TIP SHEET
FUSE SIZING CONSIDERATIONS FOR HIGHER EFFICIENCY MOTORS

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When selecting the proper fuse for short-circuit protection in motor starting applications, it is important to not only ensure that the fuse will not nuisance-open during motor start up times, but also that the fuse will coordinate as required with overload relays. When sizing fuses between 125% and 150% of the motor nameplate current, several advantages, including ease of coordination with an overload device, a smaller disconnect, and increased short circuit protection from a lower fuse rating, can be achieved. However, if sizing at this level prevents the motor from starting, it may then be necessary to increase the fuse ampere rating and it then becomes important to know the NEC sizing limitations.

As of June 1, 2016, the US Department of Energy has mandated that newly manufactured electric motors will need to meet NEMA Premium® efficiency standards. As motor efficiencies increase, motor locked rotor currents can also be expected to increase. In addition to this, with across-the-line starting applications, it is critical to understand not only the locked rotor current, but also the starting time that can be expected.

With previous efficiencies, typically motor locked rotor currents between 300% and 600% of motor nameplate currents were common. However, with the new efficiency standards, locked rotor currents for NEMA Design B, C, and D motors can reach between 600% and 700% of nameplate currents and are restricted to maximum levels per the NEMA design standards. With NEMA Design E motors, these levels can be expected to be as high as 1000% of the rated current. Design A motors have no standardized maximums for locked rotor currents, but can be very high depending on the motor kVA code value. Special attention should be paid to the motor nameplate values when sizing motor protection fuses.

For Premium® Efficiency motors, sizing fuses between 125% and 150% of the rated current may not be sufficient to allow the motor to start due to the potential magnitude of locked rotor currents. In addition to this, if the expected start time of the motor is over 5 seconds, this may be too long for this size fuse to handle without opening. Section 430.52(C)(1), Exception 1 in the NEC allows for Time-Delay Class R and J fuses to be sized at 175% of the rated motor current up to the next standard fuse size.

If sizing at 175% still does not allow for the motor to start, section 430.52(C)(1), Exception 2 in the NEC permits an absolute maximum fuse size of 225% of the motor rated current. In these cases, depending on the value determined from these multiplication factors, fuse sizes between Exceptions 1 and 2 may be exactly the same. Where Exception 1 permits rounding up to the next standard size, fuses sized to Exception 2 may not exceed the mentioned 225% value in any way.

For Time-Delay Class CC fuses, similar exceptions in the NEC also apply. Section 430.52(C)(1), Exception 1 allows for a fuse size of 300% up to the next standard rating. Section 430.52(C)(1), Exception 2 permits a fuse size not exceeding 400% of the motor rated current, should 300% sizing still not allow the motor to start.

NEC 430.52 Fuse Sizing Limits

NEC Sections	Time-Delay Class R/J Fuse	Time-Delay Class CC Fuse
NEC 430.52(C)(1), Exception 1	175%*	300%*
NEC 430.52(C)(1), Exception 2	225%**	400%**

* *Values may be rounded up to next standard fuse ampere rating.*

** *Permitted when Exception 1 ratings are not sufficient for motor starting current. Ratings may not exceed these limits*

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