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Petroleum products and lubricants — Rheological properties of lubricating greases — Determination of flow point using an oscillatory rheometer with a parallel-plate measuring system

Produits pétroliers et lubrifiants — Propriétés viscoélastiques des graisses lubrifiantes — Détermination du seuil d'écoulement au moyen d'un rhéomètre oscillant de type plan/plan

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Foreword

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This document was prepared by Technical Committee ISO/TC 28, *Petroleum and related products, fuels and lubricants from natural or synthetic sources*.

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Petroleum products and lubricants — Rheological properties of lubricating greases — Determination of flow point using an oscillatory rheometer with a parallel-plate measuring system

1 Scope

This document specifies a test method to determine the flow point of lubricating greases using an oscillatory rheometer with a parallel-plate measuring system. It also specifies a test method to evaluate further specific viscoelastic properties of lubricating greases.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 23572, *Petroleum products — Lubricating greases — Sampling of greases*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
flow point
τ_f
value of shear stress at which a material begins to flow

Note 1 to entry: The flow point is given in pascals (Pa).

3.2
yield point
τ_y
value of shear stress at the limit of the linear viscoelastic (LVE) range

Note 1 to entry: This limiting value is exceeded as soon as the first value of the storage modulus, *G′*, (3.3) or *loss modulus, G″,* (3.4) deviates from the corresponding plateau value by more than 10 %.

Note 2 to entry: The yield point is given in pascals (Pa).

3.3
storage modulus
G'
component of shear stress which is in phase with the shear strain (deformation)

Note 1 to entry: The storage modulus represents the elastic part of the viscoelastic behaviour of the sample and is given in Pa.

3.4
loss modulus
G''
component of shear stress which exhibits a phase shift of $\delta = \pi/2 = 90°$ to the shear strain (deformation)

Note 1 to entry: The loss modulus represents the viscous part of the viscoelastic behaviour of the sample and is given in pascals (Pa).

3.5
loss factor
$\tan\delta$
ratio of *loss modulus* (3.4) and *storage modulus* (3.3)

$$\tan\delta = \frac{G''}{G'}$$

Note 1 to entry: The loss factor is dimensionless.

4 Symbols

For the purposes of this document, the symbols listed in Table 1 apply.

Table 1 — Symbols

Symbol	Designation	Unit
G'	storage modulus	Pa
G''	loss modulus	Pa
H	measuring gap in the parallel-plate measuring system	mm
M	torque	Nm
t	time	s
T	temperature	°C
δ	phase shift angle	° (degrees)
$\tan\delta$	loss factor	1
γ	shear strain or shear deformation	% (with 1 = 100 %)
γ_f	shear strain at the flow point	%
γ_y	shear strain at the yield point	%
φ	deflection angle	rad
τ	shear stress	Pa
τ_f	flow point	Pa
τ_y	yield point	Pa
ω	angular frequency	s^{-1}

5 Principle

A sample of lubricating grease is tested at a constant temperature using an oscillatory rheometer with a parallel-plate measuring system. One of two possible procedures is conducted (see also 10.3), as follows:

a) method A: torque, M, is measured as a function of the deflection angle (shear strain is a preset value);

b) method B: deflection angle, φ, is measured as a function of the torque, M, (shear stress is a preset value).

Based on these results, the values of the storage modulus, G', the loss modulus, G'', and the loss factor, $\tan\delta$, are calculated and further viscoelastic properties such as the flow point are determined from these.