Application of Primary Fuses

Introduction

The wide variety of fuse links offered by the A.B. Chance Company is instrumental in reducing the many problems facing today's coordination engineers. Besides the increasingly popular ANSI K and T fuse links, there is available a series of precision engineered fuse links designed especially for transformer protection.

The up to date design and construction plus rigid quality control of Chance fuse links assures the coordination engineer of dependable electrical and mechanical fuse link operation. In nearly all cases regardless of the application or coordination problem there is a Chance fuse link to fill the need.

Scope

To more clearly understand why Chance fuse links are the answer to your every day fusing problems let us take a closer look at what is expected of a fuse link as a protective device. The following discussion of fuse link application and coordination will be limited to fuse links only. However, in actual practice the utility engineer must take into consideration substation breakers and relay settings, reclosers, sectionalizers, and power fuses. These devices are found on nearly all systems and their coordination must be treated in a manner similar to that which will be discussed for fuse links.

The Fuse Link as a Protective Device

The fuse link may be considered as the electrical weak element in the distribution system. This so-called weak element is purposely introduced into the system to prevent any damage to the lines and equipment which make up the distribution network. Whenever an overload or fault current passes through a section of line or a piece of equipment the fuse link which is the weakest element electrically must melt in time to open the circuit and prevent damage to the line or equipment. The relationship of the magnitude current passing through the link to the time required for the link to melt is referred to as the minimum melting time current characteristic of the fuse link, Figure 1. The relationship of the magnitude of the current passing through the link to the time required for the link to melt and the arc to be extinguished is referred to as the total clearing time-current characteristics of the fuse link, Figure 1.

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NOTE: Because Hubbell has a policy of continuous product improvement, we reserve the right to change design and specifications without notice.

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Transformer Overcurrent Protection

Consider first the fuse link as an overcurrent protective device. In such an application, Figure 2, the]ink serves to protect a piece of electrical equipment from any damage resulting from an overcurrent. The selection of proper fuse links to protect equipment from overcurrent is determined by the overcurrent capacity of the equipment involved. Fortunately the overcurrent capacity of electrical equipment is quite often expressed in a time and current relationship. The electrical equipment most commonly protected against overcurrent is the distribution transformer. The time-current overcurrent capacity of distribution transformers is given in ANSI/IEEE C 57.109 entitled "Guide For Transformer Through-Fault-Current Duration." With the overcurrent time-current capacity of the equipment known, and by the use of time-current characteristic fuse link curves the proper fuse link can be chosen. The ideal fuse link should provide 100% protection. In other words at any value of overcurrent or secondary fault current up to the maximum fault current available, the fuse link should operate and clear the circuit before the equipment is damaged. In actual practice however, some utilities may select fuse links which permit loading of equipment in excess of their overcurrent capacity. This policy reduces the amount of refusing necessary but also subjects equipment to overcurrent which can damage it or shorten its life expectancy.

Short Circuit Protection

The ability to protect transformers and other electrical equipment from overcurrent is not all that is required of a fuse link. A fuse link must act quickly to isolate equipment or lines when the equipment suffers internal or external failure or when the line is subjected to a fault. This requirement is necessary to limit the outage to the smallest possible area. It is also necessary in order to minimize damage to the equipment and lines. Limiting outages to the smallest area not only provides greater continuity of electrical service but also reduces the problem of locating failed or damaged equipment.

Fuse links are not only applied at the transformer but are also found in locations on the distribution system where only short circuit protection is required; such a situation is shown in Figure 2 where the fuse link is referred to as a sectionalizing or lateral fuse. The selection of the lateral fuse link is dictated by the full load current and fault current at the point of its location and by the time-current characteristics of the largest fuse link in the lateral. The process of making this selection is called coordination of fuse links and will be discussed in detail under the heading of "Coordination of Sectionalizing Fuses."

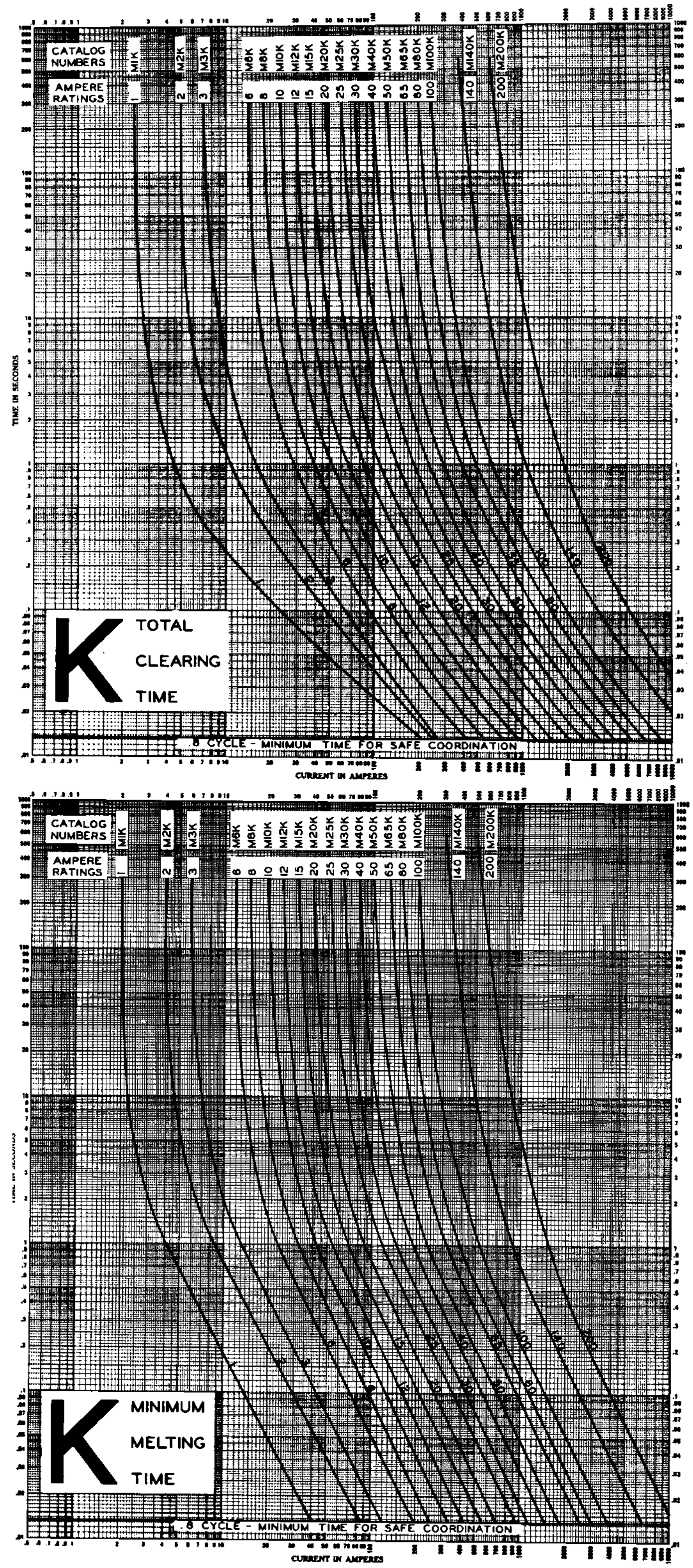


Figure 1

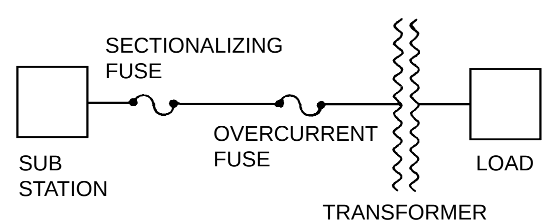


Figure 2

MECHANICAL APPLICATION OF FUSE LINKS IN CUTOUTS

The first step in the application of fuse links is to determine the type of cutout in which the fuse link is to be used, and thereby establish the fuse link construction required. For example, most open type and enclosed type cutouts are designed to use the 20 inch minimum length "universal" type fuse links. Most 18 and 23 kV cutouts and even some 15 kV cutouts require fuse links longer than the 20 inch length. Open link type cutouts require an open link type fuse link specifically designed for the purpose. Special cutouts may impose additional mechanical requirements on the fuse links. Because of the adaptability of the fuse links offered by the A. B. Chance Company these requirements can be met in nearly all cases regardless of the cutout in use. Where problems exist on mechanical applications not readily solved consult your Chance representative.

ELECTRICAL APPLICATION FUSE LINKS

The following factors are pertinent to the proper application of fuse links on a distribution system:

1. Safe loading characteristics of equipment to be protected.
2. In the case of transformer fuses, the degree of overcurrent protection to be provided.
3. Load current at the point of application.
4. The fault current available at various locations on the system.
5. Time current characteristics of fuse links to be used on the system.
6. The type of protection to be provided by the fuse link.

A typical lateral of a distribution system is shown in Figure 3. The information given in Figure 3 covers most of the factors listed above. Providing that no secondary fuses are used, the fuse links located at the transformers ideally should provide overcurrent protection, and should protect the sectionalizing fuse link. The sectionalizing fuse link will operate to isolate the entire lateral and protect the remainder of the system from interruption when a primary fault occurs between it and the transformer fuse links. At the cross marks on the line diagram of the lateral are indicated the fault current available at the various locations. The rated full load current of each single phase transformer can be calculated by dividing the KVA of the transformer by its kV rating. If we assume all transformers to be fully loaded the load current in the sectionalizing fuse link will be approximately the sum of the individual transformer full load currents.

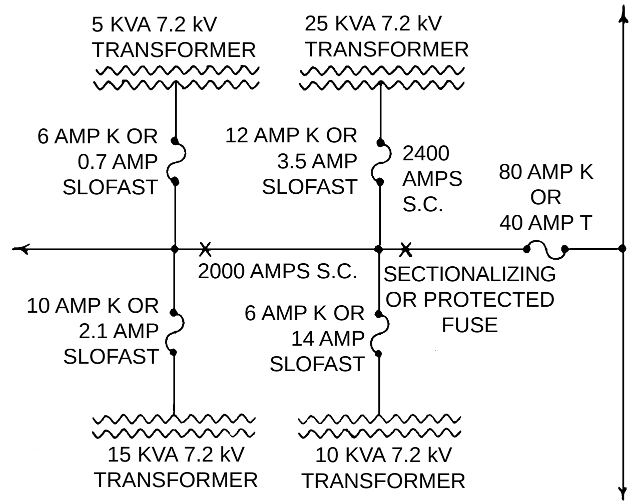
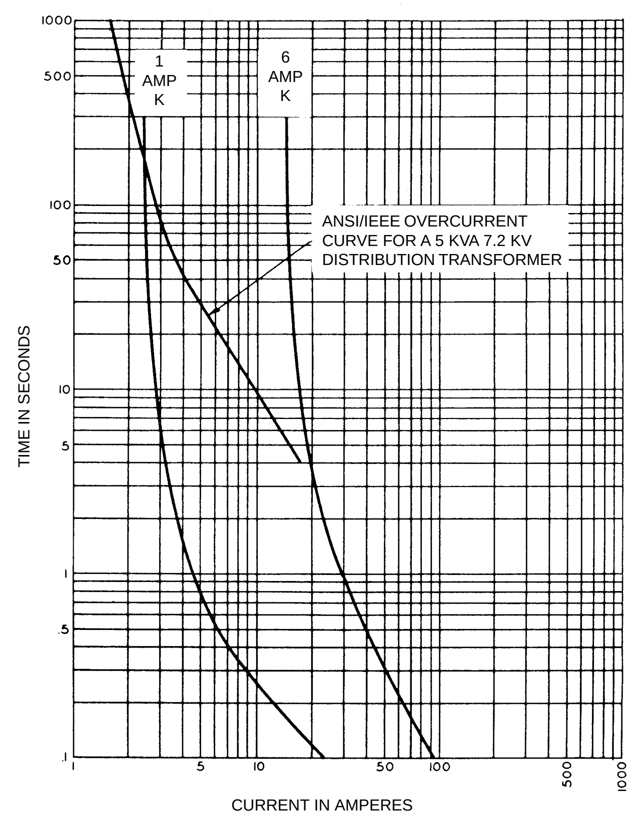


Figure 3

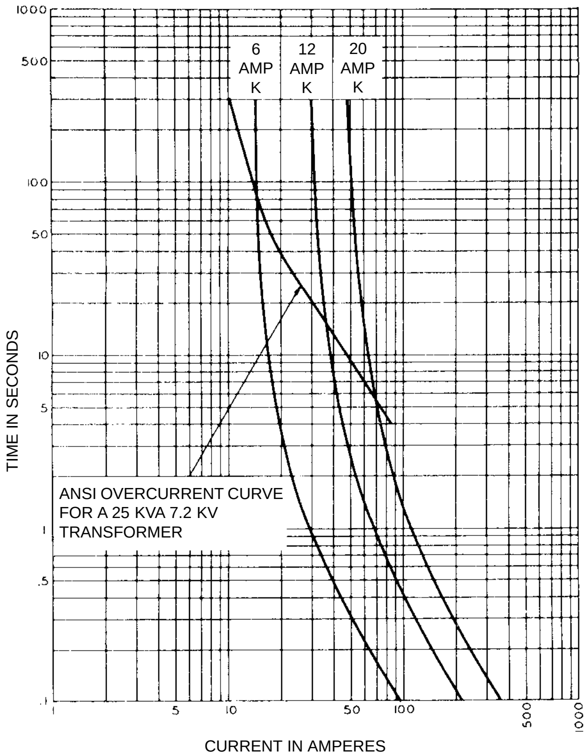
Transformer Fusing

Using the information given in Figure 3, let us determine the fuse link required for each transformer. Assume the utility has standardized on the ANSI type K fuse links for reasons of economy and supply. The 5 KVA 7.2 kV transformer has a full load current rating of approximately 0.7 amperes. Any 1 ampere fuse link will carry the full load current of this transformer without melting. However, consideration must be given to the time current characteristics of the 1 ampere fuse link compared with the overload capacity of this transformer. The ANSI overcurrent curve for this distribution transformer is shown in Figure 4. Also



ASA CURVE AND K TOTAL CLEARING CURVES

Figure 4



ANSI CURVE AND K TOTAL CLEARING CURVES

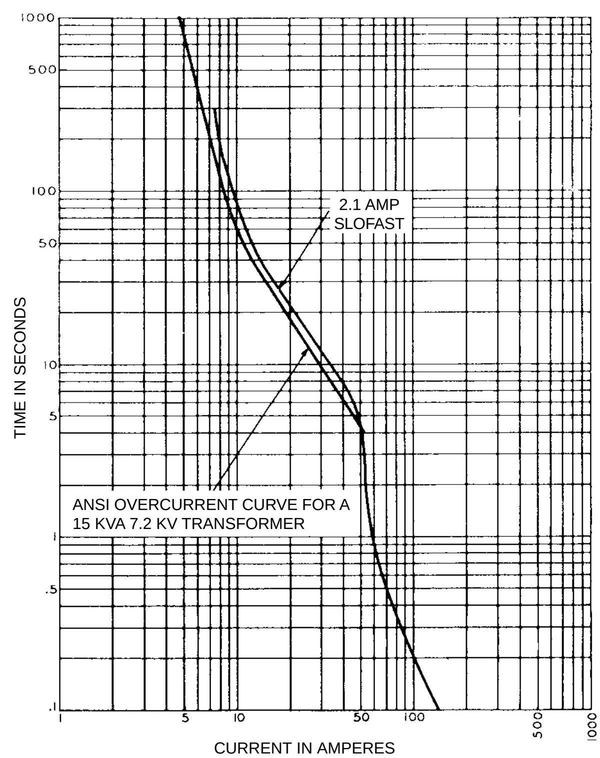
Figure 5

shown is the total clearing time curve of the Chance 1 ampere type K fuse link. Examination of Figure 4 reveals that although protection is provided for the transformer its full overcurrent capacity at the high values of current is not realized. The fusing of this transformer with a 1 ampere type K fuse link will result in the transformer being taken out of service under many overcurrent conditions which would not have damaged the transformer in any way. In order to realize the full overcurrent capacity of the transformer the 6 ampere type K fuse link in many instances would be chosen. The total clearing time curve of the 6 ampere type K fuse link is also shown in Figure 4. The application of the 6 ampere type K fuse link eliminates many unnecessary outages, but all overcurrent protection is lost. The only function that this fuse link can perform is to isolate the transformer from the system in case of faults. Many utilities justify this over-fusing of transformers by the assumption that most secondary faults or overloads will clear themselves before any damage to the transformer can occur. The above assumption seems to hold true in some cases, but in others the record of burned out transformers, does not justify this over-fusing practice.

The overcurrent curve of the 25 KVA transformer is shown in Figure 5. Since these larger transformers are more expensive some utilities feel that it is necessary to compromise between no transformer protection and lOO% transformer protection. In such cases, the 12 ampere K fuse link might be selected for fusing the 25 KVA transformer. The use of this 12 ampere K fuse link utilizes some of the overcurrent capacity of the transformer but a large portion of this capacity is sacrificed. Also, protection is lost against low overcurrents of long duration.

It can be seen from the preceding discussion that the conventional type K fuse link leaves much to be desired in the way of transformer protection. Let us consider the steps possible to provide more ideal transformer protection where such protection is considered essential. There have been for many years fuse links available with “dual” time current characteristics. These fuse links have characteristics which lend themselves to better protection and utilization of the overcurrent capacity of distribution transformers.

The A. B. Chance Company developed and markets a complete line of dual characteristic fuse links. These fuse links have been so refined that their time current characteristic curves, to all practical purposes, coincide with the ANSI transformer overcurrent curve. In Figure 3, note that the alternate proper SloFast fuse links for the transformer installations are recorded as well as the applicable type K fuse links. Figure 6 is a comparison of the total clearing time curve of a 21 ampere SloFast fuse link with the ANSI overcurrent curve for a 15 KVA 7.2 kV transformer. The rather unusual current rating assigned to SloFast fuse links is an aid in their application since the current rating assigned is identical to the continuous current rating of the transformer which they were specifically designed to protect. It can be seen from Figure 6 that the SloFast fuse link provides the highest degree of transformer protection and yet allows maximum use of available transformer overcurrent capacity.



ANSI CURVE AND SLOFAST TOTAL CLEARING CURVE

Figure 6

Coordination of Sectionalizing Fuses

In selecting a fuse link for use at a sectionalizing point, we must give consideration to coordination, that is the cooperation of one fuse link with another to limit outages to the smallest possible section of the distribution system.

When coordination is being considered, the sectionalizing fuse link shown in Figure 3 is referred to as the "protected" fuse, whereas the fuse links located at the transformers are referred to as "protecting" fuses. These two terms, "protected" and "protecting" are used to indicate that one fuse link, the protecting, operates and clears the circuit before the other, the protected, is damaged. In order to provide the necessary coordination between these fuse links we must refer to the fuse link time current characteristic curves. Using these curves, we first determine the maximum total time required by the protecting fuse link to clear the maximum short circuit fault current which is available at the point of its application. The proper protected fuse must carry the full load current and have a minimum melting time greater than the maximum total clearing time of the protecting fuse at the maximum fault current available at the protecting fuse. To provide protection against operating variables, 75% of the minimum melting time of the protected fuse link is often used. Naturally, in determining the coordination of the sectionalizing fuse link with transformer fuse links the largest transformer fuse link in the section should be considered since it will place the strictest coordination requirements on the sectionalizing fuse link.

In Figure 3 it is necessary to determine the sectionalizing fuse link required to coordinate with the largest fuse link in the branch which in this case is the 3.5 ampere SloFast fuse link used to protect the 25 KVA transformer. The total clearing time curve of the 3.5 ampere SloFast fuse link indicates that the maximum time required by this fuse link to clear a 2400 ampere fault is .0134 seconds. The proper sectionalizing fuse link, therefore, must be capable of carrying 2400 amperes for .0134 seconds without being damaged. The ANSI type T fuse links have been selected for our sectionalizing fuse because of their slow time current characteristics. The minimum melting time curves of the type T fuse links indicate that the minimum melting time of a 40 ampere T link at 2400 amperes is .0185 Sec. As previously stated, to allow for operating variables, 75% of this minimum melting time is used, or .0139 seconds. The 40 ampere T fuse link will, therefore, meet the necessary coordination requirements.

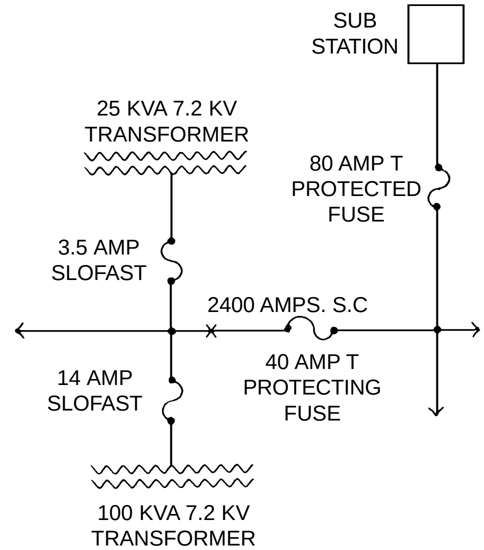
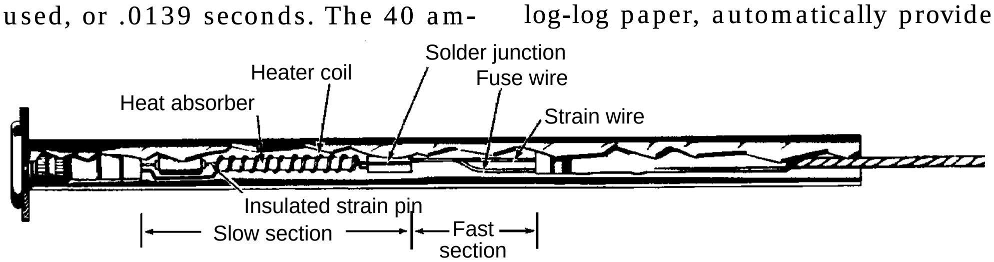


Figure 7

Where two sectionalizing fuses are in series the one farthest from the power source becomes the protecting link and the one nearest the power source becomes the protected link. In this application the proper protected link has to be selected in the same manner as in the application where a transformer fuse protects a sectionalizing fuse. As an example, there are two sectionalizing fuses shown in series in Figure 7. In the consideration to select the proper fuse link for the point nearest the power source this fuse link becomes the protected link. It has already been determined that a 40 ampere type T link is required for what has now become the protecting link. By reference to the time current characteristic curves and the use of the 75% operating variable factor it can be determined that the protected link should be an 80 ampere type T.

Use of Time Current Characteristic Curves and Coordination Tables

Since time current characteristic curves are usually printed on transparent paper, it is possible to overlay the total clearing time characteristic curve with the minimum melting time characteristic curve or vice versa. The minimum melting curve can be shifted downward by 25% with respect to the total clearing time curve. This shift, since the curves are printed on log-log paper, automatically provides for 75% of the



The dual element SloFast Fuse Link has two distinct sections to assure overall protection.

minimum melting time to be used in coordination. With the time current characteristic curves so arranged we can readily determine the values of current at which any two fuse links will coordinate.

To simplify the process of coordination the A. B. Chance Company also provides coordination charts for all fuse links which they manufacture. In the case of the SloFast fuse links, coordination charts are provided with the SloFast link as the protecting fuse link and all other Chance fuse links as the protected fuse links. These charts are used to determine the proper protected fuse link when the short circuit current available and the size of the protecting fuse link are known.

The use of coordination charts can be illustrated in Figure 7 by determining the proper fuse link to be located nearest the substation. In order to use the charts, we must first determine which fuse link is the protecting fuse link and which fuse link is the protected fuse link. The protected fuse link is always the fuse link which is located nearest the power source and the protecting fuse link is that fuse link located adjacent to the protected fuse link and nearest the load. Refer to the coordination chart of the type T fuse link. If a 40 ampere Type T fuse link is the protecting fuse link and the available short circuit current is 2400 amperes, this chart indicates that the protected link must be an 80 ampere T. The 80 ampere T link will coordinate with a 40 ampere T link at short circuit currents up to 3700 amperes.

"Rule of Thumb" Method for Coordination of ANSI Type K or Type T Fuse Links

Another method of coordinating fuse links is possible when the ANSI K or T fuse links are used. This is referred to as the "Rule of Thumb" method. The "Rule of Thumb" method is stated as follows:

Satisfactory coordination between adjacent ratings of preferred or adjacent ratings of non-preferred fuse links is provided up to current values of 13 times the smaller or protecting fuse link rating for Type K fuse links and 24 times the smaller or protecting fuse link rating for Type T fuse links.

The above coordination factors are made possible by the standardization of maximum allowable arcing time applied to the fuse links. The 75% of minimum melting time factor is also taken into consideration by this rule of thumb method. Obviously, when ANSI fuse links are used, the rule of thumb method simplifies the process of coordination in some instances.

Referring again to Figure 7, this method can be used in checking the fuse link required adjacent to the substation . In using the rule of thumb method, we must again use the terms "protected" and "protecting" fuse links. The method states that satisfactory coordination between adjacent preferred or adjacent non-preferred ratings of type "T" fuse links is possible if the short circuit current does not exceed twenty-four times the rating of the protecting fuse link, or in this case our 40 ampere "T" fuse link. It is evident that if the short circuit current does not exceed 960 amperes (24 x 40 + 960) we could use a 65 ampere T fuse link at the substation. However, the actual current is 2400 amperes and the rule of thumb method only establishes that a "T" fuse link larger than the 65 ampere rating is required. Either of the two previous described methods (time current curves or coordination charts) can be used to determine this larger required "T" fuse link.

MECHANICAL INTERCHANGEABILITY

In addition to electrical characteristics, a fuse link must have certain physical and mechanical features in order for it to be interchangeable. Mechanical interchangeability is equally as important as electrical interchangeability. Besides the standard universal fuse link for open and enclosed type cutouts, there are a few special fuse links for use in what might be called non-conventional or non-universal type cutouts.

TABLE 1
COORDINATION CHART
for
CHANCE TYPE “K” (FAST) ANSI FUSE LINKS

Protecting Type “K” Fuse Link Ampere Rating	Protected Type “K” Fuse Link Ampere Rating														
	6	8	10	12	15	20	25	30	40	50	65	80	100	140	200
	Maximum Currents (R.M.S. Amperes) For Safe Co-ordination														
1	145	220	295	370	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
2	100	185	295	370	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
3	60	150	295	370	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
6			170	320	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
8				190	400	620	840	1000	1300	1600	2250	2650	3450	5800	9400
10					250	480	840	1000	1300	1600	2250	2650	3450	5800	9400
12						310	700	1000	1300	1600	2250	2650	3450	5800	9400
15							440	750	1300	1600	2250	2650	3450	5800	9400
20								480	1000	1600	2250	2650	3450	5800	9400
25									600	1175	2250	2650	3450	5800	9400
30										740	1840	2650	3450	5800	9400
40											1150	1950	3450	5800	9400
50												1250	2650	5800	9400
65													1500	5800	9400
80														4800	9400
100														3000	9400
140															4500
200															

Above Coordination Chart based on maximum total clearing time of the protecting link and the minimum melting time of the protected link.

TABLE 2
COORDINATION CHART
for
CHANCE TYPE “T” (SLOW) ANSI FUSE LINKS

Protecting Type “T” Fuse Link Ampere Rating	Protected Type “T” Fuse Link Ampere Rating														
	6	8	10	12	15	20	25	30	40	50	65	80	100	140	200
	Maximum Currents (R.M.S. Amperes) For Safe Co-ordination														
1	280	390	510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
2	280	390	510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
3	280	390	510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
6			340	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
8				400	850	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
10					480	990	1500	1900	2490	3000	3900	4800	6200	9500	15000
12						550	1190	1900	2490	3000	3900	4800	6200	9500	15000
15							670	1500	2490	3000	3900	4800	6200	9500	15000
20								890	2000	3000	3900	4800	6200	9500	15000
25									1100	2250	3900	4800	6200	9500	15000
30										1250	3000	4800	6200	9500	15000
40											1700	3700	6200	9500	15000
50												2100	5000	9500	15000
65													2700	9500	15000
80														6600	15000
100														3900	15000
140															5200
200															

Above Coordination Chart based on maximum total clearing time of the protecting link and the minimum melting time of the protected link.

TABLE 3
COORDINATION CHART
for
CHANCE "MS" FUSE LINKS

Protecting Type "MS" Fuse Link Ampere Rating	Protected Type "MS" Fuse Link Ampere Rating															
	3	5	7	10	15	20	25	30	40	50	65	80	100	125	150	200
	Maximum Currents (R.M.S. Amperes) For Safe Co-ordination															
3			640	980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
5				980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
7					850	1600	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
10						780	1650	2600	3250	4200	5300	6200	8400	10000	10000	10000
15							1000	1900	3250	4200	5300	6200	8400	10000	10000	10000
20								1200	2250	4000	5300	6200	8400	10000	10000	10000
25									1400	3000	5300	6200	8400	10000	10000	10000
30										2150	3900	6200	8400	10000	10000	10000
40											2800	4900	8400	10000	10000	10000
50												3200	6200	10000	10000	10000
65													1400	7300	10000	10000
80														1700	9700	10000
100															6700	10000
125																10000
150																8200
200																

Above Coordination Chart based on maximum total clearing time of the protecting link and the minimum melting time of the protected link.

TABLE 4
COORDINATION CHART
for
CHANCE TYPE SLOFAST FUSE LINKS

Protecting Type SloFast Fuse Link Ampere Rating	Protected Type SloFast Fuse Link Ampere Rating																	
	.2	.3	.4	.6	.7	1.0	1.3	1.4	1.6	2.1	3.1	3.5	4.2	5.2	6.3	7.0	7.8	10.4
	Maximum Currents (R.M.S. Amperes) For Safe Co-ordination																	
.2		35	52	62	65	112	135	143	175	230	325	340	440	530	620	660	820	1060
.3						87	112	120	160	225	325	340	440	530	620	660	820	1060
.4						75	100	110	150	215	325	340	440	530	620	660	820	1060
.6						67	95	104	145	211	325	340	440	530	620	660	820	1060
.7						60	90	100	140	208	325	340	440	530	620	660	820	1060
1.0									90	168	295	315	440	530	620	660	820	1060
1.3										145	275	300	415	530	620	660	820	1060
1.4										130	265	285	405	530	620	660	820	1060
1.6											230	250	380	500	620	660	820	1060
2.1													310	445	570	610	820	1060
3.1														330	450	510	740	1050
3.5														300	430	480	700	1025
4.2															300	350	610	940
5.2																	480	820
6.3																		690
7.0																		650
7.8																		
10.4																		

Above Coordination Chart based on maximum total clearing time of the protecting link and the minimum melting time of the protected link.

TABLE 5
COORDINATION CHART
for
CHANCE TYPE SLOFAST AND TYPE “K” (FAST) ANSI FUSE LINKS

Protecting Type SloFast Fuse Link Ampere Rating	Protected Type “K” Ampere Rating															
	3	6	8	10	12	15	20	25	30	40	50	65	80	100	140	200
	Maximum Currents (R.M.S. Amperes) For Safe Co-ordination															
.2	78	165	220	295	370	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
.3		140	210	295	370	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
.4		125	195	295	370	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
.6			190	285	370	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
.7			190	285	370	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
1.0				240	350	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
1.3					320	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
1.4					320	490	620	840	1000	1300	1600	2250	2650	3450	5800	9400
1.6						440	620	840	1000	1300	1600	2250	2650	3450	5800	9400
2.1							550	840	1000	1300	1600	2250	2650	3450	5800	9400
3.1								700	950	1300	1600	2250	2650	3450	5800	9400
3.5								700	950	1300	1600	2250	2650	3450	5800	9400
4.2									820	1230	1600	2250	2650	3450	5800	9400
5.2										1100	1550	2250	2650	3450	5800	9400
6.3											1400	2250	2650	3450	5800	9400
7.0											1400	2250	2650	3450	5800	9400
7.8												2000	2550	3450	5800	9400
10.4												1700	2300	3250	5800	9400

Above Coordination Chart based on maximum total clearing time of the protecting link and the minimum melting time of the protected link.

TABLE 6
COORDINATION CHART
for
CHANCE TYPE SLOFAST AND TYPE “T” (SLOW) ANSI FUSE LINKS

Protecting Type SloFast Fuse Link Ampere Rating	Protected Type “T” Fuse Link Ampere Rating															
	3	6	8	10	12	15	20	25	30	40	50	65	80	100	140	200
	Maximum Currents (R.M.S. Amperes) For Safe Co-ordination															
.2	83	285	385	510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
.3		285	385	510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
.4		285	385	510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
.6		275	385	510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
.7		275	385	510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
1.0			370	510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
1.3				510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
1.4				510	690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
1.6					690	920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
2.1						920	1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
3.1							1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
3.5							1150	1500	1900	2490	3000	3900	4800	6200	9500	15000
4.2								1500	1900	2490	3000	3900	4800	6200	9500	15000
5.2									1900	2490	3000	3900	4800	6200	9500	15000
6.3									1800	2490	3000	3900	4800	6200	9500	15000
7.0									1800	2490	3000	3900	4800	6200	9500	15000
7.8										2300	3000	3900	4800	6200	9500	15000
10.4											2800	3900	4800	6200	9500	15000

Above Coordination Chart based on maximum total clearing time of the protecting link and the minimum melting time of the protected link.

TABLE 7
COORDINATION CHART
for
CHANCE TYPE SLOFAST AND TYPE "MS" FUSE LINKS

Protecting Type SloFast Fuse Link Ampere Rating	Protected Type "MS" Fuse Link Ampere Rating															
	3	5	7	10	15	20	25	30	40	50	65	80	100	125	150	200
	Maximum Currents (R.M.S. Amperes) For Safe Co-ordination															
.2	300	410	650	980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
.3	300	410	650	980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
.4	300	410	650	980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
.6	300	410	650	980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
.7	300	410	650	980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
1.0		400	650	980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
1.3			650	980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
1.4			650	980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
1.6			650	980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
2.1				980	1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
3.1					1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
3.5					1300	1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
4.2						1630	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
5.2						1500	2100	2600	3250	4200	5300	6200	8400	10000	10000	10000
6.3								2600	3250	4200	5300	6200	8400	10000	10000	10000
7.0								2600	3250	4200	5300	6200	8400	10000	10000	10000
7.8									3250	4200	5300	6200	8400	10000	10000	10000
10.4									3000	4200	5300	6200	8400	10000	10000	10000

Above Coordination Chart based on maximum total clearing time of the protecting link and the minimum melting time of the protected link.

TABLE 8
ELECTRICAL AND MECHANICAL INTERCHANGEABILITY TABLE
for
EQUIVALENT FUSE LINKS

Chance Type MSA Fuse Links		Kearney Type KS and KS-U Fuse Links	
Ampere Rating	Catalog Number	Ampere Rating	Catalog Number
3	M3MSA	3	21003 & 21003-U
5	M5MSA	5	21005 & 21005-U
7	M7MSA	7	21007 & 21007-U
10	M10MSA	10	21010 & 21010-U
15	M15MSA	15	21015 & 21015-U
20	M20MSA	20	21020 & 21020-U
25	M25MSA	25	21025 & 21025-U
30	M30MSA	30	21030 & 21030-U
40	M40MSA	40	21040 & 21040-U
50	M50MSA	50	21050 & 21050-U
65	M65MSA	65	21065 & 21065-U
80	M80MSA	80	21080 & 21080-U
100	M100MSA	100	21100 & 21100-U
125	M125MSA	125	21125 & 21125-U
150	M150MSA	150	21150 & 21150-U
200	M200MSA	200	21200 & 21200-U

CONVERSION TO ANSI FUSE LINKS

Advantages of Conversion

Through the joint efforts of users and manufacturers, the ANSI Standards for Distribution Fuse Links were established to provide the levels of performance and utility necessary to meet modern protective practices and operating conditions. They serve the two-fold purpose of providing guidance to the manufacturer and assurance to the user that specific electrical requirements are met.

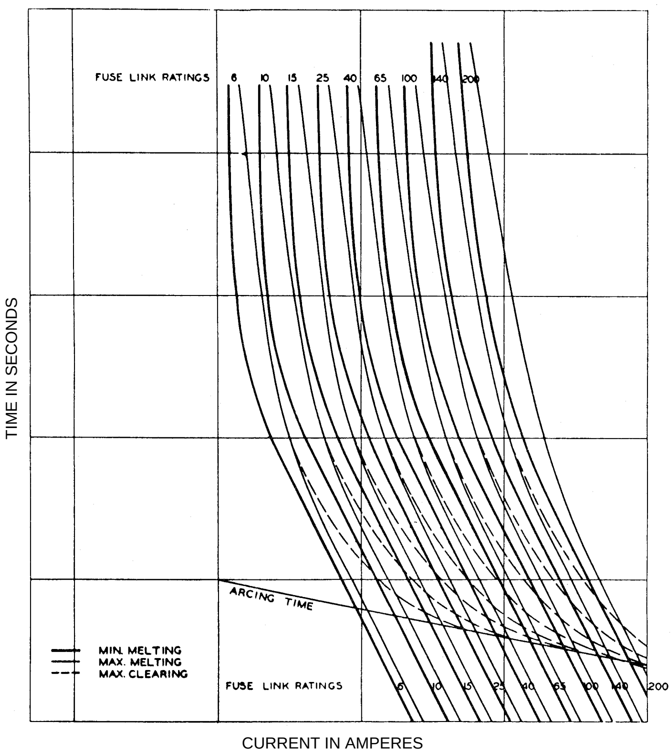
These joint standards, along with existing ANSI standards, set forth characteristics that will allow and provide for the electrical, as well as mechanical, interchangeability of fuse links. Conversion to ANSI standard fuse links therefore permits multiple sources of supply for fuse links.

The ANSI standards are prepared so as to still permit the utility engineer to select fuse links using his individual judgment based on the details of manufacture, use with related equipment and other application factors.

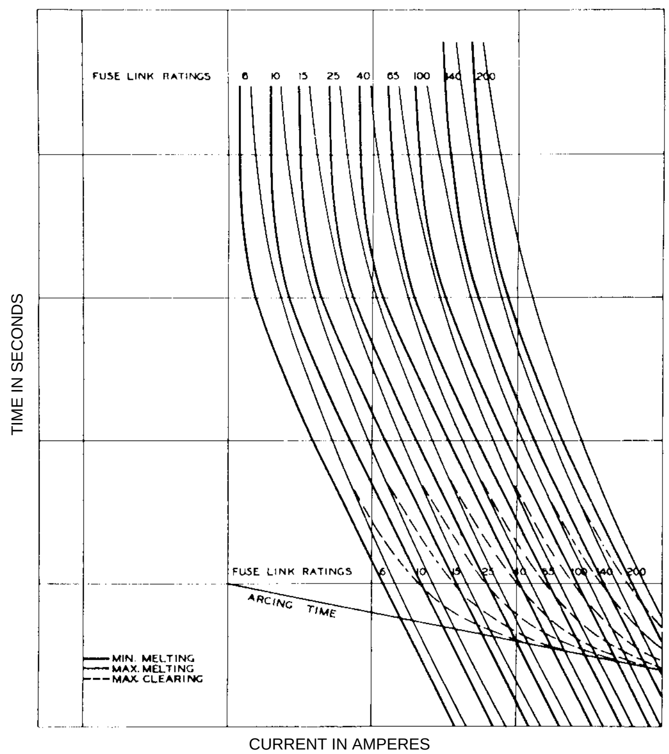
Two Speed Ratios Available

The joint ANSI standards have established two types of fuse links, designated Type “K” and Type “T”. The Type “K” link commonly called “fast” has speed ratios of the melting time-current characteristics varying from 6 for the 6-ampere rating to 8.1 for the 200 ampere rating. Type “T” (slow) fuse links have speed ratios of the melting time-current characteristic varying from 10 for the 6-ampere rating to 13 for the 200 ampere rating.

The type of link selected, “K” or “T”, is based largely on the time-current characteristics of the fuse link presently used, if such characteristics meet present day coordination requirements. The more closely the time-current characteristics meet those of the present fuse links, the easier the conversion.



“Representative” minimum and maximum time current characteristic curves for ANSI Type “K” (fast) fuse links.



“Representative” minimum and maximum curves for ANSI Type “T” (slow) fuse links.

Converting to EEE-NEMA Links

After the type of link, “K” or “T” is selected, the following steps are suggested as a guide to implementing a conversion program.

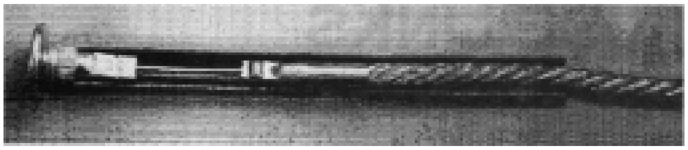
1. Select the supplier — Considerations in determining which manufacturer or manufacturers from whom you would purchase fuse links include availability of stocks, reputation of company service rendered by salesman, and, of course, the quality and consistency of performance of the fuse links produced.

Samples of links should be obtained from all potential suppliers and should include all physical types — solid buttonhead, removable buttonhead and/or open link styles — that you would use on your system.

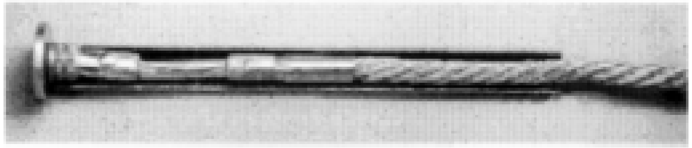
Construction details such as construction of the fuse element, auxiliary tubes and fuse link cable size and coating should also be considered along with the quality and performance of the fuse links produced.

In Chance type “K” fuse links, elements are made of silver copper or silver alloy and Type “T” fuse links are made with a tin fuse element.

The purpose of the auxiliary tube is to assist the cutout in the clearing of low fault currents and to protect the fuse element from physical damage.



Type K Fuse Link



Type T Fuse Link

The weather resistance of these auxiliary tubes should be evaluated since any fuse link may be in service many years before it operates.

The type of coating used on the fuse link cable should prevent excessive corrosion which could result in cable breakage. Chance engineers have found that lead coating gives excellent resistance to corrosion.

It is imperative that every link used on your system consistently match the published time-current characteristic curves so as to properly coordinate the protective equipment.

2. Make-up composite time current characteristics curves — In order to meet specified electrical interchangeability requirements, all manufacturers' fuse links are required to meet minimum and maximum melting current value at three time points (a) 300 seconds for fuse links rated 100 amps and below and 600 seconds for fuse links rated 140 and 200 amps, (b) 10 seconds and (c) 0.1 seconds. These standards for minimum, and maximum melting time result in a band curve for each rating of each type (see Fig. 1 and 2 on page 2).

Because these ANSI standards allow a band width for the minimum and maximum melting time curves and a variance in factors applied for arcing time by different manufacturers, each manufacturer's curve varies slightly although still within the limits of the standards. It is therefore recommended that on each size of link a composite minimum melting curve and a composite total clearing time curve be constructed from the individual curves on each make of link to be used. This can be done by preparing a chart for each size link as shown below.

To actually prepare the composite curve for each size link, the minimum figure at each current rating should be selected and plotted for the minimum melting composite curve.

When plotting the total clearing time curve, the maximum figure should be selected at each current rating.

The composite curves thus obtained will provide a band within which the fuse links of all the selected suppliers will operate.

TABULATION OF MINIMUM MELTING CURRENT VALUES TYPE K 10 AMP FUSE LINK

Time Period in Seconds	CHANCE	A	B	C
	Manufacturer — Current in Amperes			
300	19.5	19.5	19.5	20.0
100	20.0	20.0	20.0	21.0
10	25.0	23.0	24.5	26.0
1	42.5	43.0	43.0	45.0
.1	129.0	130.0	129.0	130.0

TABULATION OF MINIMUM CLEARING VALUES TYPE K 10 AMP FUSE LINK

Time Period in Seconds	CHANCE	A	B	C
	Manufacturer — Current in Amperes			
300	23.5	23.0	23.0	23.0
100	24.0	23.5	24.0	25.0
10	29.5	27.0	29.0	31.0
1	52.0	49.0	54.0	54.0
.1	167.0	170.0	170.0	180.0

3. Make-up cross reference charts — Using either the composite curves or the tabulations used to develop these composite curves, a cross reference chart like the one shown below should be made comparing the ANSI link and the link now in use. (See Fig. 8 for typical example.)

4. Check coordination with other overcurrent protection equipment — In some instances it may be necessary to check the coordination of the ANSI link with other overcurrent protection devices, but this should not be a serious problem unless the time-current characteristics of the selected ANSI link has a considerably different speed ratio than the fuse link now in use.

5. Change records and drawings — With the cross reference charts you can change over all records and drawings to specify the proper size ANSI links.

You are now ready to put these new links on your system. There are several methods by which this has been done. One of the following examples may be found to have particular advantages to your company.

Convert one division at a time, using salvaged links in un-converted districts.

Convert all but one division, using all the salvaged fuse links in one un-converted division until they are down to a disposable level.

Convert all divisions simultaneously, scrapped all non-ANSI links in stock.

Many factors will affect the conversion finally adopted. These factors can best be evaluated by the utility involved.

CHANCE TYPE MS AND MSA FUSE LINKS	RECOMMENDED CHANCE ANSI FUSE LINK		
	For Overload Protection of Transformers*	For Short Circuit Protection**	
Ampere Rating	Ampere Rating	Ampere Rating	
	"K" or "T"	"K"	"T"
3	3	10	6
5	6	12	8
7	8	20	10 or 12
10	10	25 or 30	15
15	15	40	20 or 25
20	20	50	25 or 30
25	25	65	30 or 40
30	30	80	40
40	40	80 or 100	50
50	50	100 or 140	65 or 80
65	65	140	80 or 100
80	80	140 or 200	100
100	100	140 or 200	100 or 140
125	100 or 140	200	140
150	140	—	200
200	140 or 200	—	—

Figure 6