



# ULTRASHIELD® PLUS

## Inverter Drive Insulation

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Adjustable speed drives allow standard induction motors to be run at variable speeds, which saves energy, improves control of manufacturing processes for better quality, efficiency, downtime and cost. It has been estimated that 60-70 % of the electrical energy used in the United States is consumed by three phase induction motors.

Using an ASD (Adjustable Speed Drive) allows a motor to be operated at variable speed by providing variable voltages and frequencies to the motor. The electronic ASD's convert the incoming line voltage at 60 Hertz to DC, and then the inverter generates variable frequencies that are sent to the motor. These variable frequencies can be high voltage, steep fronted waveshapes that have been linked to premature motor winding failures in 440+ Volt motors.

Some of the methods to reduce the damaging influences on the insulation include the following:

- Damage from handling, winding, inserting, blocking, or other damage to the wire will have considerable adverse effects on motor life.

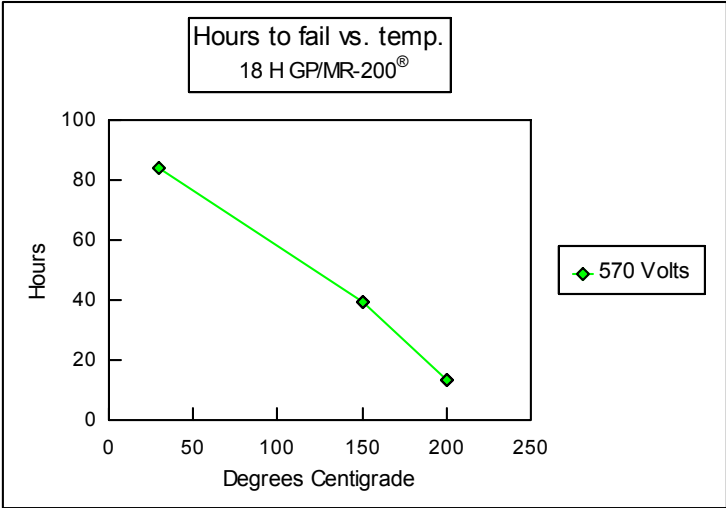
We have analyzed some actual field failures from inverter duty motors and have found that the wire was damaged before it was subjected to use with an inverter.

- The quality of the varnishing operation can also greatly affect the life of the motor windings.

Varnishing is an essential part of motor manufacturing. Varnish helps to hold the windings together and to dissipate heat, along with providing electrical insulation. Our testing has shown an increase in life of 250 times with our standard single build GP/MR-200<sup>®</sup> unvarnished vs. double dipping in varnish.

- The operating temperature affects the life of the motor. The higher the temperature, the shorter the life of the motor.

Our tests show that wire insulation life in inverter applications is directly affected by testing temperature, just as with other applications, as depicted in the following graph.

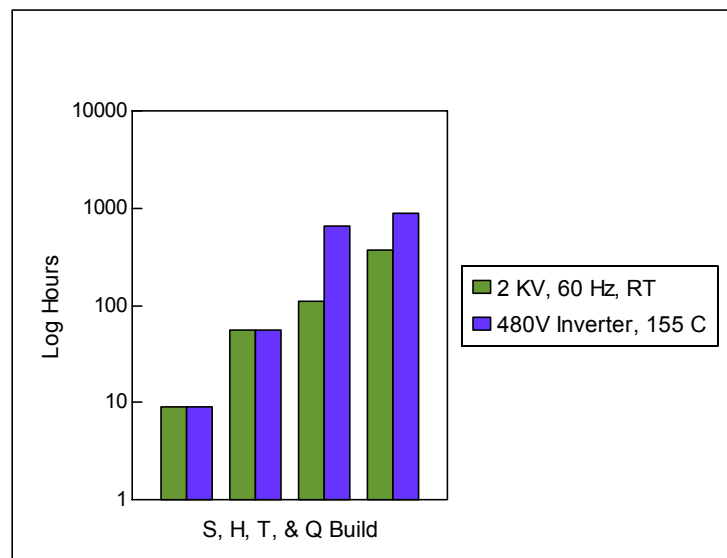


- Long lead lengths from the inverter to the motor generate increased voltage spikes to the windings, so installations should have shorter lead lengths.

This has been reported in several articles, and our testing has confirmed the reduction of insulation life with longer leads from the inverter to the motor.

- Reactor coils or filters can also be used between the inverter and the motor. The purpose of the reactor coil or filter is to absorb the voltage spikes generated by the inverter.
- Increasing the amount of insulation can greatly improve the life of motor windings subjected to inverter applications.

Testing for voltage endurance vs. insulation build shows that insulation life increases exponentially with build.



Note: No failures on Quadruple build in HV inverter after 2300 hours

Another approach to enhancing the performance of magnet wire insulation in motors used with inverter drives is to blend selected additives into magnet wire enamels. These additives are generally inorganic oxides and their addition helps to improve the magnet wire

life in higher voltage stress applications. The use of additives to enhance the electrical properties of magnet wire insulation can result in some loss of mechanical properties (flexibility). Some examples of U.S. patents that refer to magnet wire film additives are:

3,577,346

4,493,873

4,537,804

4,935,302

We have developed a new magnet wire enamel for use in inverter drive applications. The following chart illustrates the improved performance of this insulation over standard enamels.

<u>Type</u>	<u>Mils</u>	<u>Hours to Fail</u>			
		<u>Rm Temp.</u>	<u>200 C</u>	<u>hrs/mil</u>	<u>hrs/mil</u>
		<u>2 KV, 60 Hz</u>	<u>575 V Inv.</u>	<u>2KV, 60 Hz</u>	<u>575 V Inv.</u>
Std. Single	1.7	5	0.3	3	0.2
Std. Heavy	3.0	57	1	19	0.3
Std. Triple	4.3	128	4	30	0.9
Std. Quad.	6.4	485	15	76	2.3
ULTRASHIELD® PLUS	3.0	544	120	181	40.0