
Application of Metal-Enclosed Switchgear at High Altitude

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Both low- and medium-voltage metal-enclosed switchgear and the circuit breakers used in these equipments depend on air for both cooling and insulation. At high altitudes, the less dense air is less efficient both as an insulator and as a heat transfer medium. Because of this, the ANSI standards require derating when these equipments are used at high altitudes. The following tables show the altitude correction factors taken from the ANSI standards.

Low Voltage Switchgear and Breakers

Altitude (ft)*	Voltage	Current
6600 (2000 m) (and below)	1.00	1.00
8500 (2600 m)	0.95	0.99
13,000 (3900 m)	0.80	0.96

Medium Voltage Switchgear and Breakers

Altitude (ft)*	Voltage	Current
3300 (1000 m) (and below)	1.00	1.00
5000 (1500 m)	0.95	0.99
10,000 (3000 m)	0.80	0.96

* Intermediate values may be obtained by interpolation.

You will notice that there are different altitudes given for low voltage and medium voltage. I have never been able to get a reasonable answer as to why this is true, and I understand that the committee responsible for the standards is reviewing these values with the idea of reconciling them.

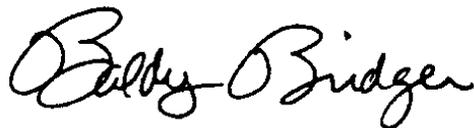
In all cases, the current correction factor is applied to the continuous current rating of the switchgear and the circuit breakers. This does not usually present a problem, as we seldom design a system with load currents over 95% of the equipment rating. The current derating does not apply to interrupting current or any of the other high-current ratings of the breakers.

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For low voltage equipments, the voltage correction factor applies to the low frequency withstand (hipot) rating of both the breaker and the equipment. It also applies to the rated maximum voltage of the circuit breaker. When derating the rated maximum voltage, the short circuit rating of the circuit breaker cannot exceed the rating at the voltage before derating. For instance, if a breaker is used on a 480 V system, as most of those in Powell equipment are, with a 0.95 rating factor the short circuit rating at 480 V may be used, since the rated maximum voltage for that system nominal voltage is 508 V, and 0.95×508 is 482.6 V, slightly above the 480 V service voltage. However, if this same system required a 0.80 rating factor, the breaker short circuit rating at 600 V must be used, since 0.80×508 is only 406 V, less than the service voltage, but 0.80×635 is 508 V, comfortably above the service voltage.

For medium voltage equipments, the voltage correction factor applies to the low frequency withstand (hipot) rating and the impulse withstand (BIL) rating of both the breaker and the equipment. It also applies to the rated maximum voltage of the circuit breaker **unless** a sealed interrupter, such as a vacuum interrupter, is used. The use of surge arresters to protect the equipment should be considered for all such high altitude installations.



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