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*भारतीय मानक मसौदा*

**संगलग्न औद्योगिक गियर चालन के लिए गियर स्नेहक — विशिष्टि**

**(IS 8406 का तीसरा पुनरीक्षण)**

*Draft Indian Standard*

**GEAR LUBRICANTS FOR ENCLOSED**

**INDUSTRIAL GEAR DRIVES — SPECIFICATION**

*(Third Revision of IS 8406)*

(ICS No. 75.100)

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Lubricants and their related products  
Sectional Committee, PCD 25

Last date for receipt of comment is  
**9 June 2024**

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**FOREWORD**

*(Formal clauses will be added later)*

This standard covers lubricants intended for use in enclosed and semi-enclosed industrial gear systems employing the following types of gears where tooth pressures and pitch line velocities are such that the use of straight mineral oil is unsuitable:

- a) Spur;
- b) Straight bevel;
- c) Spiral bevel;
- d) Worm;
- e) Herring-bone; and
- f) Helical.

This standard was first published in 1977. The first revision was carried out after review of the standard by the Committee in the light of the requirements and advancements in the field of lubrication technology in the country. Various viscosity grades were modified as per the ISO viscosity classification (*see* IS 9466 ‘Viscosity classification for industrial liquid lubricants’). The Committee also considered the then trade practices as well as the need for international co-ordination among standards prevailing in different countries. Hence, the first revision of this standard was based on American Gear Manufacturers Association Standard AGMA 250.03 ‘Lubrication of industrial enclosed gearing’, May 1972, with suitable provision for local requirements.

In the second revision, the Committee updated and aligned this standard with AGMA 250.04, September 1981. Considerable assistance was also drawn from US Steel Requirements No. 224 on 'Lead free EP Gear Oil' issued by the UX Engineers and Consultants Inc (UEC). The major changes made were modification in requirements for oxidation stability, ash percent, and demulsibility, and requirement for air release value was added. Also, for extreme pressure (EP) type gear oils, requirements for demulsibility, additive solubility, 4-ball EP test, and 4-ball wear test were added.

This third revision has been brought out to keep pace with the latest technological developments and international practices. Accordingly, the Committee has drawn considerable assistance from the latest specification of American Gear Manufacturers Association, ANSI/AGMA 9005-F16, March 2016 'Industrial Gear Lubrication'. The major changes made are mentioned below:

- a) Values for demulsibility of R & O type and EP lubricants have been updated;
- b) Requirement of air release value for lubricants has been removed;
- c) Requirement of Timken EP test for EP lubricants has been removed;
- d) FZG test requirement has been updated; and
- e) Referee test methods have been updated.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

**1 SCOPE**

**1.1** This standard prescribes the requirements and the methods of sampling and test for the gear lubricants intended for use in enclosed and semi-enclosed industrial gear systems where tooth pressures and pitch-line velocities are severe enough to render the use of straight mineral oils unsuitable.

**1.2** This standard does not cover lubricants for food and drug industries and those required to be operated under extremely severe and hostile environment as indicated below:

- a) Gear drives operating at speeds over 3600 rev/min and/or pitch-line velocities exceeding 1500 m/min;
- b) Lubricants sump temperatures generally exceeding 100 °C;
- c) Applications where incidental contact may occur with the product under manufacture; and
- d) Gear drives operating in chemical and dust laden atmospheres.

**2 REFERENCES**

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
IS 1447 (Part 1) : 2021	Methods of Sampling of Petroleum and its Products Part 1 Manual Sampling ( <i>second revision</i> )
IS 1448	Methods of test for petroleum and its products
(Part 2) : 2007 / ISO 6619 : 1988	Petroleum products and lubricants — Neutralization number — Potentiometric titration method ( <i>second revision</i> )
(Part 4/Sec1) : 2021	Determination of ash ( <i>third revision</i> )
(Part 10/Sec2) : 2021 / ISO 3016: 2019	Petroleum and related products from natural or synthetic sources Section 2 Determination of pour point ( <i>third revision</i> )
(Part 15) : 2004 / ISO 2160 : 1998	Petroleum Products — Corrosiveness to copper—Copper strip test ( <i>third revision</i> )
(Part 25/Sec 1) : 2018 / ISO 3104 : 1994	Transparent and opaque liquids section 1 Determination of kinematic viscosity and calculation of dynamic viscosity ( <i>second revision</i> )
(Part 56) : 2013 / ISO 2909 : 2002	Calculation of viscosity index from kinematic viscosity ( <i>third revision</i> )
(Part 65) : 2018	Oxidation test for lubricating oils ( <i>third revision</i> )
(Part 67) : 2020	Determination of foaming characteristics of lubricating oils ( <i>second revision</i> )
(Part 69) : 2019 / ISO 2592 : 2017	Determination of flash and fire points — Cleveland open cup method ( <i>second revision</i> )
(Part 95) : 2019	Determination of demulsibility characteristics of lubricating oils ( <i>first revision</i> )
(Part 96) : 2019	Petroleum products and lubricants — Petroleum oils and other fluids — Determination of rust-preventing characteristics in the presence of water ( <i>first revision</i> )

(Part 170) : 2021 / ISO 20623 : 2017	Determination of the extreme pressure and anti-wear properties of lubricants Four-ball method European conditions ( <i>first revision</i> )
ASTM D5182	Standard test method for evaluating the scuffing load capacity of oils (FZG Visual Method)

### **3 GRADES AND TYPES**

#### **3.1 Viscosity Grades**

The lubricant shall conform to one of the nine viscosity grades as distinguished by the prescribed viscosity limits given in Table 1.

#### **3.2 Performance Types**

The lubricant shall be of the following two performance types:

- a) Rust and oxidation inhibited (R & O); and
- b) Extreme pressure (EP).

NOTE — Extreme pressure lubricants formulated with lead naphthenate are no longer recommended because of potential health hazard and poor stability.

CAUTION — Incorporation of solid extreme pressure additives/friction reducers such as graphite or molybdenum disulphide, etc, is not recommended in gear oils because of their instability. However, soluble friction reducers can be added.

**3.3** The lubricant shall be identified using its viscosity grade and performance type. For example, Grade ‘46 R & O’ refers to viscosity grade 46 and rust and oxidation inhibited type of performance, and Grade ‘68 EP’ refers to the viscosity grade 68 and extreme pressure type of performance.

### **4 REQUIREMENTS**

#### **4.1 General Requirements**

**4.1.1** The lubricant shall consist of a refined petroleum product with suitable additive materials. Base oils can be virgin or re-refined [*see* PCD 25(22088)] or synthetic type or their mixtures.

**4.1.2** The lubricant shall be homogeneous and free from water, suspended materials, dust, sediments, and any other impurities.

#### **4.2 Specific Requirements**

The material shall comply with the requirements prescribed in Table 1 when tested according to the relevant methods prescribed in col 12 of Table 1.

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**Table 1 Requirements for Gear Lubricants (R & O and EP Types)**  
(Clause 3.1, 4.2 and 6.2)

Sl. No.	Characteristics	Requirement									Method of Test
		Grade VG 46	Grade VG 68	Grade VG 100	Grade VG 150	Grade VG 220	Grade VG 320	Grade VG 460	Grade VG 680	Grade VG 1000	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
i)	Kinematic viscosity at 40 °C <sup>a</sup> , mm <sup>2</sup> /s	41.4 to 50.6	61.2 to 74.8	90.0 to 110.0	135.0 to 165.0	198.0 to 242.0	288.0 to 352.0	414.0 to 506.0	612.0 to 748.0	900 to 1100	IS 1448 (Part 25/Sec 1)
ii)	Flash point, Cleveland (open) cup, °C, <i>Min</i>	180	200	200	200	220	220	230	230	230	IS 1448 (Part 69)
iii)	Viscosity index, <i>Min</i>	90							85		IS 1448 (Part 56)
iv)	Pour point, °C, <i>Max</i>	-6	-6	-6	-6	-3	-3	0	0	0	IS 1448 (Part 10/Sec 2)
v)	Acidity, inorganic	Nil									IS 1448 (Part 2)
vi)	Copper strip corrosion test at (100 ± 1) °C for 3 h	Not worse than 1									IS 1448 (Part 15)
vii)	Oxidation stability at 121 °C, 312 h, 10 litres air/h	Increase in kinematic viscosity at 100 °C shall not exceed 6 percent									IS 1448 (Part 65)

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viii)	Rust protection	No rust after 24 h with synthetic sea water		IS 1448 (Part 96)
ix)	Ash, percent by mass <i>Max</i>	0.1		IS 1448 (Part 4/Sec 1)
x)	Demulsibility: (for R and O type) <sup>b</sup>			IS 1448 (Part 95)
	a) Water in oil after 5 h test, percent (v/v), <i>Max</i>	0.5	2.0	
	b) Emulsion after centrifuging, ml, <i>Max</i>	2.0	4.0	
	c) Total free water collected during test (starting with 45 ml of water), ml, <i>Min</i>	30		
xi)	Foam tendency / stability, volume of foam after 10 min, ml, <i>Max</i> :			IS 1448 (Part 67)
	a) Sequence I at 24 °C	100/10		
	b) Sequence II at 93.5 °C	100/10		
	c) Sequence III at 24 °C after test at 93.5 °C	100/10		

<sup>a</sup>For R and O type gear lubricant, viscosity grades covered are VG 46 to VG 320 only.

<sup>b</sup>For EP type gear lubricants see Table 2.

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**4.3 Additional Requirements for EP Type Lubricant**

The EP type lubricant shall conform to the additional requirements in Table 2 when tested as per test methods given in col 5 of Table 2.

**5 PACKING AND MARKING**

**5.1 Packing**

The material shall be supplied in suitable containers as agreed to between the purchaser and the supplier and subject to the provisions of *Red Tariff No. 20*, incorporating *Railway Red Tariff Rules 1960*, for the conveyance by rail of explosives and other dangerous goods, issued by the Indian Railways Conference Association, with any alterations made thereafter.

**5.2 Marking**

**5.2.1** Each container shall be marked with the following information:

- a) Name, grade, and type of the material;
- b) Manufacturer’s name, initials or trade-mark;
- c) Net mass/volume of the material;
- d) Month and year of manufacture;
- e) Identification in code or otherwise to enable the lot to be traced back from records; and
- f) Any other statutory requirements.

**5.2.2 BIS Certification Marking**

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

**Table 2 Additional Requirements for Extreme Pressure Type Gear Oils**

(Clause 4.3)

Sl. No.	Type of Test	Requirement		Methods of Test
		Viscosity Grades	Limit	
(1)	(2)	(3)	(4)	(5)
i)	Demulsibility			IS 1448 (Part 95)
	a) Water in oil after 5 h test, percent v/v, Max	VG 46 to VG 1000	2.0	
	b) Emulsion after centrifuging, ml, Max	VG 46 to VG 150	1.0	
		VG 220 to VG 1000	4.0	



	c) Total free water collected during test (starting with 90 ml of water), ml, <i>Min</i>	VG 46 to VG 150	80	
		VG 220 to VG 1000	50	
ii)	Additive solubility	VG 46 to VG 1000	Must be filterable to 25 µm (microns) without loss of EP additive	IS 1448 (Part 170)
iii)	4-Ball EP test, weld load, kg, <i>Min</i>	VG 46 to VG 1000	250	
iv)	4 Ball wear (75 °C / 1200 rpm /15 kgf) scar diameter, mm, <i>Max</i>	VG 46 to VG 1000	0.35	
v)	FZG-A/8.3/90, Fail load stage, <i>Min</i>	VG 46 to VG 1000	12 <sup>th</sup> load stage	ASTM D5182

**6 SAMPLING**

**6.1** Representative samples of the material shall be drawn as prescribed in IS 1447 (Part 1).

**6.2 Number of Tests**

Tests for determining all the characteristics given in Table 1 and Table 2 shall be conducted on the composite samples.

**6.3 Criteria for Conformity**

The material shall be declared as conforming to the requirements of the specification if all the tests carried out on the composite samples meet the relevant specification requirements.