

Lubrication Specification and Methodology

Email your question—along with your name, job title and company name (if you wish to remain anonymous, no problem) to: jmcguinn@geartechnology.com; or submit your question by visiting geartechnology.com.

QUESTION

I need to specify a method of lubrication and the type of lubricant for a speed reducer with three-stage helical gear, but the peripheral speed on the reference circle is too low. We have for 1st stage the Stribeck rolling pressure $k_s = 34.76 \text{ N/mm}^2$ and the speed $v = 0.80 \text{ m/s}^2$; for the 2nd stage $k_s = 49.4 \text{ N/mm}^2$ and $v = 0.39 \text{ m/s}^2$; and finally for 3rd stage the values are $k_s = 37.6 \text{ N/mm}^2$ and $v = 0.27 \text{ m/s}^2$.

Could you help me with the type and method of lubrication? Thank you.

Response provided by Robert Errichello, GEARTECH owner/operator (geartech@mt.net)

Because of the low speed, the application warrants a rigorous analysis of the elastohydrodynamic lubrication (EHL) according to the method given in AGMA 923-A03 (Ref. 1). This method explains how to calculate the specific oil film thickness, which is the ratio of the minimum EHL oil film thickness to the composite surface roughness of the gear teeth. With the specific oil film thickness known, you can predict the probability of wear-related distress.

In lieu of an EHL analysis, ANSI/AGMA 9005-E02, Annex B, gives guidelines for lubricant viscosity based on operating oil sump temperature, pitch line velocity, and lubricant viscosity index. For example: Assume your ambient temperature is 25°C and the temperature of the oil in the oil sump is 65°C under the highest operating load. ANSI/AGMA 9005-E02 (Ref. 2) would recommend an ISO VG 680 lubricant for a mineral oil. Unfortunately, the guidelines are limited to a pitch line velocity greater than 1 m/s, and your lowest velocity is 0.27 m/s. Therefore, the viscosity should probably be increased to ISO VG 1000. If your operating temperature is greater than 65°C, the oil viscosity should be increased further.

High oil viscosity may lead to problems with oil circulation. Therefore, you need to consider cold starts, circulation of the lubricant to all gears and bearings, pumping losses, and filterability. You may need to use synthetic oil with a low pour point, or use sump heaters to pre-heat the oil for cold starts.

(Robert Errichello is a longtime AGMA member. He has served on a number of its various committees and is the instructor of the Gear Failure Analysis seminar, easily one of AGMA's most popular and attended classes. The author of numerous gear-relevant technical papers and books, Bob also serves as a Gear Technology technical editor, and is owner-operator of GEARTECH, a gear industry consultancy.)

References

- AGMA 923-A03: Effect of Lubrication on Gear Surface Distress.
- ANSI/AGMA 9005-E02: Industrial Gear Lubrication.

Standards Summary

AGMA 925—A03: Description

This document provides currently available information pertaining to oil lubrication of industrial gears for power

transmission applications. It is intended to serve as a general guideline and source of information about gear oils, their properties, and their tribological behavior in gear contacts. Equations provided allow the calculation of specific film thickness and instantaneous contact (flash) temperature for gears in service, and to help assess the potential risk of surface distress (scuffing, micropitting and macropitting, and scoring) involved with a given lubricant choice.

ANSI/AGMA 9005-E02: Description

This standard provides the end user, original equipment builder, gear manufacturer and lubricant supplier with guidelines for minimum performance characteristics for lubricants suitable for use with enclosed and open gearing which is installed in general industrial power transmission applications. It provides recommendations for selecting lubricants based on current theory and practice in the industry, and attempts to align with current ISO standards. It is not intended to supplant specific instructions from the gear manufacturer. Replaces ANSI/AGMA 9005-D94.

For more information on current AGMA standards, visit www.agma.org.

