



**International
Standard**

ISO 10050

**Lubricants, industrial oils and
related products (class L) — Family
T (Turbines) — Specifications of
triaryl phosphate ester turbine
control fluids (category ISO-L-TCD)**

*Lubrifiants, huiles industrielles et produits connexes (classe
L) — Famille T (Turbines) — Spécifications pour les fluides
de régulation de turbines à base d'esters de triaryl phosphate
(catégorie ISO-L-TCD)*

**Second edition
2024-07**

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Contents

	Page
Foreword.....	iv
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	2
4 Composition.....	2
5 Safety precautions.....	3
6 Dyes.....	3
7 Sampling.....	3
8 Required characteristics.....	3
9 Precision and interpretation of test results.....	3
Bibliography.....	6

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 28, *Petroleum and related products, fuels and lubricants from natural or synthetic sources*, Subcommittee SC 4, *Classifications and specifications*.

This second edition cancels and replaces the first edition (ISO 10050:2005), which has been technically revised.

The main changes are as follows:

- addition of precisions about the composition of the products;
- addition of safety precautions;
- updates of the specifications:
 - the temperature for elastomer compatibility has been lowered to 60 °C to reflect the conditions of use;
 - the corrosiveness to copper test has been added;
- the maintenance and use guide IEC 60978 has been replaced by ISO 11365.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Lubricants, industrial oils and related products (class L) — Family T (Turbines) — Specifications of triaryl phosphate ester turbine control fluids (category ISO-L-TCD)

WARNING — The handling and use of products as specified in this document can be hazardous, if suitable precautions are not observed. This document does not purport to address all the safety problems associated with its use. It is the responsibility of the users of this document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This document specifies the characteristics of unused triaryl phosphate ester fluids for turbine governor controls and other hydraulic systems in electrical power stations. Fluids used in this application are classified under category TCD of ISO 6743-5.

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 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 48-2, *Rubber, vulcanized or thermoplastic — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD*

ISO 760, *Determination of water — Karl Fischer method (General method)*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 2160, *Petroleum products — Corrosiveness to copper — Copper strip test*

ISO 2592, *Petroleum and related products — Determination of flash and fire points — Cleveland open cup method*

ISO 3016, *Petroleum and related products from natural or synthetic sources — Determination of pour point*

ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity*

ISO 3170, *Petroleum liquids — Manual sampling*

ISO 3675, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method*

ISO 4259-2, *Petroleum and related products — Precision of measurement methods and results — Part 2: Interpretation and application of precision data in relation to methods of test*

ISO 4406, *Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles*

ISO 6247, *Petroleum products — Determination of foaming characteristics of lubricating oils*

ISO 6614, *Petroleum products — Determination of water separability of petroleum oils and synthetic fluids*

ISO 6619, *Petroleum products and lubricants — Neutralization number — Potentiometric titration method*

ISO 10050:2024(en)

ISO 9120, *Petroleum and related products — Determination of air-release properties of steam turbine and other oils — Impinger method*

ISO 12185, *Crude petroleum, petroleum products and related products — Determination of density — Laboratory density meter with an oscillating U-tube sensor*

ISO 12937, *Petroleum products — Determination of water — Coulometric Karl Fischer titration method*

ISO 13226, *Rubber — Standard reference elastomers (SREs) for characterizing the effect of liquids on vulcanized rubbers*

ISO 14935, *Petroleum and related products — Determination of wick flame persistence of fire-resistant fluids*

ISO 15597, *Petroleum and related products — Determination of chlorine and bromine content — Wavelength-dispersive X-ray fluorescence spectrometry*

ISO 20823, *Petroleum and related products — Determination of the flammability characteristics of fluids in contact with hot surfaces — Manifold ignition test*

IEC 60247, *Insulating liquids — Measurement of relative permittivity, dielectric dissipation factor ($\tan \delta$) and d.c. resistivity*

EN 14832, *Petroleum and related products — Determination of the oxidation stability and corrosivity of fire-resistant phosphate ester fluids*

EN 14833, *Petroleum and related products — Determination of the hydrolytic stability of fire-resistant phosphate ester fluids*

3 Terms and definitions

No terms and definitions are listed in this document.

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/>

4 Composition

4.1 In general, phosphate esters are a class of organophosphorus compounds with the following chemical structure:



where R is an alkyl, aryl or aryl substituted group. In control systems applications, only triaryl phosphate fluids are used. R, in that case, is a substituted or an unsubstituted phenyl group.

4.2 When approved for use as governor fluids, substituents on the aromatic group are currently either methyl (-CH₃) or tertiary butyl (-C(CH₃)₃) groups.

4.3 If the substituents are methyl groups, the product is known as trixylyl phosphate (TXP). This material is a substance of very high concern (SVHC) and its use is subject to authorization as it is included in Annex XIV of the regulation for registration, evaluation, authorization and restriction of chemicals (REACH).^[9] Outside the European Union, the fluid is widely used.

4.4 Additives can be incorporated to enhance oxidation stability, corrosion and rust protection, and to reduce foaming. Use of viscosity modifiers is not allowed.

5 Safety precautions

5.1 Fires that can occur in turbine operations are caused by fluid or vapours contacting hot surfaces or having impregnated the insulating materials around the hot pipes. The fluid that can leak, spill and be absorbed into unprotected thermal insulation can provoke an exothermic reaction with resultant, potential, rapid temperature increase. The ignition of the absorbed fluid can occur at temperatures below the fluid auto-ignition temperature.

5.2 Phosphate esters fire-resistant fluids are difficult to ignite and show little tendency to propagate flame, but are not non-inflammable. Such fluids are intended to be filled only into systems designed for their use and where recommended by the equipment manufacturer. Regular maintenance of these fluids is important. Detailed information on their maintenance and associated safety procedures is given in ISO 11365 or can be obtained from equipment manufacturers and fluid suppliers.

5.3 The fire safety tests are used to measure and describe the properties of fire-resistant fluids under controlled laboratory conditions and should not be considered as simulating the exact behaviour of the fluids under actual fire conditions.

6 Dyes

The use of dyes for identification purposes is allowed, if required.

7 Sampling

Unless otherwise specified in commodity specifications, samples shall be drawn in accordance with ISO 3170.

Additional information on sampling as given in ISO 11365 should also be taken into account.

8 Required characteristics

The appearance of the fluid shall be clear and free from visible foreign matter when a representative sample of the fluid is examined at ambient temperature by transmitted visible light using a clear glass container of approximately 100 mm diameter.

Fluids complying with this document shall meet the limits given in [Table 1](#) when tested in accordance with the methods specified in [Table 1](#). The test methods specified in [Table 1](#) shall apply.

9 Precision and interpretation of test results

Most of the test methods specified in [Table 1](#) contain a precision statement. In cases of dispute, the procedure described in ISO 4259-2 shall apply. In such cases, it is expected that the conditions specified in ISO 4259-4 are met.

Table 1 — Required characteristics of unused triaryl phosphate ester turbine control fluids

Characteristic of test		Unit	Requirement		Test method
			32	46	
Viscosity grade according to ISO 3448					
Kinematic viscosity at 40 °C	min.	mm ² /s	28,8	41,4	ISO 3104
	max.	mm ² /s	35,2	50,6	
Kinematic viscosity at 0 °C	max.	mm ² /s	2 000	2 500	
Density at 15 °C	max.	kg/m ³	1 200	1 200	ISO 3675 or ISO 12185
Neutralization number ^a	max.	mg KOH/g	0,1	0,1	ISO 6619
Water content ^b	max.	g/kg	1,0	1,0	ISO 760 or ISO 12937
Pour point	max.	°C	-15	-15	ISO 3016
Manifold ignition test					ISO 20823
— Ignition temperature	min.	°C	700	700	
— Flame propagation	min.	rating	report	report	
Wick flame persistence	max.	s	10	10	ISO 14935
Fire point	min.	°C	300	300	ISO 2592
Foaming characteristics (tendency/stability)					
— Sequence I at 24 °C	max.	ml/ml	150/0	150/0	ISO 6247
— Sequence II at 93,5 °C	max.	ml/ml	30/0	30/0	
— Sequence III at 24 °C	max.	ml/ml	150/0	150/0	
Air release time at 50 °C	max.	min	5	6	ISO 9120
Corrosiveness to copper (3 h at 100 °C)	max.	rating	1	1	ISO 2160
Water separability					
Time to reach ≤ 3 ml emulsion	max.	min	15	15	ISO 6614
Direct current resistivity at 20 °C ^c	min.	MΩ.m	50	50	IEC 60247
Chlorine content ^c	max.	mg/kg	50	50	ISO 15597
Cleanliness at delivery stage ^d	max.	rating	-/15/12	-/15/12	ISO 4406
Oxidation stability					
— Acid number	max.	mg KOH/g	1,5	1,5	EN 14832
— Mass change Fe	max.	mg	1,0	1,0	
— Mass change Cu	max.	mg	2,0	2,0	
Hydrolytic stability					
— Increase in acid number	max.	mg KOH/g	0,5	0,5	EN 14833
Key					
IRHD international rubber hardness degree					
^a The neutralization number method provides for the determination of both the total acid number and strong acid number. The requirement in this document is for the measurement of total acid number.					
^b ISO 20764 may be applied for the preparation of test portions in instances where interference by certain chemicals shall be avoided.					
^c These characteristics only concern electro-hydraulic controlled systems equipped with servo-valves.					
^d The preferred test method for counting and sizing particles is ISO 11500, using an automatic particle counter calibrated according to ISO 11171.					
^e Standard reference elastomers (SRE) shall be in accordance with ISO 13226. Elastomers and test conditions are only suggested. Elastomer compatibility should be agreed between the end user and the supplier with respect to elastomer type and the test conditions. Recommended test conditions are given in ISO 23529.					

Table 1 (continued)

Characteristic of test	Unit	Requirement		Test method
		32	46	
Viscosity grade according to ISO 3448				
Elastomer compatibility ^e				ISO 1817
SRE-EPM/1 (168 h at 60 °C)				
SRE-FKM/2X (168 h at 60 °C)				
— Volume change	%	report	report	ISO 1817
— Hardness change	IRHD	report	report	ISO 48-2
— Change in tensile strength	%	report	report	ISO 37
— Elongation at break	%	report	report	ISO 37
Key				
IRHD international rubber hardness degree				
<p>^a The neutralization number method provides for the determination of both the total acid number and strong acid number. The requirement in this document is for the measurement of total acid number.</p> <p>^b ISO 20764 may be applied for the preparation of test portions in instances where interference by certain chemicals shall be avoided.</p> <p>^c These characteristics only concern electro-hydraulic controlled systems equipped with servo-valves.</p> <p>^d The preferred test method for counting and sizing particles is ISO 11500, using an automatic particle counter calibrated according to ISO 11171.</p> <p>^e Standard reference elastomers (SRE) shall be in accordance with ISO 13226. Elastomers and test conditions are only suggested. Elastomer compatibility should be agreed between the end user and the supplier with respect to elastomer type and the test conditions. Recommended test conditions are given in ISO 23529.</p>				

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