# INFORMATION

## TRANSMISSION AND GEAR OILS OF THE GERMAN DEMOCRATIC REPUBLIC (EAST GERMANY)

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In the German Democratic Republic (GDR) over the last few years, considerable attention has been allotted to the scientific principles of lubricating oil development and application. An important role in the expansion and coordination of scientific research in this area is that of the Commission on Lubrication Technology in the Presidium of the Chamber of Technology of the GDR. An active part in the work of this organization is taken by leading specialists of the GDR, Prof. G. Fleischer, Prof. G. Keil, and Prof. E. Pietsch, who also head the Scientific Council of the journal "Schmierungstechnik." An important place in the pages of this journal is occupied by articles on the lubrication of gears, which are one of the most important elements of modern machinery and equipment. The design, manufacture, and installation of gear transmissions, as well as the lubrication and maintenance of these transmissions, have acquired major importance.

We have not yet found any universal characteristics or methods to give a reliable prediction of the suitability of one transmission oil or another for a given mechanism. However, in connection with the constantly increasing demands placed on transmission and gear oils, efforts in this field have been intensified in the scientific-research organizations of the GDR, and already we can point to some very specific achievements. This can be attributed to the basic studies of Prof. E. Pietsch on the technique and practice of lubrication [1], those of Prof. G. Fleischer on the terminology of friction and wear [2], and those of other authors in establishing the mechanisms of action of extreme-pressure and antiwear additives [3-6]. In [4, 5] in particular, the working mechanisms of phosphorus-containing additives has been examined, and in [6] that of phosphorus- and sulfur-containing additives.

TABLE 1

| | For conventional gears | | | For hypoid gears | |
|---|---|---|---|---|---|
| | GL-60 | GL-125 | GL-265 | GS-125 | GS-200 |
| Kinematic viscosity, cS | | | | | |
| At 100°C, min | 9 | 15 | 25 | 15 | 22 |
| At 50°C | 53—63 | 115—135 | 250—280 | 115—135 | 190—270 |
| Solid point, °C, max. | —25 | —15 | —10 | —15 | —15 |
| Flash point, °C, min. | 175 | 180 | 200 | 180 | 200 |
| Water content, %, max. | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 |
| Extreme-pressure properties of oil in ZVP gear-stand test | | | | | |
| Load step at seizure, min | 12 | 12 | 10 | 8 | 8 |
| Normal seizure load, kgf/cm tooth width, min. | 815 | 815 | 636,5 | 918 | 918 |
| Seizure load in contact zone, kgf/cm², min. | 20 000 | 20 000 | 17 720 | 21 000 | 21 000 |
| Torque applied to drive-gear, kg·m, min. | 55 | 55 | 43 | 43 | 43 |

Note: No solid contaminants are present in any of the oils. All oils pass the corrosion test, with GL-265 showing traces of corrosion. Oils of the GL group were tested in the ZVP stand by the A/8.3/90 method; oils of the GS group, by the $A_S$/16.6/130 method.

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TABLE 2. Viscosity–Temperature Properties of Oils

| Oil type | Viscosity index (min.) | SAE grade |
|---|---|---|
| GL-60 | 100 | 75 |
| GL-125 | 80 | 80—90 |
| GL-265 | 80 | 140 |
| GS-125 | 80 | 80 |
| GS-200 | 80 | 90 |

TABLE 3. Conditions for Transmission Oil Oxidation

| Oxidation conditions | Oil type | |
|---|---|---|
| | GL | GS |
| Oil oxidation temperature, °C | 125 | 135 |
| Oxidation period, h | 40 | 40 |
| Oxidation medium (air), liter/h | 5 | 5 |
| Catalyst | Copper strip, 20×50×1,5 mm | |

TABLE 4. Transmission Oil Test Conditions in ZVP Stand in Accordance with Standard TGL 26890

| Basic parameters | Oil type | |
|---|---|---|
| | GL | GS |
| Test method | A/8,3/90 | A/16,6/130 |
| Test conditions | Normal | Special |
| Drive gear, rpm | 2170 | 4380 |
| Tooth width, mm | 20 | 10 |
| Oil temperature at start of test, °C | 90±3 | 130±3 |
| Gear lubrication method | Splash | |

Interesting work on the lubrication of gear trains and automotive transmissions has been published by investigators at the Scientific-Technical Center for Transmissions and Couplings. One of the more recent studies [7] was a review of the problem of gear-train lubrication in connection with the calculation and design of such units.

In the earlier stages of the work, questions that were examined included those relating to low-temperature properties of transmission oils [8], the causes of damage and wear of gears [9], the lubrication of the main drive gear (rear axles) in automotive vehicles [10], and tests on transmission and gear oils in various branches of industry [11].

On the basis of statistical studies, it is noted [9] that out of the total number of failures occurring in gears during service only 5% can be attributed to substandard quality of the lubricants that were used.

Higher speeds and loads on gears will require lubricants of better quality. The straight mineral oils that were originally used are no longer able to provide reliable gear operation. Oils developed in the GDR now include two groups of lubricants with antiwear and extreme-pressure additives in accordance with today's requirements [12]. These oils also include antioxidants and corrosion inhibitors to provide the necessary thermal-oxidative stability and protective properties in the presence of moisture.

The first groups of oils is designated Type GL, intended for the lubrication of industrial gears and units in automotive transmissions operating at contact loads up to 20,000 kgf/cm$^2$ and bulk oil operating temperatures up to 100°C. This group includes three grades of oil (Table 1), designated GL-60, GL-125, and GL-265, differing in viscosity. The respective viscosities of these oils at 50°C are 53-68, 115-135, and 250-280 cS (average values 60, 125, and 265 cS).