Sizing Bus Bars in Switchgear and Motor Control

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We occasionally get questions about how we select the size of bus bar for various continuous current ratings in Powell equipments. The answer is that we use temperature rise as the basic criterion. All of the ANSI, IEEE and NEMA standards for switchgear and motor control have requirements for the maximum operating temperature of various parts of the equipment. For bus bars, the requirement is generally for a temperature rise of no more than 65°C, although this may vary for different classes of equipment. These requirements are designed to prevent overheating the insulation supporting and enclosing the bus bars, since excessive temperature shortens the life of the insulation.

A number of factors affect the temperature rise of bus bars. Some of the major ones are:

- Size and material (copper or aluminum) of the bus bar.
- Whether the bar is insulated. Surprisingly, a bus bar covered with insulation generally runs cooler than an equivalent bare bus bar, because the usually darker color of the insulating material is a better radiator of heat than the shiny surface of a bare bus bar.
- Size and material (magnetic or non-magnetic) of the enclosure around the bus.
- Flow of ventilating air past the bus bars or the bus enclosure.
- Proximity of other conductors and other heat-producing devices.

The complex interaction of these and other factors makes it nearly impossible to calculate temperature rise, and leads to the requirement in all applicable standards for continuous current tests to determine the temperature rise of a bus design.

Specifications will sometimes call for bus sized by current density, a favorite requirement being 1000 A per square inch for copper bus. This may be a good way to choose bus sizes for the mythical "single conductor in free air", but it isn't a satisfactory way to design buswork in practical equipments. Consider the following chart, based on bus sizes used in our PowlVac® metal-clad switchgear:

Switchgear Bus Rating	**1200 A**	**2000 A**	**3000 A**
Number of bus bars per phase	1	1	2
Size of bus bar, inches	1/4 x 4	1/2 x 6	1/2 x 6
Cross section area of bus, square inches	1	3	6
Current density, amps per square inch	1200	667	500
Maximum temperature rise, from test data	60°C	59.7°C	59.5°C

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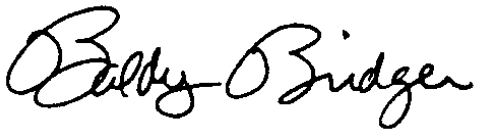
The last line of the chart shows that the temperature rises of the three bus ratings are almost identical in spite of the 2.4:1 ratio of the current densities.



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