

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 854

REQUIREMENTS FOR 28-VOLT D.C.

FLAT STRIP FUSES FOR AIRCRAFT

1st EDITION

October 1968

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BRIEF HISTORY

The ISO Recommendation R 854, *Requirements for 28-volt d.c. flat strip fuses for aircraft*, was drawn up by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led to the adoption of a Draft ISO Recommendation.

In May 1965, this Draft ISO Recommendation (No. 806) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Argentina	Israel	Sweden
Belgium	Italy	Switzerland
Brazil	Japan	U.A.R.
Canada	Netherlands	United Kingdom
Chile	Portugal	U.S.S.R.
Czechoslovakia	South Africa, Rep. of	Yugoslavia
France	Spain	

One Member Body opposed the approval of the Draft :

Germany

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in October 1968, to accept it as an ISO RECOMMENDATION.

REQUIREMENTS FOR 28-VOLT D.C. FLAT STRIP FUSES FOR AIRCRAFT

1. SCOPE

This ISO Recommendation indicates the ratings, dimensions and performance requirements for a particular range of 28 V d.c. fuse-links for aircraft, known as flat strip fuses (by virtue of their shape). The fuse-links are intended for use only in direct current electrical systems with a voltage not exceeding 28 V as a protection against short-circuit faults; they are not suitable for overload protection of equipment or cables. The links, normally constructed of a single strip element reduced in section over the fusible length and mounted in a body of ceramic or of equally suitable material, with toughened glass window, have a limited rupturing capacity which is related to the time constant of the circuit. It is considered important that the rated breaking capacity should be limited to a value at which it may safely be predicted that the window will not be shattered or displaced. In Table 1 a time constant at the location of the fuse adequate for most 28 V d.c. aircraft systems has been selected and the maximum safe prospective current stated for this particular time constant.

2. FIELD OF APPLICATION

The fuse-links are suitable for use at any ambient temperature from -65 to $+70^{\circ}\text{C}$ and at all altitudes from 0 to 12 200 m (40 000 ft). The time/current characteristic curves shown in the Annex are envelope curves enclosing the characteristics of this type of link of all known manufacture. It should be appreciated that the characteristic curves for individual fuse-links from a particular manufacturer may be within closer limits than those shown in the Annex.

This ISO Recommendation covers only the non-filled versions of the fuse-link.

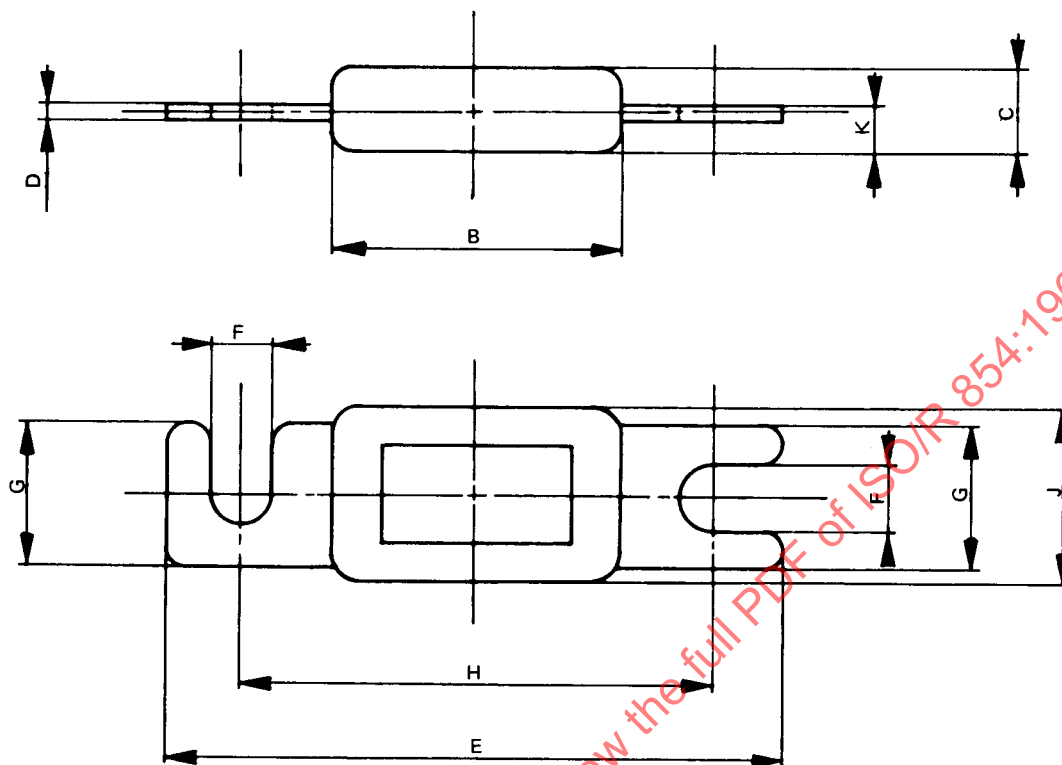
3. TERMINOLOGY

The terminology used in this ISO Recommendation is, as far as possible, in conformity with the International Electrotechnical Commission (IEC) Publication 66 : *Specification for fuses for voltages not exceeding 1000 V for a.c. and d.c.*

4. DIMENSIONS

The dimensions of the fuse-links should be in accordance with those shown in Figure 1.

All dimensions are symmetrical about the centre lines.



Dimension	millimetres	inches
<i>B</i>	36 ± 0.76	1.416 ± 0.029
<i>C</i>	9.4 ± 0.4	0.375 ± 0.015
<i>D</i>	2.4 max.	0.093 max.
<i>E</i>	81 ± 0.13	3.19 ± 0.005
<i>F*</i>	8.64 ± 0.13	0.340 ± 0.005
<i>G</i>	19 ± 0.13	0.75 ± 0.005
<i>H</i>	62 ± 0.13	2.44 ± 0.005
<i>J</i>	22.2 ± 0.46	0.874 ± 0.018
<i>K</i>	3.17 ± 0.4	0.125 ± 0.015

- For fuses of 275 A rating and above dimension *F* may be 10.3 ± 0.13 mm (0.406 ± 0.005 in).

FIG. 1 – Dimensions of fuse-links

5. TEMPERATURE AND ALTITUDE RATING

- 5.1 The fuse-links should be suitable for use in all ambient temperatures from -65 to $+25$ °C and at all altitudes up to 12 200 m (40 000 ft).
- 5.2 For ambient temperatures between 25 and 70 °C the fuse-link should be de-rated by 0.4 % of normal rated current for every one degree increase in ambient temperature above 25 °C.

6. VOLTAGE, CURRENT AND BREAKING CAPACITY RATINGS

The fuse-links should be suitable for use at a nominal voltage of 28 V d.c. The current rating and breaking capacity rating should be in accordance with those listed in Table 1, page 6. The breaking capacity rating is related to a substantially non-inductive circuit with a time constant of the value shown in Table 1.

7. ENVIRONMENT

The fuse-links should comply with the requirements of ISO Recommendation R ...,* *Environmental and operational conditions of aircraft electrical equipment – Part 1 : Scope and applicability*, including vibration (other than direct engine-mounting), acceleration, crash conditions, climatic resistance and explosion proofness. They should not support mould growth and should not deteriorate even after storage for long periods in the tropics.

8. TEMPERATURE RISE

When the fuse-link of the rating specified in Table 1, page 6, is bolted to a cable complying with ISO Recommendation R 469, *Dimensions and conductor resistance of general purpose electrical cables with copper conductors for aircraft*, using an appropriate termination and carrying rated current continuously, the temperature of the attached cable due to the combined effects of ambient and temperature rise should not exceed the safe value of the insulation as specified in ISO Recommendation R 474, *Performance requirements for general purpose electrical cables with copper conductors for aircraft*.

* At present under consideration.

TABLE 1 - Ratings of fuse-links

(1)	(2)	(3)	(4)	(5)	
Continuous current rating (- 65 to + 25 °C ambient temperature*)	Rated breaking capacity (prospective current)	Time constant	Duration of test for minimum fusing current	Copper core cable to be used during tests in accordance with ISO Recommendations R 469 and R 474	
				Cable size number	Nominal cross-sectional area of conductor
					mm ²
amperes	amperes	seconds	hours		
35	2500	} 0.005 to 0.006	} 1.5	10	5.29
50	2500			8	8.55
80	3000			6	13.6
100	3000			4	21.6
130**	3000			2	33.9
150	3000			1	41.5
200**	3000			00	68
225	3000			000	85
275**	3000			0000	107
325	3000			0000	107
350**	3000			2 × 0	106
400**	3000			2 × 00	136
500	3000			2 × 000	170

* See section 5.

** Non-preferred ratings.

9. TIME/CURRENT CHARACTERISTICS

The pre-arcing time/current characteristics of the fuse-links should be within the appropriate envelope curves shown in the Annex.

10. ENDURANCE

The fuse-links should be capable of carrying at least 80 % of their normal rated current continuously at an ambient temperature of 70 °C for a minimum period of 1000 hours without deterioration.

11. IDENTIFICATION AND MARKING

Every fuse-link should be clearly and indelibly marked with its continuous current rating, the manufacturer's name or identification, and the number of the relevant National Standard.

12. TESTS

12.1 Except where specific details are listed below, tests should be in accordance with the practice and requirements of relevant national specifications for aircraft fuses. Evidence should be available to the purchaser that fuse-links identical to those supplied as covered by this ISO Recommendation have satisfactorily passed type tests conducted in accordance with section 13.

In order that a consistent standard of quality be maintained, the manufacturer should conduct production routine tests in accordance with section 14 and production quality tests in accordance with section 15.

12.2 The source of energy should be of sufficient power to enable the specified characteristics to be proved. The applied voltage should be 110 % of the rated voltage, with a tolerance of + 10 %. The recovery voltage should be between 28 and 32 V.

12.3 Except where inappropriate, the tests should be conducted on fuse-links shielded from external draughts and fitted with minimum lengths of 0.6 m (2 ft) of cable of rating specified in Table 1, page 6, with appropriate terminations.

13. TYPE TESTS

13.1 Preliminary tests

All fuse-links subjected to type tests should first have passed the production routine tests in section 14. The fuse-links should also be subjected to a voltage drop test.

13.2 Group tests

13.2.1 After fulfilling the requirements of the tests referred to in clause 13.1, the fuse-links should be divided into groups for type testing as shown in Table 2, page 8. The voltage drop across the fuse-link contacts should be measured at the end of each of the tests defined in clauses 13.3, 13.4 and 13.6 and the value should not exceed 110 % of the initial value.

13.2.2 If any fuse-link fails to pass the type tests a further group of fuse-links should be tested. If any of these fail, the fuse-links should be deemed not to comply with the requirements of this ISO Recommendation.

13.2.3 Items used in tests in any one group should not be used subsequently for tests in any other group, and should not be returned to bulk supply.

TABLE 2 – Fuse-link group for type testing

Group	Number of fuse-links required	Clause describing test	Type of test
1	6 of the highest current rating and 6 of the lowest current rating	13.3.1 13.3.2 13.3.3	Vibration Acceleration Climatic cycling
2	1 of the lowest current rating	13.4	Crash conditions
3	6 of any current rating	13.5	Mould growth
4	6 of any current rating	13.6	Tropical exposure
5	1 of each current rating	13.7	Temperature rise
6	1 of each current rating	13.8	Extreme temperature
7	6 of each current rating	13.9	Endurance
8	3 of each current rating	13.10	Breaking capacity
9	As required of each current rating	13.11	Minimum fusing current
10	Not less than 18 of each current rating	13.12	Time/current characteristics

13.3 Group 1

13.3.1 *Vibration.* The fuse-links should be subjected to the Grade ... vibration test described in ISO Recommendation R ..., * *Environmental and operational conditions of aircraft electrical equipment – Part 8 : Vibration*, carrying rated current throughout the tests.

13.3.2 *Acceleration.* The fuse-links should be subjected to the Class ..., Grade ... acceleration test described in ISO Recommendation R ..., * *Environmental and operational conditions of aircraft electrical equipment – Part 7 : Acceleration*, carrying rated current throughout the tests.

13.3.3 *Climatic cycling test.* The fuse-links should be subjected to the cycles of climatic testing, Class ..., described in ISO Recommendation R ..., * *Environmental and operational conditions of aircraft electrical equipment – Part 2 : Temperature, pressure and humidity*, current not being carried.

13.4 Group 2. Crash conditions

The fuse-links should be subjected to the Category ... crash condition test described in ISO Recommendation R ..., * *Environmental and operational conditions of aircraft electrical equipment – Part 7 : Acceleration*.

* At present under consideration.

13.5 Group 3. Mould growth

The fuse-links should be subjected to tests for mould growth in accordance with ISO Recommendation R . . . ,* *Environmental and operational conditions of aircraft electrical equipment – Part 2 : Temperature, pressure and humidity.*

13.6 Group 4. Tropical exposure

The fuse-links should be subjected to the tropical exposure tests described in ISO Recommendation R . . . ,* *Environmental and operational conditions of aircraft electrical equipment – Part 2 : Temperature, pressure and humidity.*

13.7 Group 5. Temperature rise

The fuse-links should be tested for compliance with section 8.

13.8 Group 6. Extreme temperature

The fuse-links should be subjected to an ambient temperature of 70 °C for 1 hour carrying 80 % rated current and then be transferred directly to an ambient temperature of -65 °C for a further 1 hour without carrying current. After returning to normal ambient temperature, the fuse-link should show no evidence of cracking, loosening of parts or other damage.

13.9 Group 7. Endurance

The fuse-links, suitably mounted, should carry 80 % rated current continuously in an ambient temperature of 70 ± 5 °C for a period of 1000 hours. The voltage drop should be measured between fixed contacts at the commencement of the test and at regular intervals throughout. It should not at any time exceed 110 % of the initial value.

13.10 Group 8. Breaking capacity

The fuse-links should be capable of breaking at the specified recovery voltage, all circuits having a prospective current greater than the minimum fusing current and not greater than the rated breaking capacity and a time constant between 0.005 and 0.006 seconds.

The prospective current of the test circuit is determined from a test made as a preliminary to the breaking test. The fuse under test is replaced by a removable link of negligible impedance. The constants of the circuit are adjusted by means of resistor R and inductor L to obtain the required current and time constant (see Fig. 2).

The current and time constant are computed from the oscillogram (see Fig. 3). The time constant is deemed to be given by the abscissa OA of the point on the current trace corresponding to $0.632 I$.

The tests should be made at the maximum prospective current and time constant given in Table 1, page 6, and during the tests the fuses should be wrapped in cotton wool.

During operation of the fuse no flashover should occur between poles, and the cotton wool should show no signs of having ignited. No damage should be done to neighbouring apparatus, nor to the fuse-link contacts. The recovery voltage, between 28 and 32 volts, should be maintained for 30 seconds.

* At present under consideration.

13.11 Group 9. Minimum fusing current

The minimum fusing current of the fuse-links should be determined in accordance with the method described in the International Electrotechnical Commission (IEC) Publication 66 : *IEC specification for fuses for voltages not exceeding 1000 V for a.c. and d.c.* or by not less stringent methods in accordance with the relevant national standard. The values obtained should be within the relevant time/current characteristic curve in the Annex.

13.12 Group 10. Time/current characteristics

The time/current characteristics of the fuse-links should be determined in accordance with the method described in the International Electrotechnical Commission (IEC) Publication 66 : *IEC Specification for fuses for voltages not exceeding 1000 V for a.c. and d.c.* or by not less stringent methods in accordance with the relevant national standard. Pre-arcing times should be plotted against prospective current with both axes to logarithmic scale and the characteristic curve obtained should lie within the appropriate envelope shown in the Annex.

14. PRODUCTION ROUTINE TESTS

Every fuse-link produced should pass the following tests :

- (1) A visual inspection for satisfactory workmanship, finish and marking in accordance with section 11.
- (2) A check that the dimensions are in accordance with section 4.

15. PRODUCTION QUALITY TEST

15.1 Periodic test

The following test should be made periodically during the manufacture on 10 samples from each batch or 1 % of production, whichever is the greater, on fuse-links which have passed tests in accordance with section 14.

A current at nominal rated voltage at which the fuse-link should operate in approximately 3 seconds, as determined from the time/current characteristic curves, should be passed through the fuse-link, without pre-heating. The pre-arcing time for the fuse-link should lie within the time/current envelope characteristic. After the test the fuse-link should be examined and should show no evidence of cracking, loosening of parts or other damage.

15.2 Additional test

Should any sample fuse-link not pass this test a further equal sample should be taken at random and subjected to the test. Should any fuse-link of this sample not pass the test the batch should be deemed not to comply with this ISO Recommendation.

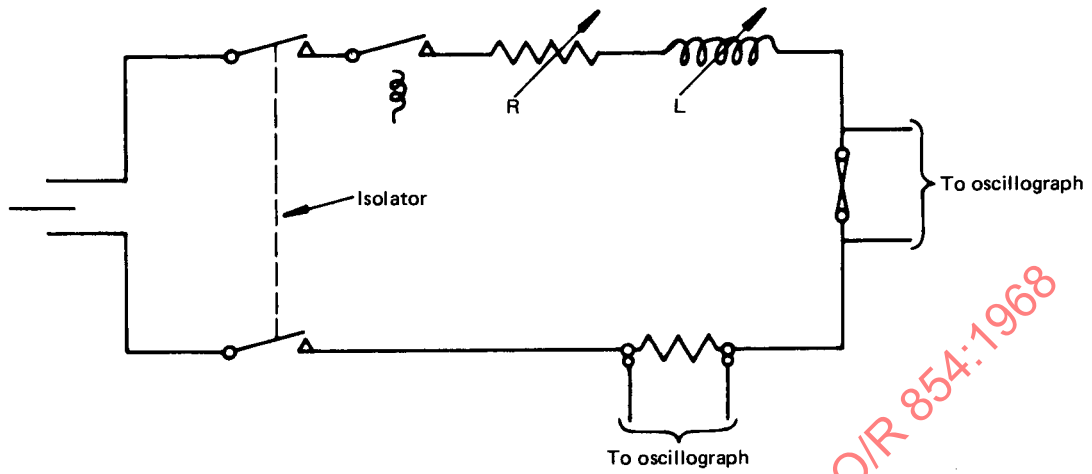
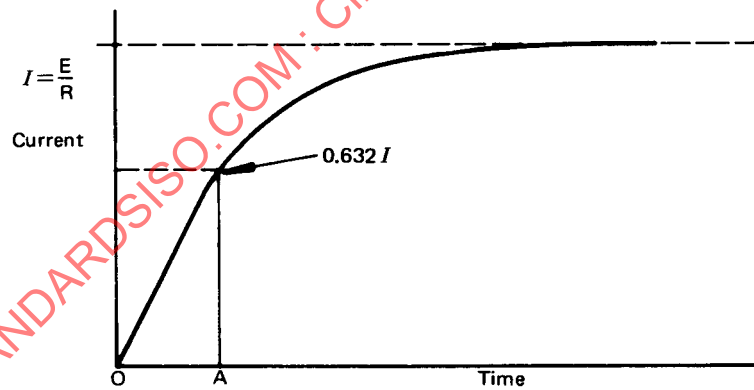


FIG. 2 – Test circuit for breaking capacity test



$OA = \text{Time constant}$

FIG. 3 – Calibration of the test circuit

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ANNEX

ENVELOPE CURVES OF TIME/CURRENT CHARACTERISTICS
OF FUSE-LINKS

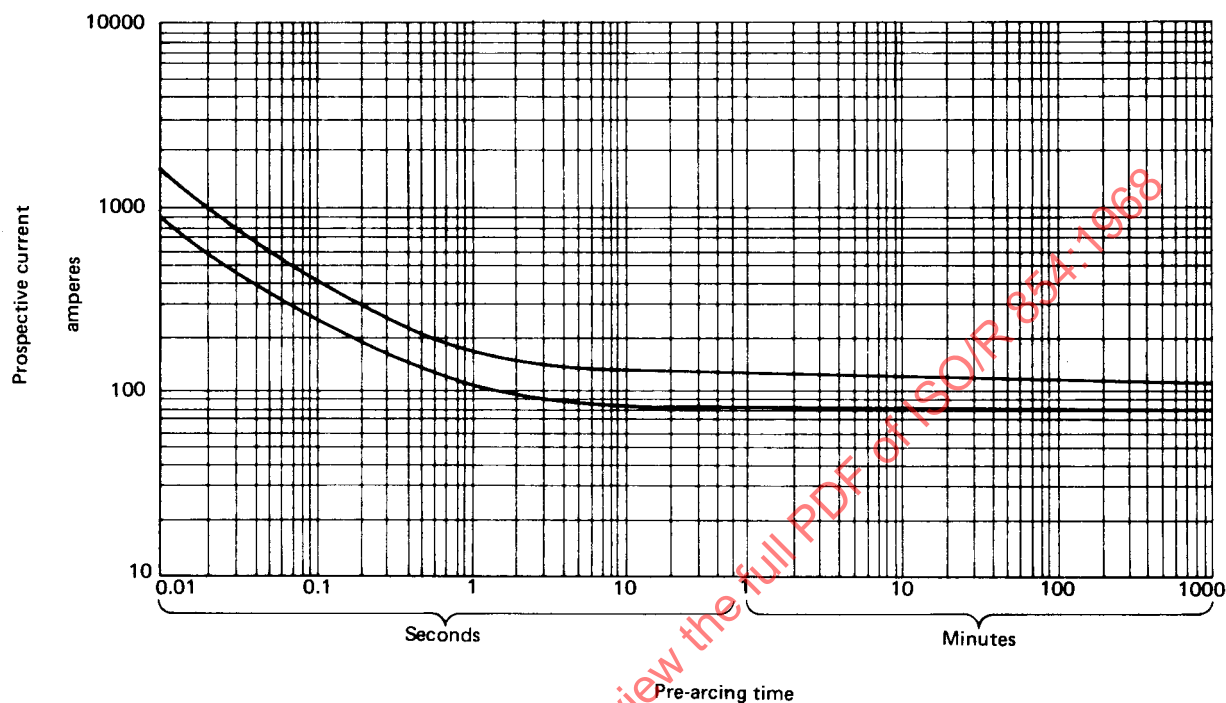


FIG. 4 — Current rating : 35 amperes

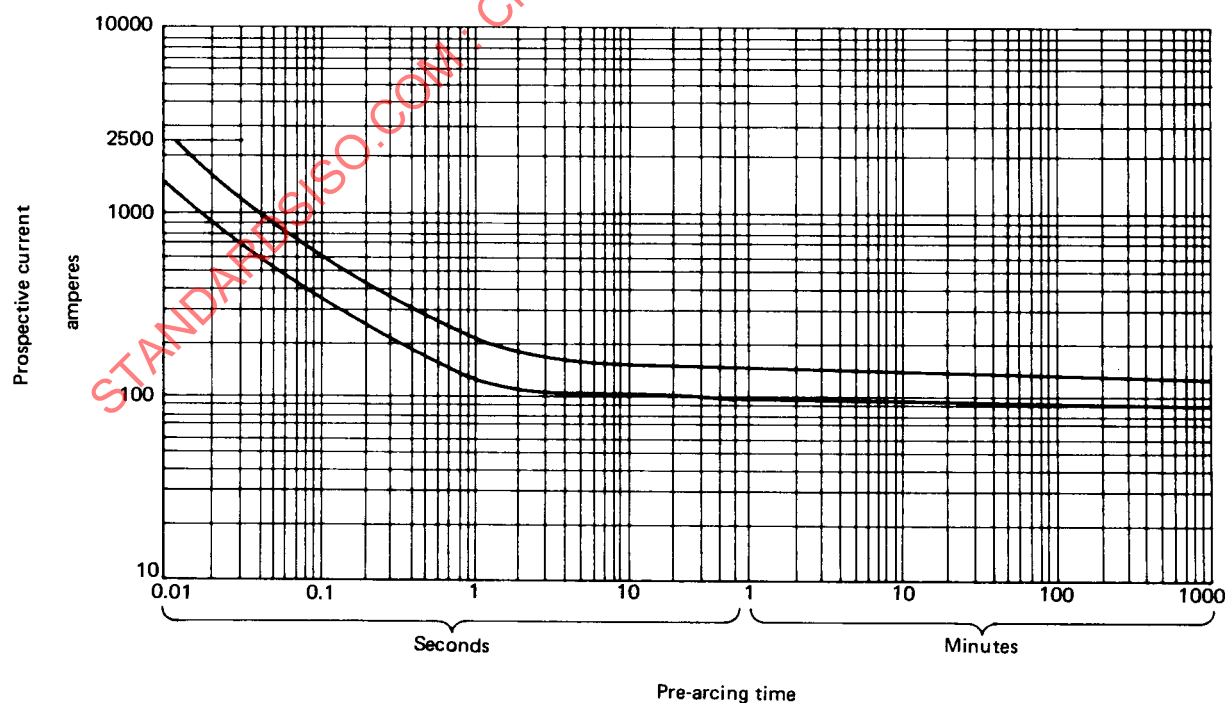


FIG. 5 — Current rating : 50 amperes

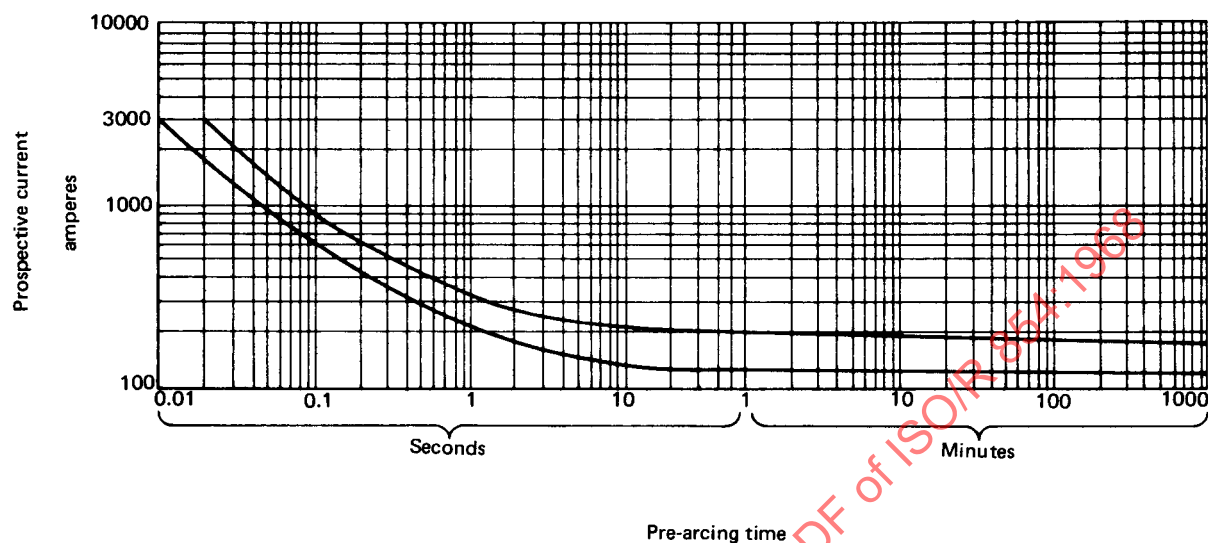


FIG. 6 – Current rating : 80 amperes

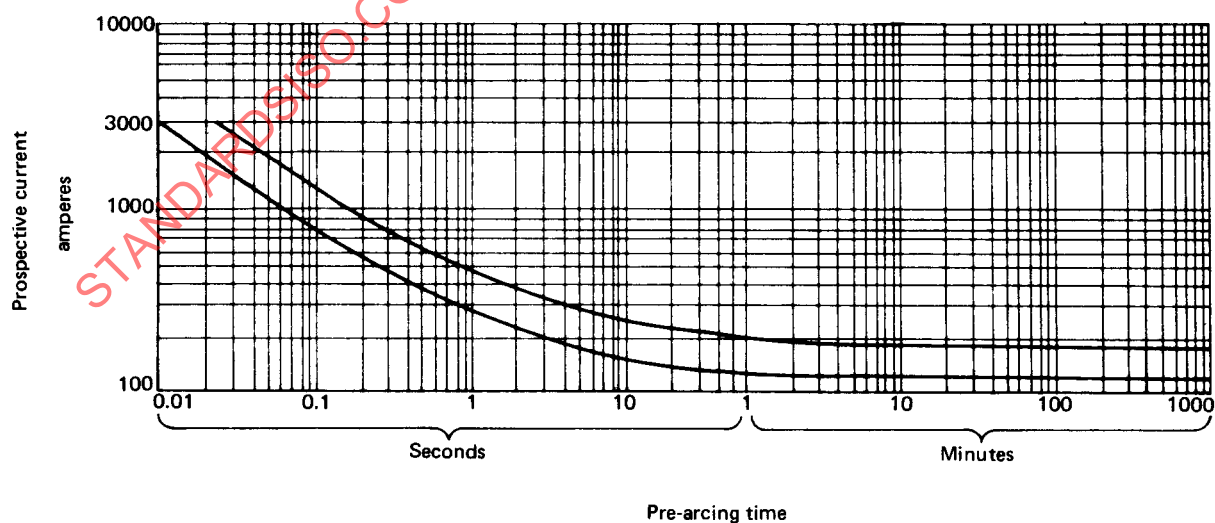


FIG. 7 – Current rating : 100 amperes

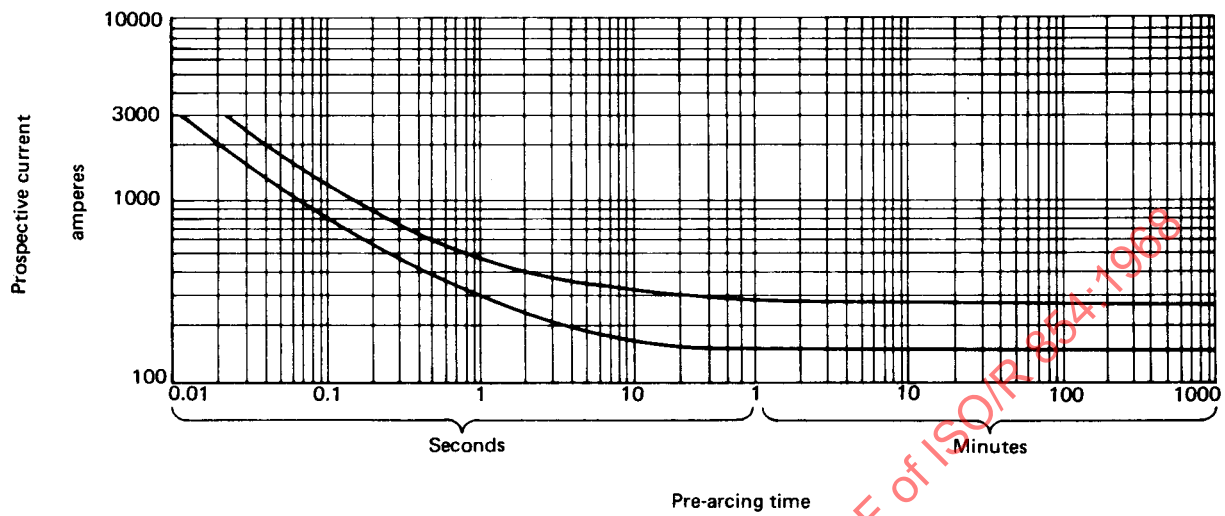


FIG. 8 – Current rating : 130 amperes

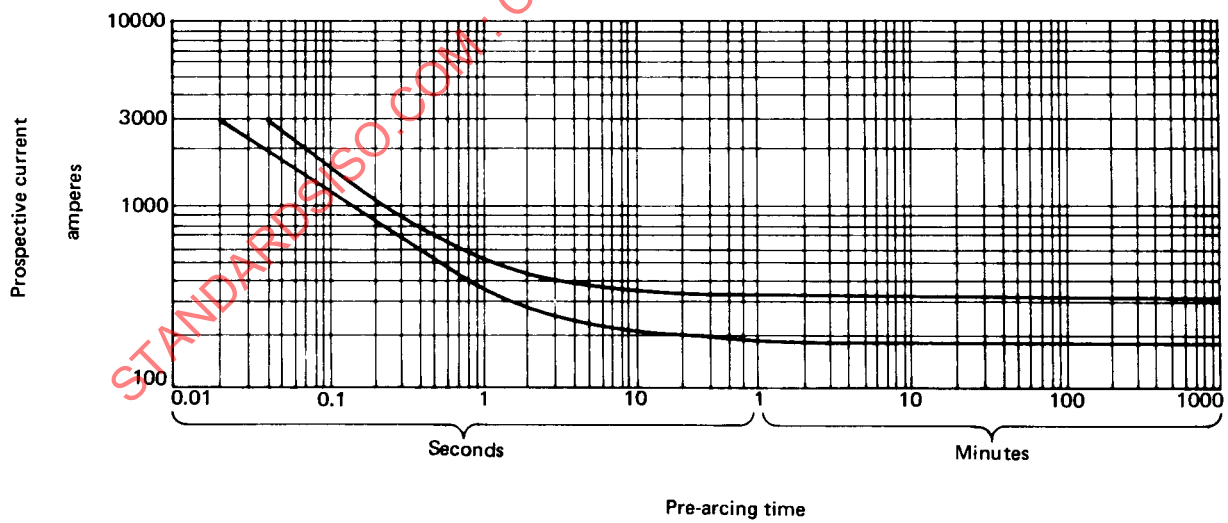


FIG. 9 – Current rating : 150 amperes

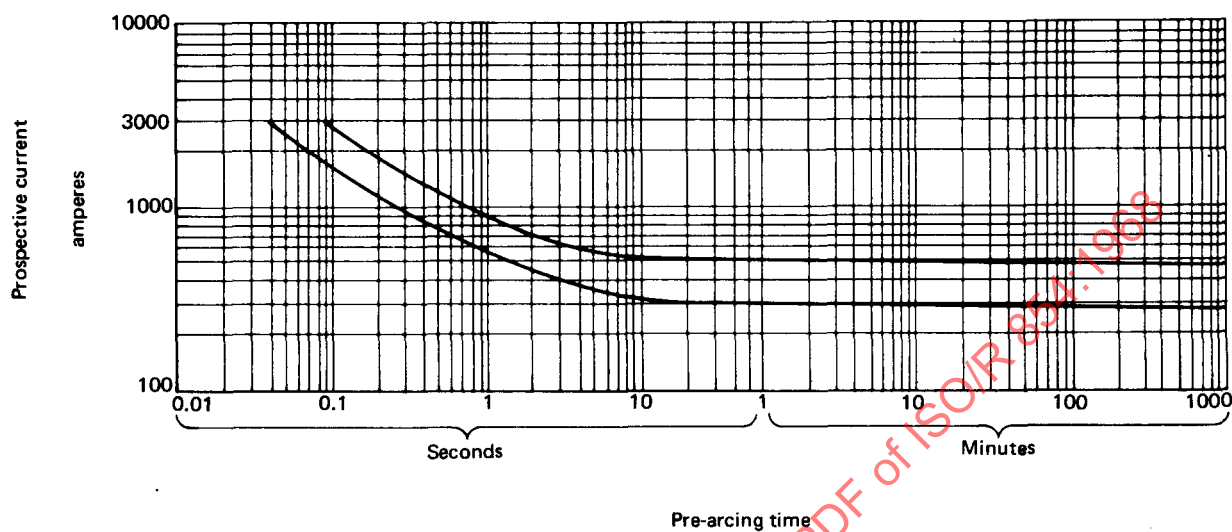


FIG. 10 – Current rating : 200 amperes

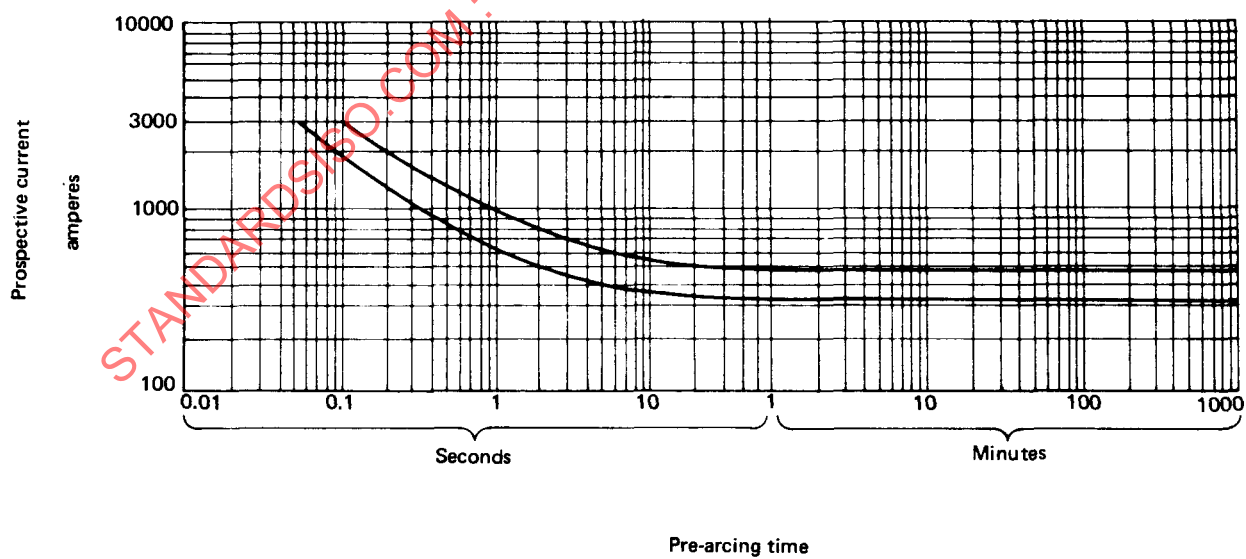


FIG. 11 – Current rating : 225 amperes