thru 5.75%	480 or 600	63.0 at 22.9 kv or 58.0 at 24.9 kv	3010 at 480v or 2410 at 600v	42		44		57	65	47		48		250	250	120	65E	Std.	153
					44		47		61	68	50		50		250	250	140	65E	Slow	119
					51		54	60	69	75	61	70	59	66	300	310	175	80E	Std.	153
					54	60	58	65	72	79	64	74	61	69	310	330	175	80E	Slow	119
					61	68	63	71	78	87	75	87	70	81	370	400	185	100E	Std.	153
					63	71	70	80	83	97	80	91	75	85	400	420	185	100E	Slow	119
					76	85	82	94	102	116	100	117	93	108	550	600	215	125E	Std.	153
					83	97	96	110	118	135	112	128	108	120	560	730	215	125E	Slow	119
					91	103	98	112	123	140	124	143	111	122	700	760	250	150E	Std.	153
					102	115	117	133	144	165	135	156	126	141	720	—	250	150E	Slow	119
					103	115	113	128	139	160	142	162	123	137	800	950	285	175E	Std.	153
					113	126	132	149	162	186	153	176	138	155	880	—	285	175E	Slow	119
3750	Up thru 5.75%	480 or 600	94.5 at 22.9 kv or 87.0 at 24.9 kv	4510 at 480v or 3610 at 600v	35		38		48		42		40		210	210	110	80E	Slow	119
					40		41		51	61	49		46		250	250	120	100E	Std.	153
					41		46		54	63	52	60	49		260	260	125	100E	Slow	119
					50		54	61	67	77	66	76	61	71	360	370	145	125E	Std.	153
					55	64	63	72	77	89	74	84	71	79	360	380	145	125E	Slow	119
					60	69	65	74	82	93	82	95	74	81	430	460	165	150E	Std.	153
					68	76	77	88	95	110	90	104	83	93	440	500	165	150E	Slow	119
					68	76	75	85	93	106	95	108	82	91	500	540	190	175E	Std.	153
					75	84	88	99	108	124	102	117	92	103	510	620	190	175E	Slow	119
					75	84	82	93	103	119	105	121	88	99	580	630	210	200E	Std.	153
					84	94	98	111	123	142	117	135	103	116	610	860	210	200E	Slow	119
					91	102	102	113	132	151	131	149	109	125	750	870	260	250E	Std.	153
					102	115	118	129	157	181	149	171	128	147	840	—	260	250E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XIII—Transformers Rated 33.0 Kv or 34.5 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes																	
			Primary	Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ–Δ Y–Y	Δ–Y ①			Speed	TCC No.
300	Up thru 4%	208 or 240	5.2 at 33.0 kv or 5.0 at 34.5 kv	830 at 208v or 720 at 240v	32		37		67	80	41				310	310	195	7E	Std.	153
					51	94	84	99	123	135	86	99		100■	440	480	285	10E	Std.	153
					103	121	105	118	141	157	107	126	106■	120	580	640	370	13E	Std.	153
					127	148	125	141	165	186	132	152	129	151	720	870	425	15E	Std.	153
					136	152	145	163	187	210	153	177	152	176	780	—	425	15E	Slow	119
		480 or 600	5.2 at 33.0 kv or 5.0 at 34.5 kv	360 at 480v or 290 at 600v	35		36		67	79	42				310	310	195	7E	Std.	153
					48		54	62	104	119	63	72			440	480	285	10E	Std.	153
					59	68	66	77	125	142	77	88			580	640	370	13E	Std.	153
					72	85	83	97	157	177	94	107			720	870	425	15E	Std.	153
					87	102	99	114	172	217	109	125			780	—	425	15E	Slow	119
500	Up thru 4%	208 or 240	8.7 at 33.0 kv or 8.4 at 34.5 kv	1390 at 208v or 1200 at 240v	30		33		73	80	51				260	260	140	10E	Std.	153
					61	71	63	70	84	94	64	75	63■	72	340	340	220	13E	Std.	153
					76	88	74	84	99	111	79	90	77	90	390	420	255	15E	Std.	153
					81	91	87	97	111	125	91	106	91	105	400	450	255	15E	Slow	119
					91	102	93	107	122	138	97	114	102	116	530	570	340	20E	Std.	153
					99	110	106	119	136	150	115	132	113	127	540	700	340	20E	Slow	119
					113	126	120	132	151	165	134	156	130	147	700	850	425	25E	Std.	153
					118	130	127	143	157	172	140	163	133	151	710	—	425	25E	Slow	119
		480 or 600	8.7 at 33.0 kv or 8.4 at 34.5 kv	600 at 480v or 480 at 600v	28		31		60	70	37				260	260	140	10E	Std.	153
					35		39		75	84	46				340	340	220	13E	Std.	153
					43		50		93	105	56	64			390	420	255	15E	Std.	153
					52	61	59	68	103	128	65	74			400	450	255	15E	Slow	119
					57	67	65	75	122	165	71	81			530	570	340	20E	Std.	153
					70	128	77	132	159	176	86	128			540	700	340	20E	Slow	119
					78	141	127	148	180	197	131	151		149●	700	850	425	25E	Std.	153
					137	153	141	160	186	206	136	156	135●	154●	710	—	425	25E	Slow	119
750	Up thru 5.75%	208 or 240	13.1 at 33.0 kv or 12.6 at 34.5 kv	2080 at 208v or 1800 at 240v	40		41		56	62	42		42■		230	230	90	13E	Std.	153
					48		49		65	73	52	60	50		260	260	140	15E	Std.	153
					53	60	56	64	73	82	60	69	59	69	270	280	170	15E	Slow	119
					60	68	62	71	81	92	65	76	68	77	350	360	225	20E	Std.	153
					65	73	70	79	90	100	76	88	75	84	360	370	225	20E	Slow	119
					75	84	80	88	101	110	89	103	86	98	440	480	285	25E	Std.	153
					78	87	85	95	105	114	93	108	88	101	450	490	285	25E	Slow	119
					86	96	91	103	113	128	109	126	103	118	550	600	340	30E	Std.	153
					91	101	100	115	119	137	117	135	109	128	560	720	340	30E	Slow	119
		480 or 600	13.1 at 33.0 kv or 12.6 at 34.5 kv	900 at 480v or 720 at 600v	23		26		49		30				230	230	90	13E	Std.	153
					28		32		61	68	36				260	260	140	15E	Std.	153
					33		38		67	81	42				270	280	170	15E	Slow	119
					38		43		81	110	47				350	360	225	20E	Std.	153
					46	85	51	88	106	117	55	85			360	370	225	20E	Slow	119
					52	94	84	98	119	131	87	100		99●	440	480	285	25E	Std.	153
					91	102	94	107	124	137	90	104	90●	103●	450	490	285	25E	Slow	119
					99	116	102	115	136	153	105	123	104●	120	550	600	340	30E	Std.	153
					107	120	112	128	145	164	113	132	111	128	560	720	340	30E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

■ Applicable at 208 v only.

● Applicable at 480 v only.

TABLE CONTINUED ⟶

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

THE FUSE SELECTION TABLES

TABLE XIII—Transformers Rated 33.0 Kv or 34.5 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
			Full-Load Current, Amperes		Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Primary	Secondary	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
1000	Up thru 8%	208 or 240	17.5 at 33.0 kv or 16.7 at 34.5 kv	2780 at 208v or 2410 at 240v	45		46		60	68	48		50		260	260	135	20E	Std.	153
					48		52		67	74	56	65	56	62	260	260	165	20E	Slow	119
					56	62	59	65	75	82	66	77	64	73	330	340	210	25E	Std.	153
					58	64	63	70	78	85	69	80	66	75	330	340	210	25E	Slow	119
					65	72	68	78	85	96	82	94	77	89	400	420	255	30E	Std.	153
					68	76	75	86	89	102	88	101	82	96	400	440	255	30E	Slow	119
					79	90	85	98	105	122	105	120	98	113	540	590	325	40E	Std.	153
					91	104	107	120	129	148	121	138	115	128	570	830◆	325	40E	Slow	119
					103	117	113	127	139	160	137	157	125	138	710	870◆	400	50E	Std.	153
					114	126	128	145	158	182	150	173	136	152	850	—	400	50E	Slow	119
		480 or 600	17.5 at 33.0 kv or 16.7 at 34.5 kv	1200 at 480v or 960 at 600v	28		31		59	81	34				260	260	135	20E	Std.	153
					34	63	37	65	78	87	40	63			260	260	165	20E	Slow	119
					38	69	63	73	89	98	65	75		74●	330	340	210	25E	Std.	153
					68	76	70	79	92	102	67	77	67●	76●	330	340	210	25E	Slow	119
					74	87	77	87	102	115	79	92	78●	90	400	420	255	30E	Std.	153
					80	90	84	96	108	123	85	99	84	96	400	440	255	30E	Slow	119
					94	105	94	107	124	140	101	117	98	116	540	590	325	40E	Std.	153
					108	121	116	131	149	167	119	138	119	135	570	830◆	325	40E	Slow	119
					118	134	124	139	159	176	134	156	134	151	710	870◆	400	50E	Std.	153
					128	143	139	156	174	190	150	173	144	162	850	—	400	50E	Slow	119
1500	Up thru 5.75%	208 or 240	26.2 at 33.0 kv or 25.1 at 34.5 kv	4160 at 208v or 3610 at 240v	38		41		52		46		43		220	220	110	25E	Slow	119
					43		45		56	62	54	62	50		260	260	160	30E	Std.	153
					45		49		58	67	58	66	54	62	270	270	170	30E	Slow	119
					53	60	57	65	69	81	70	80	65	75	350	360	215	40E	Std.	153
					60	69	71	80	85	98	80	92	77	85	350	380	215	40E	Slow	119
					69	78	75	85	93	106	91	105	83	92	450	480	265	50E	Std.	153
					75	84	85	96	105	121	100	115	90	101	460	550	265	50E	Slow	119
					86	97	95	110	122	141	121	139	103	118	600	690	340	65E	Std.	153
					90	100	103	117	131	151	126	142	109	124	620	820	340	65E	Slow	119
		480 or 600	26.2 at 33.0 kv or 25.1 at 34.5 kv	1800 at 480v or 1440 at 600v	45		46		61	67	44				220	220	110	25E	Slow	119
					47		50		67	75	52	60	51●		260	260	160	30E	Std.	153
					52		55	63	71	80	55	65	55●	63	270	270	170	30E	Slow	119
					62	69	62	71	83	93	67	78	65	77	350	360	215	40E	Std.	153
					72	80	77	87	99	111	79	92	79	90	350	380	215	40E	Slow	119
					79	89	82	93	106	117	89	104	89	100	450	480	265	50E	Std.	153
					85	95	92	103	116	126	100	115	96	108	460	550	265	50E	Slow	119
					98	108	102	115	128	141	119	138	114	132	600	690	340	65E	Std.	153
					101	113	111	126	133	151	126	145	118	135	620	820	340	65E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

● Applicable at 480 v only.

◆ Applicable to transformers through 5.75% impedance.

TABLE CONTINUED→

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XIII—Transformers Rated 33.0 Kv or 34.5 Kv Three-Phase—with Low-Voltage Secondary Current-Limiting Fuses—Continued

Transformer Data (Self Cooled)					Low-Voltage Secondary Current-Limiting Fuse—Upper Limit for Ampere Rating, Percent of Transformer Secondary Full-Load Current										S&C Primary Fuse					
					Bussmann		Federal Pacific		General Electric		Gould		Westinghouse		Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Feeder	Main	Δ-Δ Y-Y	Δ-Y ①			Speed	TCC No.
			Primary	Secondary																
2000	Up thru 5.75%	480 or 600	35.0 at 33.0 kv or 33.5 at 34.5 kv	2410 at 480v or 1930 at 600v	39		41		53	60	41		41●		200	200	110	30E	Slow	119
					45		46		61	69	50		48		260	260	145	40E	Std.	153
					53		57	64	73	82	58	68	58	67	260	270	160	40E	Slow	119
					59	66	61	69	79	87	66	77	66	75	330	340	200	50E	Std.	153
					63	71	69	77	86	94	74	85	72	80	330	340	200	50E	Slow	119
					73	81	77	86	96	106	89	104	86	99	440	470	255	65E	Std.	153
					76	84	83	95	100	113	95	109	88	101	440	500	255	65E	Slow	119
					86	97	92	105	114	129	112	129	105	121	560	650	310	80E	Std.	153
					90	100	103	117	124	141	118	135	110	130	580	820	310	80E	Slow	119
					104	119	112	129	138	158	137	157	128	142	740	860	335	100E	Std.	153
					108	125	126	142	153	175	144	164	136	151	750	—	335	100E	Slow	119
2500	Up thru 5.75%	480 or 600	43.7 at 33.0 kv or 41.8 at 34.5 kv	3010 at 480v or 2410 at 600v	42		46		59	66	47		47		210	210	130	40E	Slow	119
					46		48		62	69	52	61	52		260	260	140	50E	Std.	153
					50		54	61	69	74	59	67	57	63	260	270	160	50E	Slow	119
					58	65	61	68	76	84	71	82	68	78	340	350	205	65E	Std.	153
					60	67	66	75	79	90	75	86	70	83	340	360	205	65E	Slow	119
					69	78	74	84	91	104	90	103	84	97	420	470	250	80E	Std.	153
					72	80	82	94	99	113	95	108	88	104	440	490	250	80E	Slow	119
					83	95	89	103	109	126	109	125	102	113	540	610	270	100E	Std.	153
					86	99	100	113	121	139	114	131	108	120	570	770	270	100E	Slow	119
					106	119	116	132	145	166	146	167	126	141	800	920	310	125E	Std.	153
					118	132	136	154	170	195	160	187	144	162	950	—	310	125E	Slow	119
3750	Up thru 5.75%	480 or 600	65.6 at 33.0 kv or 62.8 at 34.5 kv	4510 at 480v or 3610 at 600v	39		40		50		47		45		230	230	105	65E	Std.	153
					40		44		52		50		46		230	230	135	65E	Slow	119
					45		48		60	68	59	68	55	63	280	280	165	80E	Std.	153
					47		54	61	65	74	62	71	58	68	280	300	165	80E	Slow	119
					55	63	59	68	73	83	72	83	68	75	350	360	180	100E	Std.	153
					57	66	67	75	80	92	76	87	72	80	360	380	180	100E	Slow	119
					70	79	77	88	96	110	97	111	84	93	500	540	205	125E	Std.	153
					78	87	90	102	113	130	107	124	96	108	510	630	205	125E	Slow	119
					83	93	91	103	117	135	120	134	98	111	640	690	240	150E	Std.	153
					92	103	108	119	138	158	131	150	113	129	660	—	240	150E	Slow	119
					92	104	103	115	134	154	133	153	111	127	720	830	270	175E	Std.	153
					101	114	118	129	155	179	147	170	127	145	780	—	270	175E	Slow	119

① For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

● Applicable at 480 v only.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

THE FUSE SELECTION TABLES

TABLE XIV—Transformers Rated 12.0 Kv or 12.47 Kv Three-Phase—with Medium-Voltage Secondary Circuit Breakers or Class E-2 Industrial Control Equipment

Transformer Data (Self Cooled) ↓					Medium-Voltage Secondary Circuit Breaker—Upper Limit for Nominal Relay Operating Time at Maximum Three-Phase Secondary Fault Current, Seconds①								High-Voltage Industrial Control Equipment, Class E-2—Maximum Fuse Rating		S&C Primary Fuse					
Overcurrent Relay Pickup Current, Percent of Transformer Secondary Full-Load Current →					Up thru 100		101 thru 150		151 thru 200		201 thru 250				Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Relay Characteristics →			Full-Load Current, Amperes																	
Kva, Three-Phase	Impedance	Secondary Voltages	Primary	Secondary	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	2400-volt Secondary	4160-volt Secondary	Δ-Δ ⅄-⅄	Δ-⅄ ②			Speed	TCC No.
1500	5.5%	2400 or 4160	72.2 at 12.0 kv or 69.5 at 12.47 kv	360 at 2400v or 210 at 4160v									5R	3R	210	210	125	65E	Slow	119
													6R	3R	250	260	135	80E	Std.	153
													6R	3R	260	270	150	80E	Slow	119
													6R	5R	320	330	160	100E	Std.	153
					0.07	0.07	0.07	0.06	Inst.	0.06	Inst.	Inst.	6R	5R	330	340	160	100E	Slow	119
					0.08	0.07	0.08	0.07	Inst.	0.07	Inst.	0.07	9R	6R	450	470	190	125E	Std.	153
					0.26	0.24	0.26	0.23	0.25	0.23	0.25	0.22	9R	6R	470	530	190	125E	Slow	119
					0.18	0.17	0.17	0.16	0.17	0.15	0.17	0.15	12R	6R	560	610	215	150E	Std.	153
					0.47	0.44	0.46	0.42	0.46	0.41	0.45	0.40	12R	6R	580	700	215	150E	Slow	119
					0.24	0.23	0.24	0.22	0.24	0.21	0.23	0.21	12R	6R	650	800	245	175E	Std.	153
					0.64	0.59	0.63	0.57	0.62	0.55	0.61	0.54	12R	6R	680	860	245	175E	Slow	119
					0.33	0.31	0.33	0.29	0.32	0.29	0.31	0.28	12R	9R	750	—	275	200E	Std.	153
					0.91	0.84	0.89	0.80	0.88	0.78	0.86	0.76	18R	9R	870	—	275	200E	Slow	119
2000	5.5%	2400 or 4160	96.2 at 12.0 kv or 92.6 at 12.47 kv	480 at 2400v or 280 at 4160v									6R	3R	190	190	105	80E	Slow	119
													6R	5R	230	240	115	100E	Std.	153
													6R	5R	240	240	120	100E	Slow	119
													9R	6R	320	340	140	125E	Std.	153
					0.07	0.06	0.07	0.06	Inst.	0.06	Inst.	Inst.	9R	6R	330	350	140	125E	Slow	119
					Inst	0.04	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	400	430	160	150E	Std.	153
					0.19	0.18	0.19	0.17	0.19	0.17	0.18	0.16	12R	6R	410	450	160	150E	Slow	119
					0.08	0.08	0.08	0.07	0.08	0.07	Inst.	0.07	12R	6R	460	500	185	175E	Std.	153
					0.28	0.26	0.27	0.25	0.27	0.24	0.26	0.24	12R	6R	470	530	185	175E	Slow	119
					0.12	0.11	0.12	0.10	0.11	0.10	0.11	0.10	12R	9R	540	580	205	200E	Std.	153
					0.40	0.37	0.40	0.36	0.39	0.35	0.38	0.34	18R	9R	550	700	205	200E	Slow	119
					0.29	0.27	0.29	0.26	0.28	0.25	0.28	0.25	18R	12R	690	780	260	250E	Std.	153
					0.79	0.74	0.78	0.70	0.77	0.68	0.75	0.67	18R	12R	740	—	260	250E	Slow	119
2500	5.5%	2400 or 4160	120.3 at 12.0 kv or 115.7 at 12.47 kv	600 at 2400v or 350 at 4160v									6R	5R	190	190	95	100E	Slow	119
													9R	6R	260	270	110	125E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	9R	6R	260	270	110	125E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	310	330	130	150E	Std.	153
					0.06	0.06	Inst.	0.06	Inst.	Inst.	Inst.	Inst.	12R	6R	320	340	130	150E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	360	380	150	175E	Std.	153
					0.13	0.12	0.12	0.11	0.12	0.11	0.12	0.11	12R	6R	370	390	150	175E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	9R	420	430	165	200E	Std.	153
					0.20	0.19	0.20	0.18	0.20	0.18	0.19	0.17	18R	9R	440	470	165	200E	Slow	119
					0.13	0.12	0.13	0.12	0.13	0.11	0.13	0.11	18R	12R	540	590	205	250E	Std.	153
					0.43	0.40	0.42	0.38	0.41	0.37	0.40	0.36	18R	12R	580	640	205	250E	Slow	119
					0.33	0.30	0.32	0.29	0.32	0.28	0.31	0.28	24R	12R	640	740	245	300E	Std.	153
					0.93	0.87	0.92	0.83	0.90	0.80	0.88	0.79	30R	12R	760	—	245	300E	Slow	119
3750	5.5%	2400 or 4160	180.4 at 12.0 kv or 173.6 at 12.47 kv	900 at 2400v or 520 at 4160v									12R	6R	240	240	100	175E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	250	250	100	175E	Slow	119
					—	—	—	—	—	—	—	—	12R	9R	270	280	110	200E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	18R	9R	280	290	110	200E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	18R	12R	340	360	135	250E	Std.	153
					0.11	0.10	0.11	0.10	0.11	0.09	0.10	0.09	18R	12R	350	370	135	250E	Slow	119
					0.07	0.07	0.07	0.06	Inst.	0.06	Inst.	Inst.	24R	12R	400	420	165	300E	Std.	153
					0.31	0.29	0.31	0.28	0.30	0.27	0.29	0.26	30R	12R	440	520	165	300E	Slow	119
					0.18	0.16	0.17	0.16	0.17	0.15	0.17	0.15	30R	18R	560	610	220	400E	Std.	153
					0.56	0.52	0.55	0.49	0.54	0.48	0.53	0.47	36R	18R	690	850	220	400E	Slow	119
					0.28	0.26	0.28	0.25	0.27	0.24	0.27	0.24	36R	18R	750	960	245	2-250E	Std.	153
					0.85	0.79	0.83	0.75	0.82	0.73	0.80	0.71	36R	24R	850	—	245	2-250E	Slow	119
					0.58	0.54	0.57	0.52	0.56	0.50	0.55	0.49	36R	24R	910	—	295	2-300E	Std.	153

① For relays not carefully calibrated at maximum three-phase secondary fault current, add or subtract (as applicable) the difference between the actual relay time-tolerance value and the assumed tolerance value (0.07 second) to the nominal relay operating time *before* comparing with entries in the table. See text, page 34.

② For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

TABLE CONTINUED ——►

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XIV—Transformers Rated 12.0 Kv or 12.47 Kv Three-Phase—with Medium-Voltage Secondary Circuit Breakers or Class E-2 Industrial Control Equipment—Continued

Transformer Data (Self Cooled) ↓					Medium-Voltage Secondary Circuit Breaker—Upper Limit for Nominal Relay Operating Time at Maximum Three-Phase Secondary Fault Current, Seconds①								High-Voltage Industrial Control Equipment, Class E-2—Maximum Fuse Rating		S&C Primary Fuse					
Overcurrent Relay Pickup Current, Percent of Transformer Secondary Full-Load Current →					Up thru 100		101 thru 150		151 thru 200		201 thru 250				Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Relay Characteristics →			Full-Load Current, Amperes		Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	2400-volt Secondary	4160-volt Secondary	Δ-Δ Y-Y	Δ-Y ②			Speed	TCC No.
Kva, Three-Phase	Impedance	Secondary Voltages	Primary	Secondary																
5000	5.5%	2400 or 4160	240.6 at 12.0 kv or 231.5 at 12.47 kv	1200 at 2400v or 690 at 4160v									18R	12R	260	260	100	250E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	18R	12R	260	270	100	250E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	24R	12R	310	320	125	300E	Std.	153
					0.10	0.10	0.10	0.09	0.10	0.09	0.10	0.09	30R	12R	310	340	125	300E	Slow	119
					Inst.	0.05	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	30R	18R	420	440	165	400E	Std.	153
					0.26	0.24	0.26	0.23	0.25	0.22	0.25	0.22	36R	18R	470	540	165	400E	Slow	119
					0.12	0.11	0.12	0.11	0.12	0.11	0.12	0.10	36R	18R	550	590	185	2-250E	Std.	153
					0.42	0.39	0.41	0.37	0.40	0.36	0.39	0.35	36R	24R	560	740	185	2-250E	Slow	119
					0.27	0.25	0.26	0.24	0.26	0.23	0.25	0.22	36R	24R	670	750	220	2-300E	Std.	153
					0.77	0.71	0.75	0.68	0.74	0.66	0.73	0.65	36R	30R	800	—	220	2-300E	Slow	119
					0.52	0.48	0.51	0.46	0.50	0.45	0.49	0.44	36R	36R	920	—	295	2-400E	Std.	153
					1.51	1.41	1.49	1.34	1.47	1.30	1.43	1.28	36R	36R	1400	—	295	2-400E	Slow	119
7500	6.5%	2400 or 4160	360.8 at 12.0 kv or 347.2 at 12.47 kv	1800 at 2400v or 1040 at 4160v	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	30R	18R	270	280	110	400E	Std.	153
					0.08	0.08	0.08	0.08	0.08	0.07	Inst.	0.07	36R	18R	290	310	110	400E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	18R	340	360	125	2-250E	Std.	153
					0.18	0.17	0.18	0.16	0.18	0.16	0.17	0.16	36R	24R	350	370	125	2-250E	Slow	119
					0.12	0.11	0.12	0.11	0.12	0.10	0.11	0.10	36R	24R	410	430	150	2-300E	Std.	153
					0.42	0.39	0.42	0.38	0.41	0.37	0.40	0.36	36R	30R	440	520	150	2-300E	Slow	119
					0.29	0.27	0.28	0.25	0.28	0.25	0.27	0.24	36R	36R	570	600	200	2-400E	Std.	153
					0.84	0.78	0.82	0.74	0.81	0.72	0.79	0.71	36R	36R	690	—	200	2-400E	Slow	119
10000	6.5%	2400 or 4160	481.1 at 12.0 kv or 463.0 at 12.47 kv	2410 at 2400v or 1390 at 4160v	Inst.	0.05	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	24R	260	270	90	2-250E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	24R	310	320	110	2-300E	Std.	153
					0.16	0.15	0.15	0.14	0.15	0.13	0.15	0.13	36R	30R	310	340	110	2-300E	Slow	119
					0.10	0.09	0.10	0.09	0.10	0.09	Inst.	0.08	36R	36R	420	440	150	2-400E	Std.	153
					0.38	0.36	0.38	0.34	0.37	0.33	0.36	0.32	36R	36R	470	540	150	2-400E	Slow	119

① For relays not carefully calibrated at maximum three-phase secondary fault current, add or subtract (as applicable) the difference between the actual relay time-tolerance value and the assumed tolerance value (0.07 second) to the nominal relay operating time *before* comparing with entries in the table. See text, page 34.

② For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

THE FUSE SELECTION TABLES

TABLE XV—Transformers Rated 13.2 Kv or 13.8 Kv Three-Phase—with Medium-Voltage Secondary Circuit Breakers or Class E-2 Industrial Control Equipment

Transformer Data (Self Cooled) ↓					Medium-Voltage Secondary Circuit Breaker—Upper Limit for Nominal Relay Operating Time at Maximum Three-Phase Secondary Fault Current, Seconds①								High-Voltage Industrial Control Equipment, Class E-2—Maximum Fuse Rating		S&C Primary Fuse					
Overcurrent Relay Pickup Current, Percent of Transformer Secondary Full-Load Current →					Up thru 100		101 thru 150		151 thru 200		201 thru 250				Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Relay Characteristics →			Full-Load Current, Amperes																	
Kva, Three-Phase	Impedance	Secondary Voltages	Primary	Secondary	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	2400-volt Secondary	4160-volt Secondary	Δ-Δ ⅄-⅄	Δ-⅄ ②			Speed	TCC No.
1500	5.5%	2400 or 4160	65.6 at 13.2 kv or 62.8 at 13.8 kv	360 at 2400v or 210 at 4160v									5R	2R	210	210	95	50E	Slow	119
													5R	3R	220	230	105	65E	Std.	153
													5R	3R	230	230	135	65E	Slow	119
													6R	4R	270	280	165	80E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	6R	4R	280	290	165	80E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	6R	5R	350	360	180	100E	Std.	153
					0.12	0.12	0.12	0.11	0.12	0.11	0.12	0.11	6R	5R	360	380	180	100E	Slow	119
					0.13	0.12	0.13	0.11	0.12	0.11	0.12	0.11	12R	6R	490	520	205	125E	Std.	153
					0.35	0.33	0.35	0.31	0.34	0.30	0.33	0.30	12R	6R	520	620	205	125E	Slow	119
					0.25	0.23	0.24	0.22	0.24	0.21	0.24	0.21	12R	6R	620	670	240	150E	Std.	153
					0.62	0.57	0.60	0.55	0.60	0.53	0.58	0.52	12R	6R	650	800	240	150E	Slow	119
					0.34	0.32	0.33	0.30	0.33	0.29	0.32	0.29	12R	9R	720	—	270	175E	Std.	153
					0.82	0.76	0.81	0.73	0.79	0.71	0.78	0.69	12R	9R	780	—	270	175E	Slow	119
2000	5.5%	2400 or 4160	87.5 at 13.2 kv or 83.7 at 13.8 kv	480 at 2400v or 280 at 4160v									6R	4R	210	210	125	80E	Slow	119
													6R	5R	260	260	135	100E	Std.	153
													6R	5R	260	270	135	100E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	360	370	155	125E	Std.	153
					0.11	0.10	0.11	0.10	0.11	0.09	0.10	0.09	12R	6R	370	400	155	125E	Slow	119
					0.08	0.07	0.08	0.07	0.08	0.07	Inst.	0.07	12R	6R	450	470	180	150E	Std.	153
					0.27	0.25	0.26	0.24	0.26	0.23	0.25	0.22	12R	6R	450	530	180	150E	Slow	119
					0.12	0.11	0.12	0.10	0.11	0.10	0.11	0.10	12R	9R	510	550	205	175E	Std.	153
					0.35	0.32	0.34	0.31	0.34	0.30	0.33	0.29	12R	9R	520	640	205	175E	Slow	119
					0.17	0.16	0.17	0.15	0.16	0.15	0.16	0.14	18R	9R	590	650	225	200E	Std.	153
					0.51	0.47	0.50	0.45	0.49	0.44	0.48	0.43	18R	9R	620	900	225	200E	Slow	119
					0.39	0.36	0.38	0.34	0.38	0.33	0.37	0.33	24R	12R	770	920	285	250E	Std.	153
					1.00	0.93	0.98	0.89	0.97	0.86	0.95	0.84	24R	12R	910	—	285	250E	Slow	119
2500	5.5%	2400 or 4160	109.3 at 13.2 kv or 104.6 at 13.8 kv	600 at 2400v or 350 at 4160v									6R	5R	210	210	105	100E	Slow	119
													12R	6R	290	290	125	125E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	290	300	125	125E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	350	370	140	150E	Std.	153
					0.11	0.11	0.11	0.10	0.11	0.10	0.11	0.10	12R	6R	350	390	140	150E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	9R	410	430	165	175E	Std.	153
					0.18	0.17	0.18	0.16	0.18	0.16	0.17	0.15	12R	9R	410	440	165	175E	Slow	119
					0.07	0.07	Inst.	0.06	Inst.	0.06	Inst.	Inst.	18R	9R	470	500	180	200E	Std.	153
					0.29	0.27	0.28	0.25	0.28	0.25	0.27	0.24	18R	9R	480	560	180	200E	Slow	119
					0.20	0.18	0.20	0.18	0.19	0.17	0.19	0.17	24R	12R	600	660	225	250E	Std.	153
					0.58	0.53	0.56	0.51	0.56	0.50	0.54	0.49	24R	12R	630	880	225	250E	Slow	119
					0.43	0.40	0.42	0.38	0.42	0.37	0.41	0.36	30R	12R	720	960	270	300E	Std.	153
					1.20	1.12	1.18	1.06	1.16	1.03	1.14	1.01	30R	18R	930	—	270	300E	Slow	119
3750	5.5%	2400 or 4160	164.0 at 13.2 kv or 156.9 at 13.8 kv	900 at 2400v or 520 at 4160v									12R	6R	230	230	95	150E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	230	240	95	150E	Slow	119
					—	—	—	—	—	—	—	—	12R	9R	270	270	110	175E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	9R	270	280	110	175E	Slow	119
					—	—	—	—	—	—	—	—	18R	9R	310	320	120	200E	Std.	153
					Inst.	0.03	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	18R	9R	310	320	120	200E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	24R	12R	380	400	150	250E	Std.	153
					0.17	0.15	0.16	0.15	0.16	0.14	0.16	0.14	24R	12R	390	420	150	250E	Slow	119
					0.12	0.11	0.11	0.10	0.11	0.10	0.11	0.11	30R	12R	460	480	180	300E	Std.	153
					0.41	0.38	0.41	0.37	0.40	0.36	0.39	0.35	30R	18R	500	620	180	300E	Slow	119
					0.25	0.23	0.24	0.22	0.24	0.21	0.23	0.21	36R	18R	640	700	240	400E	Std.	153
					0.72	0.67	0.70	0.63	0.69	0.62	0.68	0.60	36R	24R	780	—	240	400E	Slow	119
					0.39	0.37	0.39	0.35	0.38	0.34	0.37	0.33	36R	24R	850	—	270	2-250E	Std.	153
					1.07	0.99	1.05	0.95	1.03	0.92	1.01	0.90	36R	24R	1020	—	270	2-250E	Slow	119

① For relays not carefully calibrated at maximum three-phase secondary fault current, add or subtract (as applicable) the difference between the actual relay time-tolerance value and the assumed tolerance value (0.07 second) to the nominal relay operating time *before* comparing with entries in the table. See text, page 34.

② For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

TABLE CONTINUED →

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XV—Transformers Rated 13.2 Kv or 13.8 Kv Three-Phase—with Medium-Voltage Secondary Circuit Breakers or Class E-2 Industrial Control Equipment—Continued

Transformer Data (Self Cooled) ↓					Medium-Voltage Secondary Circuit Breaker—Upper Limit for Nominal Relay Operating Time at Maximum Three-Phase Secondary Fault Current, Seconds①								High-Voltage Industrial Control Equipment, Class E-2—Maximum Fuse Rating		S&C Primary Fuse					
Overcurrent Relay Pickup Current, Percent of Transformer Secondary Full-Load Current →					Up thru 100		101 thru 150		151 thru 200		201 thru 250				Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Relay Characteristics →			Full-Load Current, Amperes																	
Kva, Three-Phase	Impedance	Secondary Voltages	Primary	Secondary	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	2400-volt Secondary	4160-volt Secondary	Δ–Δ ⅄–⅄	Δ–⅄ ②			Speed	TCC No.
5000	5.5%	2400 or 4160	218.7 at 13.2 kv or 209.2 at 13.8 kv	1200 at 2400v or 690 at 4160v									18R	9R	230	230	90	200E	Slow	119
													24R	12R	280	290	110	250E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	24R	12R	290	300	110	250E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	30R	12R	350	350	135	300E	Std.	153
					0.16	0.14	0.15	0.14	0.15	0.13	0.15	0.13	30R	18R	350	390	135	300E	Slow	119
					0.08	0.08	0.08	0.08	0.08	0.07	Inst.	0.07	36R	18R	470	500	180	400E	Std.	153
					0.34	0.32	0.33	0.30	0.33	0.29	0.32	0.29	36R	24R	520	630	180	400E	Slow	119
					0.16	0.15	0.15	0.14	0.15	0.14	0.15	0.13	36R	24R	610	680	205	2-250E	Std.	153
					0.51	0.47	0.50	0.45	0.49	0.44	0.48	0.43	36R	24R	620	900	205	2-250E	Slow	119
					0.35	0.33	0.35	0.31	0.34	0.30	0.33	0.30	36R	30R	750	940	245	2-300E	Std.	153
					0.97	0.90	0.95	0.86	0.94	0.84	0.92	0.82	36R	30R	930	—	245	2-300E	Slow	119
7500	6.5%	2400 or 4160	328.0 at 13.2 kv or 313.8 at 13.8 kv	1800 at 2400v or 1040 at 4160v									30R	12R	230	230	90	300E	Std.	153
					Inst.	0.03	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	30R	18R	230	230	90	300E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	18R	310	310	120	400E	Std.	153
					0.14	0.13	0.13	0.12	0.13	0.12	0.13	0.12	36R	24R	320	350	120	400E	Slow	119
					Inst.	0.04	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	24R	380	410	135	2-250E	Std.	153
					0.25	0.24	0.25	0.23	0.25	0.22	0.24	0.21	36R	24R	390	420	135	2-250E	Slow	119
					0.17	0.16	0.17	0.15	0.16	0.15	0.16	0.14	36R	30R	470	500	165	2-300E	Std.	153
					0.54	0.50	0.53	0.48	0.52	0.46	0.51	0.45	36R	30R	500	630	165	2-300E	Slow	119
					0.34	0.31	0.33	0.30	0.32	0.29	0.32	0.28	36R	36R	640	700	215	2-400E	Std.	153
					1.01	0.94	0.99	0.89	0.98	0.87	0.95	0.85	36R	36R	790	—	215	2-400E	Slow	119
10000	6.5%	2400 or 4160	437.4 at 13.2 kv or 418.4 at 13.8 kv	2410 at 2400v or 1390 at 4160v	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	24R	240	250	90	400E	Slow	119
					—	—	—	—	—	—	—	—	36R	24R	290	290	100	2-250E	Std.	153
					0.07	0.07	0.07	0.06	Inst.	0.06	Inst.	Inst.	36R	24R	290	300	100	2-250E	Slow	119
					Inst.	0.03	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	30R	350	360	120	2-300E	Std.	153
					0.23	0.21	0.23	0.20	0.22	0.20	0.22	0.19	36R	30R	350	390	120	2-300E	Slow	119
					0.15	0.14	0.15	0.13	0.14	0.13	0.14	0.13	36R	36R	460	490	165	2-400E	Std.	153
					0.51	0.47	0.50	0.45	0.49	0.44	0.48	0.43	36R	36R	540	630	165	2-400E	Slow	119

① For relays not carefully calibrated at maximum three-phase secondary fault current, add or subtract (as applicable) the difference between the actual relay time-tolerance value and the assumed tolerance value (0.07 second) to the nominal relay operating time *before* comparing with entries in the table. See text, page 34.

② For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XVI—Transformers Rated 22.9 Kv or 24.9 Kv Three-Phase—with Medium-Voltage Secondary Circuit Breakers or Class E-2 Industrial Control Equipment

Transformer Data (Self Cooled) ↓					Medium-Voltage Secondary Circuit Breaker—Upper Limit for Nominal Relay Operating Time at Maximum Three-Phase Secondary Fault Current, Seconds①								High-Voltage Industrial Control Equipment, Class E-2—Maximum Fuse Rating		S&C Primary Fuse					
Overcurrent Relay Pickup Current, Percent of Transformer Secondary Full-Load Current →					Up thru 100		101 thru 150		151 thru 200		201 thru 250				Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Relay Characteristics →			Full-Load Current, Amperes		Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	2400-volt Secondary	4160-volt Secondary	Δ-Δ ⅄-⅄	Δ-⅄ ②			Speed	TCC No.
Kva, Three-Phase	Impedance	Secondary Voltages	Primary	Secondary																
1500	5.5%	2400 or 4160	37.8 at 22.9 kv or 34.8 at 24.9 kv	360 at 2400v or 210 at 4160v									5R	2R	200	200	90	30E	Slow	119
													5R	3R	250	250	120	40E	Std.	153
													6R	3R	250	260	150	40E	Slow	119
													6R	4R	310	320	185	50E	Std.	153
					0.07	0.06	0.07	0.06	Inst.	0.06	Inst.	Inst.	6R	5R	310	330	185	50E	Slow	119
					Inst.	0.05	Inst.	0.05	Inst.	Inst.	Inst.	Inst.	9R	5R	420	440	235	65E	Std.	153
					0.18	0.17	0.18	0.16	0.17	0.15	0.17	0.15	9R	5R	420	460	235	65E	Slow	119
					0.14	0.13	0.13	0.12	0.13	0.12	0.13	0.11	12R	6R	530	600	290	80E	Std.	153
					0.39	0.36	0.38	0.35	0.38	0.34	0.37	0.33	12R	6R	550	710	290	80E	Slow	119
					0.32	0.30	0.31	0.28	0.31	0.28	0.30	0.27	12R	6R	690	800	310	100E	Std.	153
					0.78	0.73	0.77	0.69	0.76	0.67	0.74	0.66	12R	6R	700	—	310	100E	Slow	119
2000	5.5%	2400 or 4160	50.4 at 22.9 kv or 46.4 at 24.9 kv	480 at 2400v or 280 at 4160v									6R	4R	230	240	95	50E	Std.	153
													6R	5R	230	240	135	50E	Slow	119
													9R	5R	300	320	175	65E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	9R	5R	310	320	175	65E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	380	410	215	80E	Std.	153
					0.14	0.13	0.14	0.12	0.14	0.12	0.13	0.12	12R	6R	400	420	215	80E	Slow	119
					0.12	0.11	0.11	0.10	0.11	0.10	0.11	0.10	12R	6R	470	540	230	100E	Std.	153
					0.34	0.32	0.34	0.30	0.33	0.30	0.32	0.29	12R	6R	500	600	230	100E	Slow	119
					0.31	0.29	0.30	0.27	0.30	0.26	0.29	0.26	18R	12R	710	800	270	125E	Std.	153
					0.73	0.68	0.72	0.65	0.71	0.63	0.69	0.62	18R	12R	760	—	270	125E	Slow	119
					0.54	0.51	0.53	0.48	0.53	0.47	0.51	0.46	24R	12R	900	—	310	150E	Std.	153
					1.29	1.19	1.26	1.14	1.24	1.11	1.22	1.08	24R	12R	1120	—	310	150E	Slow	119
2500	5.5%	2400 or 4160	63.0 at 22.9 kv or 58.0 at 24.9 kv	600 at 2400v or 350 at 4160v									6R	5R	190	190	105	50E	Slow	119
													9R	5R	250	250	120	65E	Std.	153
													9R	5R	250	250	140	65E	Slow	119
													12R	6R	300	310	175	80E	Std.	153
					Inst.	0.03	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	310	330	175	80E	Slow	119
					Inst.	0.03	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	370	400	185	100E	Std.	153
					0.17	0.16	0.17	0.15	0.16	0.15	0.16	0.14	12R	6R	400	420	185	100E	Slow	119
					0.17	0.16	0.17	0.15	0.16	0.15	0.16	0.14	18R	12R	550	600	215	125E	Std.	153
					0.44	0.41	0.43	0.39	0.42	0.38	0.41	0.37	18R	12R	560	730	215	125E	Slow	119
					0.31	0.29	0.31	0.28	0.30	0.27	0.30	0.26	24R	12R	700	760	250	150E	Std.	153
					0.75	0.70	0.74	0.67	0.73	0.65	0.71	0.63	24R	12R	720	—	250	150E	Slow	119
					0.42	0.39	0.41	0.37	0.41	0.36	0.40	0.36	30R	12R	800	950	285	175E	Std.	153
					1.01	0.94	0.99	0.89	0.98	0.87	0.95	0.85	30R	12R	880	—	285	175E	Slow	119
3750	5.5%	2400 or 4160	94.5 at 22.9 kv or 87.0 at 24.9 kv	900 at 2400v or 520 at 4160v									12R	6R	210	210	110	80E	Slow	119
													12R	6R	250	250	120	100E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	260	260	125	100E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	18R	12R	360	370	145	125E	Std.	153
					0.10	0.09	0.09	0.08	0.09	0.08	Inst.	0.08	18R	12R	360	380	145	125E	Slow	119
					0.07	0.07	0.07	0.06	Inst.	0.06	Inst.	Inst.	24R	12R	430	460	165	150E	Std.	153
					0.25	0.23	0.25	0.22	0.24	0.22	0.24	0.21	24R	12R	440	500	165	150E	Slow	119
					0.11	0.11	0.11	0.10	0.11	0.10	0.11	0.10	30R	12R	510	540	190	175E	Std.	153
					0.35	0.33	0.34	0.31	0.34	0.30	0.33	0.30	30R	12R	510	620	190	175E	Slow	119
					0.16	0.15	0.16	0.14	0.15	0.14	0.15	0.13	30R	18R	580	630	210	200E	Std.	153
					0.48	0.44	0.47	0.42	0.46	0.41	0.45	0.40	30R	18R	610	860	210	200E	Slow	119
					0.37	0.35	0.37	0.33	0.36	0.32	0.35	0.32	36R	24R	750	870	260	250E	Std.	153
					0.92	0.86	0.91	0.82	0.89	0.80	0.87	0.78	36R	24R	840	—	260	250E	Slow	119

① For relays not carefully calibrated at maximum three-phase secondary fault current, add or subtract (as applicable) the difference between the actual relay time-tolerance value and the assumed tolerance value (0.07 second) to the nominal relay operating time *before* comparing with entries in the table. See text, page 34.

② For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

TABLE CONTINUED →

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XVI—Transformers Rated 22.9 Kv or 24.9 Kv Three-Phase—with Medium-Voltage Secondary Circuit Breakers or Class E-2 Industrial Control Equipment—Continued

Transformer Data (Self Cooled) ↓					Medium-Voltage Secondary Circuit Breaker—Upper Limit for Nominal Relay Operating Time at Maximum Three-Phase Secondary Fault Current, Seconds①								High-Voltage Industrial Control Equipment, Class E-2—Maximum Fuse Rating		S&C Primary Fuse					
Overcurrent Relay Pickup Current, Percent of Transformer Secondary Full-Load Current →					Up thru 100		101 thru 150		151 thru 200		201 thru 250				Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Relay Characteristics →					Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	2400-volt Secondary	4160-volt Secondary	Δ-Δ ⅄-⅄	Δ-⅄ ②			Speed	TCC No.
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes																	
			Primary	Secondary																
5000	5.5%	2400 or 4160	126.1 at 22.9 kv or 115.9 at 24.9 kv	1200 at 2400v or 690 at 4160v									12R	6R	190	190	90	100E	Slow	119
													18R	12R	260	270	105	125E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	18R	12R	260	270	105	125E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	24R	12R	320	340	125	150E	Std.	153
					0.06	0.06	Inst.	0.06	Inst.	Inst.	Inst.	Inst.	24R	12R	320	340	125	150E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	30R	12R	370	390	140	175E	Std.	153
					0.12	0.11	0.12	0.11	0.12	0.11	0.12	0.10	30R	12R	370	390	140	175E	Slow	119
					Inst.	0.03	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	30R	18R	420	450	155	200E	Std.	153
					0.21	0.19	0.20	0.18	0.20	0.18	0.20	0.18	30R	18R	430	480	155	200E	Slow	119
					0.15	0.14	0.15	0.13	0.15	0.13	0.14	0.13	36R	24R	540	590	195	250E	Std.	153
					0.46	0.43	0.45	0.41	0.45	0.40	0.44	0.39	36R	24R	560	740	195	250E	Slow	119
					0.34	0.32	0.33	0.30	0.33	0.29	0.32	0.29	36R	30R	660	750	235	300E	Std.	153
					0.92	0.86	0.91	0.82	0.89	0.80	0.87	0.78	36R	30R	800	—	235	300E	Slow	119
7500	6.5%	2400 or 4160	189.1 at 22.9 kv or 173.9 at 24.9 kv	1800 at 2400v or 1040 at 4160v	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	30R	12R	240	250	95	175E	Slow	119
					—	—	—	—	—	—	—	—	30R	18R	280	280	105	200E	Std.	153
					Inst.	0.05	Inst.	0.05	Inst.	Inst.	Inst.	Inst.	30R	18R	280	280	105	200E	Slow	119
					Inst.	0.03	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	24R	350	370	130	250E	Std.	153
					0.22	0.20	0.21	0.19	0.21	0.19	0.21	0.18	36R	24R	350	370	130	250E	Slow	119
					0.17	0.15	0.16	0.15	0.16	0.14	0.16	0.14	36R	30R	420	450	155	300E	Std.	153
					0.51	0.47	0.50	0.45	0.49	0.44	0.48	0.43	36R	30R	440	520	155	300E	Slow	119
10000	6.5%	2400 or 4160	252.1 at 22.9 kv or 231.9 at 24.9 kv	2410 at 2400v or 1390 at 4160v									36R	24R	260	260	95	250E	Std.	153
					0.07	0.06	Inst.	0.06	Inst.	0.06	Inst.	Inst.	36R	24R	260	270	95	250E	Slow	119
					Inst.	0.03	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	30R	310	320	115	300E	Std.	153
					0.21	0.19	0.20	0.18	0.20	0.18	0.19	0.17	36R	30R	310	340	115	300E	Slow	119

① For relays not carefully calibrated at maximum three-phase secondary fault current, add or subtract (as applicable) the difference between the actual relay time-tolerance value and the assumed tolerance value (0.07 second) to the nominal relay operating time *before* comparing with entries in the table. See text, page 34.

② For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

THE FUSE SELECTION TABLES

TABLE XVII—Transformers Rated 33.0 Kv or 34.5 Kv Three-Phase—with Medium-Voltage Secondary Circuit Breakers or Class E-2 Industrial Control Equipment

Transformer Data (Self Cooled) ↓					Medium-Voltage Secondary Circuit Breaker—Upper Limit for Nominal Relay Operating Time at Maximum Three-Phase Secondary Fault Current, Seconds①								High-Voltage Industrial Control Equipment, Class E-2—Maximum Fuse Rating		S&C Primary Fuse					
Overcurrent Relay Pickup Current, Percent of Transformer Secondary Full-Load Current →					Up thru 100		101 thru 150		151 thru 200		201 thru 250				Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Relay Characteristics →					Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	2400-volt Secondary	4160-volt Secondary	Δ-Δ ⅄-⅄	Δ-⅄ ②			Speed	TCC No.
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes: Primary	Full-Load Current, Amperes: Secondary																
1500	5.5%	2400 or 4160	26.2 at 33.0 kv or 25.1 at 34.5 kv	360 at 2400v or 210 at 4160v									5R	3R	220	220	105	25E	Std.	153
													5R	3R	220	220	125	25E	Slow	119
													6R	3R	260	260	160	30E	Std.	153
													6R	3R	270	270	170	30E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	6R	5R	350	360	215	40E	Std.	153
					0.14	0.13	0.14	0.12	0.13	0.12	0.13	0.12	6R	5R	350	380	215	40E	Slow	119
					0.07	0.07	0.07	0.07	Inst.	0.06	Inst.	Inst.	9R	6R	450	480	265	50E	Std.	153
					0.34	0.32	0.34	0.31	0.33	0.30	0.33	0.29	12R	6R	460	550	265	50E	Slow	119
					0.27	0.25	0.27	0.24	0.26	0.23	0.26	0.23	12R	6R	600	690	340	65E	Std.	153
					0.56	0.52	0.55	0.50	0.55	0.49	0.53	0.48	12R	6R	620	820	340	65E	Slow	119
2000	5.5%	2400 or 4160	34.5 at 33.0 kv or 33.5 at 34.5 kv	480 at 2400v or 280 at 4160v									6R	3R	200	200	110	30E	Slow	119
													6R	5R	260	260	145	40E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	6R	5R	260	270	160	40E	Slow	119
					—	—	—	—	—	—	—	—	9R	6R	330	340	200	50E	Std.	153
					0.11	0.10	0.11	0.10	0.11	0.09	0.10	0.09	9R	6R	330	340	200	50E	Slow	119
					0.09	0.08	0.09	0.08	0.09	0.08	Inst.	0.08	12R	6R	440	470	255	65E	Std.	153
					0.24	0.22	0.24	0.21	0.23	0.21	0.23	0.20	12R	6R	440	500	255	65E	Slow	119
					0.19	0.18	0.19	0.17	0.19	0.17	0.18	0.16	18R	9R	560	650	310	80E	Std.	153
					0.50	0.46	0.49	0.44	0.48	0.43	0.47	0.42	18R	9R	580	820	310	80E	Slow	119
					0.41	0.38	0.40	0.36	0.39	0.35	0.38	0.34	18R	12R	740	860	335	100E	Std.	153
					0.96	0.89	0.94	0.85	0.92	0.82	0.90	0.81	18R	12R	750	—	335	100E	Slow	119
2500	5.5%	2400 or 4160	43.7 at 33.0 kv or 41.8 at 34.5 kv	600 at 2400v or 350 at 4160v									6R	5R	210	210	130	40E	Slow	119
													9R	6R	260	260	140	50E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	9R	6R	260	270	160	50E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	12R	6R	340	350	205	65E	Std.	153
					0.09	0.08	0.09	0.08	0.09	0.08	Inst.	0.08	12R	6R	340	360	205	65E	Slow	119
					0.09	0.08	0.08	0.08	0.08	0.07	Inst.	0.07	18R	9R	420	470	250	80E	Std.	153
					0.25	0.24	0.25	0.22	0.25	0.22	0.24	0.21	18R	9R	440	490	250	80E	Slow	119
					0.21	0.20	0.21	0.19	0.21	0.18	0.20	0.18	18R	12R	540	610	270	100E	Std.	153
					0.50	0.47	0.49	0.44	0.49	0.43	0.47	0.42	18R	12R	570	770	270	100E	Slow	119
					0.50	0.46	0.49	0.44	0.48	0.43	0.47	0.42	30R	18R	800	920	310	125E	Std.	153
					1.10	1.02	1.08	0.97	1.06	0.95	1.04	0.93	30R	18R	950	—	310	125E	Slow	119
3750	5.5%	2400 or 4160	65.6 at 33.0 kv or 62.8 at 34.5 kv	900 at 2400v or 520 at 4160v									9R	6R	180	180	95	50E	Slow	119
													12R	6R	230	230	105	65E	Std.	153
													12R	6R	230	230	135	65E	Slow	119
													18R	9R	280	280	165	80E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	18R	9R	280	300	165	80E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	18R	12R	350	360	180	100E	Std.	153
					0.15	0.14	0.14	0.13	0.14	0.13	0.14	0.12	18R	12R	360	380	180	100E	Slow	119
					0.14	0.13	0.14	0.13	0.14	0.12	0.14	0.12	30R	18R	500	540	205	125E	Std.	153
					0.39	0.36	0.38	0.34	0.38	0.33	0.37	0.33	30R	18R	510	630	205	125E	Slow	119
					0.28	0.26	0.28	0.25	0.27	0.24	0.27	0.24	36R	18R	640	690	240	150E	Std.	153
					0.68	0.63	0.66	0.60	0.65	0.58	0.64	0.57	36R	18R	660	—	240	150E	Slow	119
					0.37	0.35	0.37	0.33	0.36	0.32	0.35	0.32	36R	24R	720	830	270	175E	Std.	153
					0.93	0.86	0.91	0.82	0.90	0.80	0.88	0.78	36R	24R	780	—	270	175E	Slow	119

① For relays not carefully calibrated at maximum three-phase secondary fault current, add or subtract (as applicable) the difference between the actual relay time-tolerance value and the assumed tolerance value (0.07 second) to the nominal relay operating time *before* comparing with entries in the table. See text, page 34.

② For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

TABLE CONTINUED ⟶

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

TABLE XVII—Transformers Rated 33.0 Kv or 34.5 Kv Three-Phase—with Medium-Voltage Secondary Circuit Breakers or Class E-2 Industrial Control Equipment—Continued

Transformer Data (Self Cooled) ↓					Medium-Voltage Secondary Circuit Breaker—Upper Limit for Nominal Relay Operating Time at Maximum Three-Phase Secondary Fault Current, Seconds①								High-Voltage Industrial Control Equipment, Class E-2—Maximum Fuse Rating		S&C Primary Fuse					
Overcurrent Relay Pickup Current, Percent of Transformer Secondary Full-Load Current →					Up thru 100		101 thru 150		151 thru 200		201 thru 250				Transformer Protection Index, Percent of Transformer Full-Load Current (see text, page 35)		Loading Capability, Percent of Transformer Primary Full-Load Current	Rating, Amperes	Time-Current Characteristic	
Relay Characteristics →																				
Kva, Three-Phase	Impedance	Secondary Voltages	Full-Load Current, Amperes		Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	Inv. or Very Inv.	Ext. Inv.	2400-volt Secondary	4160-volt Secondary	Δ-Δ ⅄-⅄	Δ-⅄ ①			Speed	TCC No.
			Primary	Secondary																
5000	5.5%	2400 or 4160	87.5 at 33.0 kv or 83.7 at 34.5 kv	1200 at 2400v or 690 at 4160v									18R	9R	210	220	125	80E	Slow	119
													18R	12R	260	260	135	100E	Std.	153
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	18R	12R	260	280	135	100E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	30R	18R	360	390	155	125E	Std.	153
					0.15	0.14	0.15	0.14	0.15	0.13	0.15	0.13	30R	18R	370	390	155	125E	Slow	119
					0.11	0.10	0.11	0.10	0.11	0.09	0.10	0.09	36R	18R	450	500	180	150E	Std.	153
					0.34	0.31	0.33	0.30	0.33	0.29	0.32	0.28	36R	18R	460	530	180	150E	Slow	119
					0.16	0.15	0.16	0.15	0.16	0.14	0.16	0.14	36R	24R	520	570	205	175E	Std.	153
					0.46	0.43	0.46	0.41	0.45	0.40	0.44	0.39	36R	24R	530	680	205	175E	Slow	119
					0.22	0.21	0.22	0.20	0.22	0.19	0.21	0.19	36R	24R	610	680	225	200E	Std.	153
					0.62	0.58	0.61	0.55	0.60	0.54	0.59	0.53	36R	30R	630	960	225	200E	Slow	119
					0.47	0.44	0.46	0.42	0.45	0.40	0.44	0.40	36R	30R	800	970	285	250E	Std.	153
					1.21	1.12	1.19	1.07	1.17	1.04	1.14	1.02	36R	36R	900	—	285	250E	Slow	119
7500	6.5%	2400 or 4160	131.2 at 33.0 kv or 125.5 at 34.5 kv	1800 at 2400v or 1040 at 4160v									30R	18R	240	240	100	125E	Std.	153
					Inst.	0.03	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	30R	18R	240	250	100	125E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	18R	290	300	120	150E	Std.	153
					0.11	0.11	0.11	0.10	0.11	0.10	0.11	0.10	36R	18R	300	310	120	150E	Slow	119
					Inst.	0.04	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	24R	340	350	135	175E	Std.	153
					0.19	0.18	0.19	0.17	0.19	0.17	0.18	0.16	36R	24R	350	360	135	175E	Slow	119
					0.08	0.08	0.08	0.07	0.08	0.08	Inst.	0.07	36R	24R	390	410	150	200E	Std.	153
					0.30	0.28	0.29	0.27	0.29	0.26	0.28	0.25	36R	30R	390	420	150	200E	Slow	119
					0.26	0.25	0.26	0.23	0.26	0.23	0.25	0.22	36R	30R	500	530	190	250E	Std.	153
					0.64	0.59	0.63	0.56	0.62	0.55	0.60	0.54	36R	36R	500	610	190	250E	Slow	119
					0.47	0.43	0.46	0.41	0.45	0.40	0.44	0.39	36R	36R	610	680	225	300E	Std.	153
					1.25	1.16	1.22	1.11	1.21	1.07	1.18	1.05	36R	36R	680	—	225	300E	Slow	119
10000	6.5%	2400 or 4160	175.0 at 33.0 kv or 167.3 at 34.5 kv	2410 at 2400v or 1390 at 4160v									36R	24R	250	260	100	175E	Std.	153
					Inst.	0.03	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	24R	260	260	100	175E	Slow	119
					Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	Inst.	36R	24R	290	300	110	200E	Std.	153
					0.10	0.09	0.10	0.09	0.10	0.09	0.09	0.08	36R	30R	290	300	110	200E	Slow	119
					0.07	0.07	0.07	0.06	Inst.	0.06	Inst.	Inst.	36R	30R	360	380	140	250E	Std.	153
					0.28	0.26	0.28	0.25	0.28	0.25	0.27	0.24	36R	36R	370	390	140	250E	Slow	119
					0.22	0.21	0.22	0.20	0.22	0.19	0.21	0.19	36R	36R	440	460	170	300E	Std.	153
					0.67	0.62	0.66	0.59	0.65	0.57	0.63	0.56	36R	36R	460	550	170	300E	Slow	119

① For relays not carefully calibrated at maximum three-phase secondary fault current, add or subtract (as applicable) the difference between the actual relay time-tolerance value and the assumed tolerance value (0.07 second) to the nominal relay operating time *before* comparing with entries in the table. See text, page 34.

② For delta grounded-wye connected transformers with the neutral grounded through an impedance, the values in the "delta delta" column apply.

Note: Refer to "How to Use the Fuse Selection Tables" on page 76 (foldout).

THE FUSE SELECTION TABLES

TABLE XVIII—Primary Fuse Ratings (with SM Refill Units or SMU-20 Fuse Units)

Fuse Unit or Refill Unit Type →		SM-4			SMU-20						SM-5								
Power Fuse Type	Indoor →	SM-4Z and SML-4Z with Silencer			SM-20 and SML-20 with Silencer						SM-5S with Snuffler			SM-5SS with Super Snuffler					
	Outdoor →	SM-4						SMD-20									SM-5		
Kv, Nominal		Amperes, Rms																	
Fuse	System	Max	Interrupting①		Max	Interrupting①		Max	Interrupting①		Max	Interrupting①		Max	Interrupting①		Max	Interrupting①	
			Sym.②	Asym.		Sym.②	Asym.		Sym.①	Asym.		Sym.②	Asym.		Sym.②	Asym.		Sym.①	Asym.
4.16★	2.4										720E●	37 500	60 000				720E●	37 500	60 000
	2.4/4.16Y										720E●	37 500	60 000				720E●	37 500	60 000
7.2▲	2.4	200E	17 200	27 500							720E●	28 000	44 500				720E●	28 000	44 500
	2.4/4.16Y	200E	17 200	27 500							720E●	28 000	44 500				720E●	28 000	44 500
14.4⊕	12	200E	12 500	20 000	200E	14 000	22 400	200E	14 000	22 400	720E●	25 000	40 000	400E	34 600	55 000	400E 720E●	34 600 25 000	55 000 40 000
	7.2/12.47Y	200E	12 500	20 000	200E	14 000	22 400	200E	14 000	22 400	720E●	25 000	40 000	400E	34 600	55 000	400E 720E●	34 600 25 000	55 000 40 000
	7.62/13.2Y	200E	12 500	20 000	200E	14 000	22 400	200E	14 000	22 400	720E●	25 000	40 000	400E	34 000	54 000	400E 720E●	34 000 25 000	54 000 40 000
	13.8	200E	12 500	20 000	200E	14 000	22 400	200E	14 000	22 400	720E●	25 000	40 000	400E	34 000	54 000	400E 720E●	34 000 25 000	54 000 40 000
25	7.2/12.47Y	200E	12 500	20 000	200E	12 500	20 000	200E	12 500	20 000	300E	20 000	32 000				300E	20 000	32 000
	7.62/13.2Y	200E	12 500	20 000	200E	12 500	20 000	200E	12 500	20 000	300E	20 000	32 000				300E	20 000	32 000
	13.8	200E	12 500	20 000	200E	12 500	20 000	200E	12 500	20 000	300E	20 000	32 000				300E	20 000	32 000
	23	200E	9 400	15 000	200E	12 500	20 000	200E	12 500	20 000	300E	20 000	32 000				300E	20 000	32 000
	14.4/24.9Y	200E	9 400	15 000	200E	12 500	20 000	200E	12 500	20 000	300E	20 000	32 000				300E	20 000	32 000
	14.4/24.9Y◆	200E	12 500	20 000															
	20/34.5Y§							200E	12 500	20 000									
34.5†	23	200E	9 400	15 000	200E	8 450	13 500	200E	10 000	16 000	300E	17 500	28 000				300E	17 500	28 000
	14.4/24.9Y	200E	8 700	13 900	200E	8 450	13 500	200E	10 000	16 000	300E	17 500	28 000				300E	17 500	28 000
	20/34.5Y	200E	6 250	10 000	200E	8 450	13 500	200E	10 000	16 000	300E	17 500	28 000				300E	17 500	28 000
	34.5	200E	6 250	10 000	200E	8 450	13 500	200E	10 000	16 000	300E	17 500	28 000				300E	17 500	28 000

① **60-hertz ratings. For 50-hertz ratings, refer to the nearest S&C Sales Office.**

② **Symmetrical ratings assigned are based on available symmetrical short-circuit current at locations where the X/R ratio is 15. Higher symmetrical ratings have been determined for these fuses where X/R = 10 and X/R = 5. These higher ratings are set forth in the following S&C descriptive bulletins:**

Power Fuse Type	Descriptive Bulletin No.
SM-4 SM-5	242-30
SMD-20	242-32
SM-4Z and SML-4Z SM-5S and SM-5SS SM-20 and SML-20	252-30

★ Interrupting ratings shown for SM-5S and SM-5 Power Fuses are applicable to 4.16-kv refill units installed in 7.2-kv holders, for use in 4.8-kv or 7.2-kv mountings, respectively.

▲ SML-4Z Power Fuses are not available at 7.2 kv. Interrupting ratings shown for SM-4Z and SM-5S Power Fuses are applicable to 7.2-kv refill units installed in 7.2-kv holders for use in 4.8-kv mounings for system voltages through 4.16 kv.

⊕ Interrupting ratings shown for SM-4Z, SML-4Z, SM-5S, and SM-5SS Power Fuses are applicable to 14.4-kv refill units installed in 14.4-kv holders for use in 13.8-kv mountings. Interrupting ratings shown for SM-20 and SML-20 Power Fuses are applicable to 14.4-kv fuse units installed in 13.8-kv mountings.

† SML-4Z and SML-20 Power Fuses are not available at 34.5 kv.

● Applicable to solidly-grounded-neutral system only with fuses connected by a single concentric-neutral cable (or directly coupled) to a transformer or transformers, each with a wye-grounded-neutral primary connection.

§ Applicable to 25-kv Overhead—Pole-Top Style only, for protection of single-phase-to-neutral circuits (lines or transformers) only.

● Parallel-fuse arrangements.

How to Use the Fuse Selection Tables

In using these tables, it is recommended that the transformer-primary fuse be coordinated with the largest feeder protective device, rather than the main secondary-side protective device (if any). This will provide superior protection for the transformer while maintaining the same degree of service continuity. Accordingly, you should follow the steps below as they apply to your largest feeder protective device. *The examples on pages 37 through 39 illustrate the use of these steps in selecting a primary fuse.*

STEP 1. Locate the appropriate table based on the secondary-side overcurrent protective device. See page 77 for index to selection tables.

STEP 2. When using low-voltage circuit breakers: Calculate, in percent, the ratio of the highest feeder circuit breaker short-time or instantaneous pickup current* to the transformer secondary full-load current.

When using low-voltage current-limiting fuses: Calculate, in percent, the ratio of the highest feeder fuse ampere rating* to the transformer secondary full-load current.

When using "R" rated fuses in Class E-2 high-voltage industrial control equipment: Proceed to Step 3.

When using medium-voltage circuit breakers: Calculate, in percent, the ratio of the highest feeder circuit breaker overcurrent relay pickup current* to the transformer secondary full-load current.

STEP 3. When using low-voltage circuit breakers: Enter the table in the "Low-Voltage Secondary Circuit Breaker . . ." column containing the clearing time corresponding to the short-time delay or instantaneous setting, and circuit breaker application (i.e., feeder or main). Select the first line containing an entry equal to or larger than the value calculated in Step 2.†●

When using low-voltage current-limiting fuses: Enter the table in the "Low-Voltage Secondary Current-Limiting Fuse . . ." column corresponding to the fuse manufacturer and fuse application (i.e., feeder or main). Select the first line containing an entry equal to or larger than the value calculated in Step 2.†

When using "R" rated fuses in Class E-2 high-voltage industrial control equipment: Enter the table in the "High-Voltage Industrial Control Equipment . . ." column corresponding to the secondary voltage of the transformer. Select the first line containing an entry equal to or larger than the largest control equipment fuse rating.

When using medium-voltage circuit breakers: Enter the table in the "Medium-Voltage Secondary Circuit Breaker . . ." column pertaining to the range of relay pickup currents encompassing the value calculated in Step 2, and in the specific column corresponding to the relay characteristic. Select the first line containing an entry equal to or larger than the nominal relay operating time at maximum three-phase secondary fault current.§

STEP 4. In the line selected in Step 3, and in the "Transformer Protection Index . . ." column corresponding to the transformer connection, determine the Transformer Protection Index (TPI). If there is no TPI in this line, choose a smaller primary fuse ampere rating as described below. Compare the TPI to the entries listed in Table XIX, below, corresponding to the transformer connection and impedance. Entries greater than or equal to the TPI indicate the fault types for which transformer protection is provided in accordance with the transformer short-time characteristic curve. If protection is not provided for one or more of the fault types listed, you may wish to select a smaller primary fuse ampere rating to obtain a smaller TPI, as follows:

When using low-voltage circuit breakers: Lower the short-time or instantaneous pickup current by using a lower short-time or instantaneous setting (e.g., 2X instead of 4X). Return to Step 2.—And/Or—Use a lower short-time delay setting (i.e., "intermediate" setting instead of "maximum" setting), or use a high-level instantaneous setting, if available, in addition to a short-time delay setting (allowing use of the "Instantaneous" columns in the fuse selection tables). Return to Step 2.

When using low-voltage current-limiting fuses: Use a low-voltage fuse with a lower ampere rating or from a different manufacturer. Return to Step 2.

When using "R" rated fuses in Class E-2 high-voltage industrial control equipment: Use a fuse with a lower "R" rating. Return to Step 3.

When using medium-voltage circuit breakers: Lower the relay time-dial setting. Return to Step 3.—Or—Lower the relay pickup current. Return to Step 2.—Or—Use a different relay time-current characteristic. Return to Step 3.

If the above procedures do not produce complete coordination between the primary fuse and the main secondary-side protective device, it is suggested that you reconsider your coordination requirements as described on pages 25 through 27.

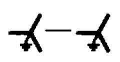
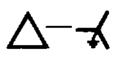
STEP 5. In the line selected in Step 4, and in the column headed "Loading Capability . . .," verify that the listed value is sufficient for your application. If not, read down the table in this column, stopping in the first line containing an adequate loading capability value. Verify that the entries in the secondary-side protective device ratings or settings columns and the "Transformer Protection Index . . ." columns are still acceptable. If not, try the next line down in this column, or you may wish to consider reducing your loading requirement.

STEP 6. The primary fuse ampere rating and time-current characteristic shown in the line selected above are those recommended for your application.

STEP 7. Verify that the primary fuse selected in Step 6 coordinates with the upstream protective device. See text, page 27.

STEP 8. To select the type of primary fuse (i.e., SM-4, SM-4Z, SM-5, SM-5S, SMD-20, SM-20, etc.), refer to Table XVIII on page 74. Based on the fuse location (i.e., indoor or outdoor), system voltage, interrupting duty, and maximum continuous current, note the power fuse types that can be used. Your local S&C Sales Office will help you make the most economical selection.

TABLE XIX—Secondary Fault Currents①

Transformer Connection	Impedance	Arcing ϕ-Grd Fault②	Maximum Primary-Side Line Current, for Various Types of Secondary Faults, Percent of Transformer Full-Load Current		
			ϕ-Grd	ϕ-ϕ	3ϕ
	4%	1000%	2500%	2180%	2500%
	5.5%	■	1820	1580	1820
	5.75%	700	1740	1510	1740
	6.5%	■	1540	1340	1540
	8%	500	1250	1090	1250
	4%	Not Applicable	Not Applicable	2180	2500
	5.5%			1580	1820
	5.75%			1510	1740
	6.5%			1340	1540
	8%			1090	1250
	4%	580	1450	2500	2500
	5.5%	■	1050	1820	1820
	5.75%	400	1010	1740	1740
	6.5%	■	890	1540	1540
	8%	290	730	1250	1250

① Reflected to primary lines.

② Commonly accepted arcing-fault-current values for secondary-switchboard and other nearby faults. See text, page 14.

■ For transformers with medium-voltage secondaries (2.4 kv or 4.16 kv), the entries in the "ϕ-Grd" column apply.

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* Alternately, the main secondary-side protective device can be used in this step if it is deemed necessary for the transformer-primary fuse to coordinate with the main secondary-side device instead of the largest feeder device.

† The entries listed in the columns for feeder applications are based on the coordination requirements for delta grounded-wye connected transformers. For grounded-wye grounded-wye or delta delta connected transformers, the tables may be used as described above by first dividing the value calculated in Step 2 by 1.15.

● For this purpose, treat low-voltage *fused* circuit breakers as circuit breakers with instantaneous settings.

§ The entries listed are based on the coordination requirements for delta grounded-wye connected transformers. For grounded-wye grounded-wye or delta delta connected transformers, the tables may be used as described above by first dividing the nominal relay operating time at maximum three-phase secondary fault current by 1.05 for Inverse and Very Inverse relays, or by 1.13 for Extremely Inverse relays.

TABLE XX—Index to Selection Tables

Transformer Rating (Self Cooled)			Secondary-Side Overcurrent Protective Device					
Kv	Kva, Three Phase	Impedance	Low-Voltage Molded-Case or Power Circuit Breaker		Low-Voltage Current-Limiting Fuse		Medium-Voltage Circuit-Breaker or Class E-2 High-Voltage Industrial Control Equipment	
			Table Number	Page Number	Table Number	Page Number	Table Number	Page Number
4.16	300 thru 750 750 1000 1000 1000 1500 1500 thru 3750	4% 5.75% 4% 5.75% 8% 4% 5.75%	IV	40 and 41	IX	50 thru 52	—	—
12.0-12.47	300 thru 750 750 1000 1000 1000 1500 1500 thru 3750	4% 5.75% 4% 5.75% 8% 4% 5.75%	V	42 and 43	X	53 thru 56	—	—
	1500 thru 5000 7500 and 10000	5.5% 6.5%	—	—	—	—	XIV	66 and 67
13.2-13.8	300 thru 750 750 1000 1000 1000 1500 1500 thru 3750	4% 5.75% 4% 5.75% 8% 4% 5.75%	VI	44 and 45	XI	57 thru 59	—	—
	1500 thru 5000 7500 and 10000	5.5% 6.5%	—	—	—	—	XV	68 and 69
22.9-24.9	300 thru 750 750 1000 1000 1000 1500 1500 thru 3750	4% 5.75% 4% 5.75% 8% 4% 5.75%	VII	46 and 47	XII	60 thru 62	—	—
	1500 thru 5000 7500 and 10000	5.5% 6.5%	—	—	—	—	XVI	70 and 71
33.0-34.5	300 thru 750 750 1000 1000 1000 1500 1500 thru 3750	4% 5.75% 4% 5.75% 8% 4% 5.75%	VIII	48 and 49	XIII	63 thru 65	—	—
	1500 thru 5000 7500 and 10000	5.5% 6.5%	—	—	—	—	XVII	72 and 73

Note: See over for "How to Use the Fuse Selection Tables" on page 76. For your convenience, these instructions should be left folded out for ready reference while using the fuse selection tables.

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