

Insulation Criteria for WEG motors driven by Variable Speed Drives

The stator windings of WEG low voltage (LV) motors for the African market are wound with class “F” or class “H” insulation systems and are suitable for either direct-on-line (DOL), soft starting or variable speed drive (VSD) starting. The WEG LV motors are wound with the exclusive “WEG Insulation System Evolution” (WISE®) insulation system - which ensures superior electrical insulation characteristics.

The WEG LV motor stator winding is suitable for VSD applications taking into account the limits shown in the table and notes below:

Motor rated voltage	Voltage spikes	dV/dt*	Rise Time*	Maximum Time Between Successive Pulses
	at motor terminals (phase-phase)	at motor terminals (phase-phase)		
$V_{rated} < 460V$	$\leq 1600V$	$\leq 5200V/\mu s$	$\geq 0.1\mu s$	$\geq 6\mu s$
$460V \leq V_{rated} < 575V$	$\leq 2000V$	$\leq 6500V/\mu s$		
$575V \leq V_{rated} < 1000V$	$\leq 2400V$	$\leq 7800V/\mu s$		

* dV/dt and Rise Time definition according to NEMA Std. MG1 - part 30.

- In order to protect the motor insulation system, the maximum recommended switching frequency is 5kHz
- If one of the above conditions is not met, a filter (load reactor or dV/dt filter) must be installed at the output of the VSD
- General purpose motors with rated voltage greater than 575V, which at the time of purchase did not have any indication of operation with VSD, are able to withstand the electrical limits set in the table above for rated voltage up to 575V. If such conditions are not fully satisfied, a filter (load reactor or dV/dt filter) must be installed at the output of the VSD
- General purpose motors of the dual/multi voltage type, for example 400/690V Δ/Y , which at the time of purchase did not have any indication of operation with VSD, are able to be driven by a VSD in the lower voltage. The motor can also be driven by a VSD in the higher voltage only if the limits set in the table above for rated voltage up to 460V is met, otherwise, a load reactor or a dV/dt filter must be installed at the output of the VSD. (In other words; a 400/690V motor from stock can be used on a 690V VSD if a load reactor or a dV/dt filter is installed at the output of the VSD or if the VSD output limits are limited in accordance with the table above for rated voltage up to 460V)
- From frame size 315 upwards, additional measures should be taken in order to avoid detrimental bearing currents. This can be accomplished by means of the use of an insulated bearing or an insulated end shield at the non-drive end side and a shaft grounding brush mounted on the motor shaft extension. (Motors from stock with frames 315 and upwards already have an insulated non-drive end shield, however a shaft grounding brush still have to be fitted once confirmations is received that the motor will be driven with a VSD)
- Motors driven by a VSD may present a higher temperature rise than when operating under sinusoidal supply. This occurs due to the combined effects of the loss increase resulting from the pulse width modulation (PWM) harmonics and the reduction in ventilation experienced by self-ventilated motors when operated at lower speeds

The following solutions are to avoid excessive overheating of the motor when driven by a VSD:

- Torque derating (oversizing of the self-ventilated motor frame size)
- Forced cooling (use of an independent ventilation system to cool the motor)
- Optimal Flux Solution® (exclusive to applications where both motor and drive are WEG).