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## Using Switchgear at Frequencies Other Than 60Hz

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All ANSI circuit breaker and switchgear equipment standards specify a rated frequency of 60 Hz, and all Powell switchgear is designed for and tested at 60 Hz. The nameplates of PowlVac<sup>®</sup> circuit breakers carry a rated frequency of 60 Hz.

However, many applications of Powell switchgear are made at other frequencies, particularly 50 Hz, and users may question the suitability of the circuit breakers and equipment at other frequency. The following paragraphs discuss the effect of frequency on various major characteristics of switchgear.

**BIL:** Since the BIL rating is the ability to withstand a dc impulse, power system frequency has no effect on the BIL rating of switchgear equipment.

**Power Frequency Withstand:** Although this rating is best demonstrated by a test at rated frequency, ANSI/IEEE C37.09 allows the test to be made at rated frequency  $\pm 20\%$ . This allows 50 Hz tests to establish a 60 Hz rating, and vice versa. Since the voltage level is the same, regardless of frequency, and the rate-of-rise of the voltage increases with frequency, the higher frequency test is slightly more severe than the lower frequency test. Thus, an equipment which is tested at 60 Hz is satisfactory at any lower frequency.

**Continuous Current:** The ac resistant of a conductor, and thus the heat loss at a given current, increases with frequency. The ANSI standards require continuous current test to be made at a frequency no lower than the rated frequency. The standards actually allow the assigning of a higher continuous current rating at very low frequencies, such as 25 Hz.

**Momentary, Short Time and Interrupting Currents:** Again, ANSI/IEEE C37.09 allows these test to be made at rated frequency (20%, so tests at either 50 Hz or 60 Hz can cover both frequencies. For lower frequencies, it may be necessary to derate the interrupting capacity of vacuum interrupters. One of Powell's vacuum interrupter suppliers has tested at various frequencies and suggests the following derating formula:

$$I_f = I_{60} \sqrt{f/60}$$

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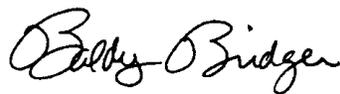
Where

**f** = power system frequency,  $16 \frac{2}{3}\text{Hz} \leq f < 50 \text{ Hz}$

**I<sub>f</sub>** = short circuit current at frequency f

**I<sub>60</sub>** = short circuit current at 60 Hz

Summarizing, switchgear equipment and power circuit breakers rated 60 Hz may be applied at 50 Hz without changing ratings. At lower frequencies, some derating of interrupting capacity may be required, and some increase of continuous current rating may be possible. Of course, devices in the switchgear, such as relays, instruments and instrument transformers, must be checked for application at the power system frequency.



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