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TechTopics No. 19

Bus joint current density

In TechTopics No. 16, we discussed the fundamentals of good bolted bus bar joint design. In this issue, we discuss the topic of bus joint current density. Some users request a particular maximum value of current density in bus joints, but this design criterion may not have any relation to the resulting temperature rise of the bus system.

We saw in TechTopics No. 16 that most of the actual current transfer in a bus joint occurs under the area defined by the heavy flat washer used under the bolt head and under the nut. The result is that regions of the joint not in the area defined by the washer carry little current. They also do not have a significant effect on temperature rise of the joint. Therefore, increasing the area of the bus connection joint, by itself, does little to reduce the temperature rise of the bus system.

We could also try to improve the performance of a bus joint (in other words, lower its temperature rise) by adding more bolts. However, as with many other aspects of electrical engineering, the "law of diminishing returns" applies. Usually, bus joints are constructed with a single row of bolts (one, two or three bolts, depending on bus size), located across the width of the bus bar. If we add a second row of bolts, we find that the second row has only a small effect on the temperature rise of the joint. The reason for this is that most of the current transfer occurs in the row of bolts located closest to the end of the bus bar.

Over the years, we have learned that the current density in the joint is not necessarily correlated with the temperature rise performance of the joint. Of much greater importance is the manner in which the clamping pressure of the bolts is distributed over as wide an area of the bus joint as possible. Also important are the general factors that influence temperature rise in the bus system, as discussed in TechTopics No. 17.

For these reasons, whenever possible, we design our bus joints to have a single row of bolts across the width of the bus bars, with the number of bolts determined by the width of the bus and the configuration of the joint. Our bus joint configurations have passed continuous current tests to verify that the bus system operates within the 65 °C temperature rise limitation of the standards. They have also passed short-circuit tests, including short-time withstand current and momentary withstand-current tests, to verify that the designs withstand the thermal and mechanical stresses associated with short-circuit duties.

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