

Application Guidance Notes: Technical Information from Cummins Generator Technologies

AGN 181 - Winding Temperature Rise Measurement

INTRODUCTION

Standard test, ER140 - Temperature Rise, is a procedure for measuring the temperature rise within the stator winding. The aim of the test is as follows:

- To ensure that specified temperatures are not exceeded at any given rating.
- To verify that temperature recording devices, if fitted, are reading correctly.

The procedure must only be carried out by suitably trained technicians.

INSTRUMENTATION

The following Instruments are required to conduct the test:

- AC Kilowatt meter, voltmeter, ammeter and frequency meter.
- DC voltmeter and ammeter
- Wheatstone bridge, thermocouples, clock, stopwatch.

PROCEDURE

Suitably trained technicians may conduct the following test procedure:

1. Operate the alternator at rated speed, voltage, current and power factor. Record the speed, output volts, amps, kW and P.F. Also record the excitation volts and amps. Also record the temperatures of the ambient air, the alternator's air inlet, air outlet and

frame. Also record the temperature of the bunched leads or cables. Also record the time the readings were taken.

2. Without any adjustments, repeat the readings at 30 minute intervals until there is stability in the difference of three readings of the alternator's air inlet and air outlet temperatures.
3. Shut down the alternator as quickly as is practicable and measure all winding resistance. If shutdown cannot be within the following times, then the resistances and the time after shutdown are to be recorded at 30 set intervals over a 5 minute period. Temperature rises are to be calculated as shown below and then graphically extrapolated back to the prescribed time or to time zero, whichever is required:

- Alternators with an output of up to 50kVA 30sec
- Alternators with an output of 51kVA to 200kVA 90sec
- Alternators with an output of over 200kVA 120sec

$$\text{Temperature rise} = \left[\frac{R_{hot} - R_{cold}}{R_{cold}} \right] \times [(234.5 + T_1) - (T_2 - T_1)]$$

Where; T1 = the ambient air temperature at time of cold readings
and T2 = the ambient air temperature at time of hot readings.

Criteria; The specified temperatures are not recorded within the machine and the alternator temperature recording devices, if fitted, are reading correctly.

Example:-

Example readings as follows:

R_{hot} = 1.4Ω and T₂ = 25°C

R_{cold} = 1.0Ω and T₁ = 20°C

Temperature Rise calculation:

$$\left[\left(\frac{1.4 - 1.0}{1.0} \right) \right] \times [(234.5 + 20) - (25 - 20)]$$

$$= 0.4 \times 249.5$$

$$= 99.8^\circ\text{C}$$