

The Role of Reliability for Bearings and Gears

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TECHNICAL PAPER

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[The statements and opinions contained herein are those of the author and should not be construed as an official action or opinion of the American Gear Manufacturers Association.]

ABSTRACT:

Life prediction or performance assessment is primarily done for bearings or gears with recognition of the significant role of stress level to such assessments. Reliability or probability of performance is known to relate to the stress-life relationship but the details as to how these interact are not often clearly defined.

This paper details the experimental basis for the relationship between stress (load), life and reliability for bearings and gears considering the similarity and differences of their respective systems. The role of stress level and life scatter in terms of the Weibull distribution will be addressed. The background and equations to calculate the reliability factors, as included in both bearing and gear standards, are then developed.

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Within any vital operating equipment, the reliability of the components that make up the unit must be known if any sound predictions of life or stress capability are to be made. Reliability of course is not an independent quality or factor of any component, whether it be bearing or gear. The interdependence of these three factors, life, stress (or load level) and reliability was demonstrated years ago by Waloddi Weibull (1) as illustrated in Fig. 1. The figure shows three interlinking plots in what Weibull called the complete fatigue diagram.

Section 1 on the figure is the typical S/N curve with S representing stress on a linear scale and N representing life in stress cycles on a log scale. The curves labeled P are the full range of probability that can theoretically occur from P=0 (100% reliability) to P=1 (zero reliability). All testing or real life component operations fall within these extremes. For a given stress and expected or determined life, a probability or reliability value must exist. For bearings and gears one tends to consider only a few specific curves represented by section 1 of the diagram.

In sections 2 and 3 of Fig. 1, other representations of the stress-life-reliability relationship are illustrated. For this figure the spacing of the curves and the log or linear scales are arbitrary. In actuality the underlying distributions or scales are determined by experiment. And when curves are drawn and

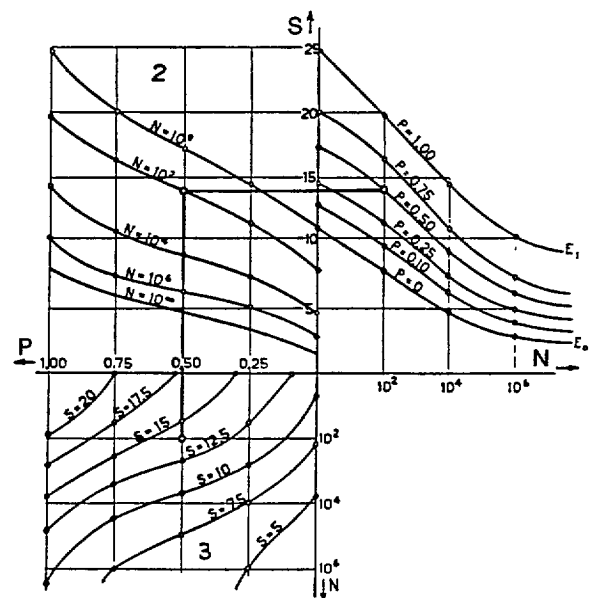


Fig. 1 The Complete Fatigue Diagram (1).

eventually used in gear and bearing standards, they have been developed from tests. The S/N curves are based on fatigue tests and the reliability-life or reliability-stress relationships depend on related or additional testing, usually with multiple tests at each of several stress levels.