Application Guidance Notes: Technical Information from Cummins Generator Technologies

# AGN 009 - Bearing Life

## DESCRIPTION

Vibration is a major cause in life reduction of bearings. Alternators manufactured by Cummins Generator Technologies are designed to withstand typical vibration levels encountered on generating sets, built to meet the requirements of **ISO 8528-9** (taken to be a broad band measurement), and the predominant vibration levels of rotating electrical machines driven by reciprocating internal combustion engines, to meet **BS5000 Part 3.**

Description of vibration levels and shock loading is detailed in **AGN008**. Cummins Generator Technologies will uphold alternator warranty liabilities provided that the requirements of these standards are not compromised. Cummins Generator Technologies should be contacted immediately, should there be any difficulty in maintaining the levels stated in **AGN008**.

There are factors outside of the above specifications that can affect specifically, the life of bearings on an alternator. The following circumstances identified must be taken into consideration to prevent the reduction of bearing life or failure:

- Design to protect against adverse operating conditions and severe application environment.
- Avoid where possible, long stationary periods in an environment where there is vibration. Vibration causes false Brinelling, which puts flats on the bearing race's balls and grooves.
- Guard against very humid atmospheres or wet conditions, which can emulsify bearing grease and cause bearing corrosion.
- Ensure regreasable bearings are not over greased, as this will lead to excessive bearing temperatures.
- Use only the recommended grease for each regreasable bearing type. Refer to the Owner's Manual for details of the grease to be used.

## TECHNICAL DISCUSSION

### L10 Statistical Life.

'L10' life is a statistical life based only on application load and assumes ideal operating conditions. The application life is determined by considering the static and dynamic load associated with the rotor mass along with the operational running speed.

The starting point is the chosen bearing manufacturer's designed capability expressed as a constant 'C', which equates to "the basic dynamic load rating". The specific bearing's value for 'C' is then combined with the proposed bearing's application, and the expected radial loading level, eg: rotor mass, unbalanced magnetic pull (UMP) etc, and generator's operating speed.

$L10_H$ [L10 life expressed in hours] is then calculated for the proposed application under what can only be considered to be as perfectly controlled, almost laboratory conditions. Therefore, $L10_H$ is a design statistical figure for reference only. Typically, this $L10_H$ will indicate many tens of thousands of operating hours.

### Service Life.

When a bearing is in operation its 'Service Life' will usually be less than the predicted L10 life. In real life the bearing will be subjected to other operational environmental factors, examples of which follow:

**Vibration** imposed from prime mover or adjacent operating equipment, including other generating sets.

**Shock loads**, which result from mechanical vibration, or torsionally generated axial movements / vibration. These 'vibrations' introduce less than perfect continuous ball/race alignment, and less than steady state regular loading, which may result in the bearing lubricant film momentary failing and thus ball and race contact as bare metal surfaces.

**Temperature** at the installation location. The key to any potential problem is the range of variation of the local ambient temperatures and the rate at which temperatures are likely to change.

**Humidity** at the site location, which can introduce corrosion issues that are likely to affect bearing float and bearing seals.

**Lubricant contamination** that can be introduced by imposed vibration, which prompts fretting or Brinelling, wide variation of bearing temperature, high humidity, and contamination introduced at point of manual re-greasing maintenance work.

**Electrical loading** that is unbalanced across the three phases, particularly a three phase alternator is providing a single phase output.

**Poor concentric alignment** of single bearing generators, which then adds to the inherent UMP. UMP is a consequence of alternator component dimensional tolerances, which affect the achievement of perfect rotor to stator concentricity.

### Bearing Service Life Expectancy.

Further details on life expectancy are published in the Owner's Manual for each alternator.