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Jobsite Power Supply Voltage vs. Motor Namplate Voltage

The objective of this letter is to briefly explain the differences between site voltage and motor nameplate voltage, which is a common question during submittal review and/or installation.

480V is a system voltage. Motors built to run on a 480V system are properly rated 460V. Since motors are designed to run on a system voltage that is from +10% to -10% of their nameplate voltage, a 460V motor should live a normal life when the system voltage is from 414V to 506V. A 480Vsystem voltage is well within those limits.

Voltage and Amperage have an inverse relationship. As the system voltage goes up, the current the motor draws goes down by the same percentage. Consequently, when the system voltage goes down, the motor current goes up. So, if the motor nameplate is 460V and the system voltage is 480V, the higher voltage causes the current required for the motor to do its job to be less than the nameplate current. Example: On a hot afternoon in August, the system voltage will usually sag below the standard 480V. For the first 20V that the system sags, the system voltage will actually be getting closer to the motor voltage, and the motor current will still be lower than normal. But if that motor is rated 480V, the system voltage is getting further away from the motor voltage with each volt it drops, causing the motor current to go above the nameplate current.

Motor manufacturers usually charge a premium price for a motor to have a nameplate voltage of 480V, and the motor will have a shorter life than one with a 460V rating. These same parameters apply to a 230V motor on a 240V system.

While this is rather general, the fact is that a motor will live longer on 480V when it is wound for 460V instead of 480V.

Attached is a graph that illustrates this phenomenon taken from the EASA handbook.

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GENERAL EFFECT OF VOLTAGE AND FREQUENCY VARIATIONS ON INDUCTION MOTOR CHARACTERISTICS

CHARACTERISTIC	VOLTAGE		FREQUENCY	
	110%	90%	105%	95%
Starting Torque	Up 21%	Down 19%	Down 10%	Up 11%
Maximum Torque	Up 21%	Down 19%	Down 10%	Up 11%
Percent Slip	Down 15–20%	Up 20–30%	Up 10–15%	Down 5–10%
Efficiency Full Load	Down 0–3%	Down 0–2%	Up Slightly	Down Slightly
¾ Load	0–Down Slightly	Little Change	Up Slightly	Down Slightly
½ Load	Down 0–5%	Up 0–1%	Up Slightly	Down Slightly
Power Factor Full Load	Down 5–15%	Up 1–7%	Up Slightly	Down Slightly
¾ Load	Down 5–15%	Up 2–7%	Up Slightly	Down Slightly
½ Load	Down 10–20%	Up 3–10%	Up Slightly	Down Slightly
Full-Load Current	Down Slightly To Up 5%	Up 5–10%	Down Slightly	Up Slightly
Starting Current	Up 10%	Down 10%	Down 5%	Up 5%
Full-Load Temperature Rise	Up 10%	Down 10–15%	Down Slightly	Up Slightly
Maximum Overload Capacity	Up 21%	Down 19%	Down Slightly	Up Slightly
Magnetic Noise	Up Slightly	Down Slightly	Down Slightly	Up Slightly

EFFECT OF VOLTAGE VARIATION

ON INDUCTION MOTOR CHARACTERISTICS