Fusing Equipment
Reference Data
TD132004EN

Effective May 2023
Supersedes March 2015

COOPER POWER SERIES

Pad-mounted transformer fusing philosophies

General

This document was created as a supplement to Eaton's Cooper Power™ series products standard catalog sections. The fusing philosophies described in this document have been used for many years to create fuse selection and coordination tables for Eaton's Cooper Power series fuses used in pad-mounted transformer applications. The information provided in this document is meant as a guide only. The equipment specifier has the ultimate responsibility for the fuse selection as well as fuse coordination. There are typically options to consider when making those selections and it is therefore important that the selection criteria behind published tables is understood. Please contact your Eaton representative for any questions related to this document.

Dual sensing (358C--), dual element (108C--) and high ampere Bay-O-Net fuse (361C--)

Step 1. Inrush: Selected fuse's minimum melt should withstand 12 x transformer full load current (at base rating) for 0.1 seconds.

Step 2. Cold load: Selected fuse's minimum melt should withstand 3 x transformer full load current for 10 seconds (optional requirement for transformers).

Step 3. Long-time loading recommendation: Selected fuse provides approximately 200% of transformer full load for 2 hours and 160% of transformer full load for 7 hours with:

1. Transformer preloaded to 75% of nameplate.
2. Outside ambient temperature of 35 °C (examination of calculated long-time curves at 2 and 7 hours will indicate where the selected fuse will melt, per initial conditions as a percent of load).

Step 4. Select fuse to satisfy Steps 1, 2, and 3.

Current sensing Bay-O-Net fuse (353C--)

Step 1. Inrush: Selected fuse's minimum melt should withstand 12 x transformer full load current for 0.1 seconds.

Step 2. Cold load: Selected fuse's minimum melt should withstand 3 x transformer full load current for 10 seconds (optional requirement for transformers).

Step 3. Loading recommendation: Minimum melt of the selected fuse at 300 seconds shall be at least 3 to 4 x transformer rated current.

- 3 x rated current for tin elements (353C4 thru 12)
- 4 x rated current for copper elements (353C14 thru 17)

This allows for twice (normal) nameplate rating continuously.

Step 4. Select a fuse to satisfy Steps 1, 2, and 3.

38 kV Bay-O-Net fuse (380C--)

Step 1. Inrush: Selected fuse's minimum melt should withstand 12 x transformer full load current for 0.1 seconds.

Step 2. Cold load: Selected fuse's minimum melt should withstand 3 x transformer full load current for 10 seconds (optional requirement for transformers).

Step 3. Loading recommendation: Minimum melt of the selected fuse at 300 seconds shall be at least 2 to 3 x transformer rated current.

- 2.5 x rated current for (380C06 thru 12)
- 2 x rated current for (380C14)

Step 4. Select a fuse to satisfy Steps 1, 2, and 3.

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Current sensing cartridge fuse (718C--, 719C--)

Step 1. Inrush: Selected fuse's minimum melt should withstand 12 x transformer full load current for 0.1 seconds.

Step 2. Cold load: Selected fuse's minimum melt should withstand 3 x transformer full load current for 10 seconds (optional requirement for transformers.)

Step 3. Loading recommendation: Minimum melt of the selected fuse at 300 seconds shall be at least 3 to 4 x transformer rated current.

- 3 x rated current for tin elements (718C--, 719C thru 12)
- 4 x rated current for copper elements (718C, 719C16 thru 18)

This allows for twice (normal) nameplate rating continuously.

Step 4. Select fuse to satisfy Steps 1, 2, and 3.

Dual sensing cartridge fuse (628C--, 629C--, 722C--, 723C--)

Step 1. Inrush: Selected fuse's minimum melt should withstand 12 x transformer full load current for 0.1 seconds.

Step 2. Cold load: Selected fuse's minimum melt should withstand 3 x transformer full load current for 10 seconds (optional requirement for transformers.)

Step 3. Loading recommendation: Minimum melt of the selected fuse at 300 seconds shall be at least 4 x transformer rated current.

Step 4. Faults in excess of interrupting capacity of cartridge fuse are cleared by backup device.

Step 5. Select a fuse to satisfy Steps 1, 2, 3 and 4.

Current sensing cartridge fuse with secondary breaker (718C--, 719C--)

Step 1. Inrush: Selected fuse's minimum melt should withstand 12 x transformer full load current for 0.1 seconds.

Step 2. Cold load: Selected fuse's minimum melt should withstand 3 x transformer full load current for 10 seconds (optional requirement for transformers).

Step 3. Fuse must coordinate with secondary breaker: The minimum melt curve of the cartridge fuse should lie to the right of the total operating curve of the selected breaker when converted to the same base (secondary breaker operating curve must be converted to the primary side of the transformer—Ratio = transformer primary voltage/transformer secondary voltage).

Step 4. Select fuse to satisfy Steps 1, 2, and 3.

Backup current-limiting fuse with Bay-O-Net fuse (ELSP in series with Bay-O-Net fuse)

Step 1. Select the low current clearing Bay-O-Net fuse (358C--) per the philosophy set down in section Current Sensing (353C--) Dual Sensing (358C--), Dual Element (108C--) and High Ampere Bay-O-Net (361C--), 38 kV Bay-O-Net (380C--).

Step 2. Select a current-limiting fuse that will coordinate with the selected Bay-O-Net fuse.

1. Calculate the maximum thru fault for the particular transformer as follows:

$$\text{Maximum Thru Fault} = \frac{\text{Full Load Current of the Transformer at Base Rating} \times 100}{\text{Z\% Impedance of the Transformer}}$$

   (A general rule of thumb for impedances single- and three-phase, when values are not known, can be found on **page 3**.)
2. Place the family of minimum melting curves for the backup underoil (ELSP) current-limiting fuse directly on top of (one on one) the total clearing of the chosen Bay-O-Net fuse curve.
3. Select an ELSP fuse whose minimum melt curve crosses the maximum clear curve of the Bay-O-Net fuse at a time-current relationship (crossover) that is greater than the calculated maximum thru fault (Step 1).

   This ensures that the current-limiting fuse is only subjected (melt) to a current that would represent a failed transformer (current greater than maximum secondary fault). The first current-limiting fuse that meets this criterion is then the smallest ampere rated current-limiting fuse that can be selected. Any ampere rated fuse larger will also coordinate properly.
4. Look up the minimum interrupting current for the current-limiting fuse chosen in Step 3 (minimum interrupting currents are listed on the individual spec sheets found in your protective equipment catalog).
5. Re-examine the crossover point of the current-limiting fuse to the expulsion fuse (do step 2 over again).

   Crossover point of the two fuses should also be at a current magnitude that is equal to or greater than the minimum interrupting current of the current-limiting fuse.

   This ensures that the current-limiting fuse is only subjected (melt) to a current that it can clear by itself.
6. Re-examine the crossover point of the current-limiting fuse to the expulsion fuse (as done in step E).

   Crossover point of the two fuses should also be at a current magnitude that is less than the maximum interrupting rating of the Bay-O-Net fuse assembly.

   This ensures that the Bay-O-Net fuse will interrupt all secondary fault currents below the maximum thru fault and up to where the two fuses cross (Bay-O-Net Clear and ELSP Minimum Melt TCC curves).
7. To complete the coordination between backup current-limiting fuses and Bay-O-Net fuses, the chosen Bay-O-Net fuse's maximum clear current must be equal to or less than 90% of the current-limiting fuse's minimum melt current at 300 seconds.

Standard transformer impedances used to calculate maximum thru fault

Single-phase impedances transformer sizes (kVA)	Single-phase impedances (%)
10	1.90
15	1.90
25	1.90
37.5	1.90
50	1.90
75	1.90
100	2.00
267	2.60
250	4.00
333	5.00
500	6.00

Three-phase impedances transformer sizes (kVA)	Single-phase impedances (%)
75	1.60
112.5	1.80
150	2.00
225	3.00
300	3.50
500	4.00
750 and up	5.75

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Printed in USA
Publication No. TD132004EN / Z27096
May 2023

For Eaton's Cooper Power series transformer fuse product information, call 1-877-277-4636 or visit Eaton.com/cooperpowerseries.

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