

Short-Circuit Bracing for Motor Starters

Question:

I am trying to find out short circuit bracing ratings for full voltage, non-reversing starters. I spoke with three major manufactures of starters and they said starters do not have short circuit bracing ratings and that the bracing depends upon the interrupting rating of the overcurrent protection device before the starter.

For example, I have a NEMA size 3 starter rate 208 volts. According to the manufactures' data sheet, if I use a thermal magnetic breaker, the starter bracing rating is 5,000 amperes. If I use a class R fuse with the same starter, the bracing rating is 100,000 amperes. How can this be?

Carl Virgil, CVirgil467@cs.com

From: Jim Pauley, Square D

There is no such thing as a "bracing rating" for a starter. Starters, like many other pieces of electrical equipment, have a short circuit current rating, see NEC Section 110-10.

UL 508 - Industrial Control equipment provides the basis for these requirements. The default rating (in conjunction with a non-specific overcurrent device) varies from 1000 amperes and goes up based on the HP rating. In your case, the rating is 5000 amperes.

The reason the same starter has a higher short circuit current rating with a Class R fuse is that the starter has been evaluated in conjunction with that fuse class. Since the short circuit rating is higher than 5000 amperes, the overcurrent device must be specified. The only way you could use the starter you discuss at 17,000 amperes is to use it in conjunction with the specified overcurrent device stated in the material with the starter. Some manufacturers have done this only with fuses... others with both fuses and breakers.

From: Saporita, Vince, Bussman Fuses

A short-circuit bracing rating would refer to the bracing of the bus bars in a motor control center, not the short-circuit rating of an individual motor starter. Current-limiting fuses, such as Class R fuses, can be used to limit or reduce the amount of short-circuit current that would flow under short-circuit conditions. A properly chosen current-limiting fuse ahead of the motor control center could reduce the available short-circuit current to a level such that the bus bars would not be mechanically damaged because of magnetic forces. (Magnetic forces are proportional to the square of the peak current.

So if a current-limiting fuse reduces the available peak current to less than 1/4 of that which is available, the magnetic forces will be reduced to less than 1/16 of that which is available.) New motor control centers are typically tested and marked for use with various protective devices and may have different short-circuit ratings depending upon whether or not they are protected by current-limiting or non-current-limiting devices. Individual starters can also have different short-circuit ratings based upon whether or not they are protected by current-limiting devices or non-current-limiting devices.

It's the thermal energy that often causes the problems in individual motor starters, the welding of contacts and the burning open of overload relays. Thermal damage is proportional to the rms current squared. (If a current-limiting device were to reduce the rms current to less than 1/8 of that which was available, the thermal damage would be reduced to less than 1/64 of that which was available.) This current limiting ability allows the motor starter to have a much higher rating when used with the Class R fuses.

From: Neeser, Dan, Bussman Fuses

It appears the Circuit Breaker combination starters were not tested as a combination assembly above the UL 508 minimum testing levels. Thus, the short circuit rating is based upon the UL 508 minimum testing levels as is indicated in the manufacturers literature.

Obviously, with the current limiting effect and high interrupting rating of a current-limiting fuse, you can achieve combination ratings tested per UL 508 well above the minimum ratings. Since the fuse is current limiting, it will protect the starter at much higher fault levels. This is why the short circuit ratings are typically 100kA.

The simple thing is, if you need to be assured of a high short circuit rating for your combination starters, go with a fusible (Class R or J) combination starters and you should always have a combination short circuit rating of 100kA.

There is still more to the story if we start getting into Type 1 & Type 2 protection as well. Type 1 protection is the allowable damage level per UL 508. This will permit damage to the starter, such as welded contacts, during a fault situation, but will pass UL 508 as long as the door remains closed during the fault and the starter does not become a fire or shock hazard. Type 2 protection on the other hand does not allow for this. Thus, it is referred to as "no damage" protection and the overcurrent protection device will protect the starter from damage. This is a tested combination of an overcurrent protection device and a specific manufacturers starter. Bussmann has Type 2 sheets, which show the tested combinations of Buss fuses with different manufacturers. This is available by request.

If your customer would like to assure high short circuit current rating and actual component protection, he should specify fusible combination motor starters, which are Type 2 tested.

From: Chuck Goetz, Underwriters Laboratories Inc.

Motor starters are evaluated to UL508, Standard for Industrial Control Equipment. For a size 3 starter, 5000A is the minimum required available short circuit current the starter is subjected to while protected by fuses and thermal-magnetic circuit breakers. Additionally, the manufacturer may elect to subject the starter to a high fault short circuit current (that is higher than the minimum 5000A) while protected by a specific fuse or breaker. In this case, a Class R fuse was apparently used. For these tests, the available current is calibrated on the line side of the protective device and conductors (with a total length of not more than 8 feet) are used rather than bus bar for connections to all components. The starter is placed in a commercially available enclosure that is just large enough to accommodate the motor starter. The manufacturers data appears to reflect the short

circuit testing performed to the requirements in UL508. UL508 does not define or refer to a "bracing" rating for motor controllers.

Motor control centers are evaluated to UL845, Standard for Motor Control Centers. UL Lists "Motor Control Center Units" consisting of a motor starter, breaker and control devices mounted to a subpanel for inclusion in Listed "motor control center sections". UL agrees that without such an investigation it is not known how the motor starter will perform under a fault condition.

Due to the use of a motor starter/circuit breaker combination being installed on a circuit where the current available exceeds the short circuit current rating of the motor starter when protected by a circuit breaker and also due to smaller enclosure volumes and use of bus bars in motor control centers, UL would require an investigation of this assembly to UL845 before Listing as a motor control unit. UL recommends that the questioner purchase a UL Listed motor control center unit having the short circuit current rating equal or greater than the available current in his motor control center.