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Date: 24 June 2024

Origin: International

Latest date for receipt of comments: 17 August 2024

Project No. 2023/02288

Responsible committee: PTI/7 Lubricants and process fluids

Interested committees:

Title: Draft BS ISO 11366 Petroleum and related products - Guidance for in-servicing of steam, gas and combined cycle turbines lubricating oils.

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Introduction

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 11366

Petroleum and related products — Guidance for in-servicing of steam, gas and combined cycle turbines lubricating oils

Pétrole et produits connexes — Lignes directrices pour le suivi en service des huiles lubrifiantes pour turbines à vapeur, à gaz et à cycle combiné

ICS: 75.100

ISO/TC 28/SC 4

Secretariat: **AFNOR**

Voting begins on:
2024-06-24

Voting terminates on:
2024-09-16

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ISO/DIS 11366:2024(en)

Full document details: 24/30480828 DC

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Published in Switzerland

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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).

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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 first edition of ISO 11366 cancels and replaces ISO/TS 11366:2011.

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.

Introduction

The in-service monitoring of turbine oils is largely recognized by the power generation industry as necessary to insure long and trouble-free operation of turbines.

There are three main types of stationary turbines used in power generation plants: steam turbines, gas turbines and combined cycle turbines. The combined cycle turbines are of two types; the first type associates a gas turbine with a steam turbine, with separated lubricating circuits, and the second type called single shaft combined cycle turbines in which the steam and the gas turbines are on the same shaft and are lubricated with the same oil.

The lubrication requirements of gas turbines and steam turbines are quite similar, but there are some big differences. As a matter of fact, gas turbine oils are submitted to localized hot spots, and water contamination is less likely.

Gas turbine oils have shorter service life than steam turbine oils. The lifetime of steam turbines oils is of many years and experience is available with lifetimes from 10 to 20 years depending on the top up level. The lifetime of gas turbine oils can be between five to ten years or more.

The values of the various characteristics mentioned in this document are purely indicative. In fact, for proper interpretation of the results, account has to be taken of many factors like type of equipment, design of the lubricating oil circuit, top-up level.

In any case, the manufacturer's instructions have to be followed.

Petroleum and related products — Guidance for in-servicing of steam, gas and combined cycle turbines lubricating oils

1 Scope

This document applies to mineral oils used as lubricating oils and control fluids used to lubricate steam, gas and combined cycle turbines in service. The lubricants considered in this document are those classified in ISO 6743-5^[1] and specified in ISO 8068,^[2] except the grades TSD, TGD and TCD (phosphate esters) for which ISO 11365^[3] is more relevant and the grades TGCE, THA, THCH, THGE and THE.

This document is intended to:

- help power equipment operators evaluate the conditions of the oil in their equipment and maintain oils in serviceable conditions;
- help users understand how the oils deteriorate and carry out a meaningful program of sampling and testing of oils in use.

This document also gives instructions with respect to the corrective actions that are taken to maximize service life.

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 3170, *Petroleum liquids — Manual sampling*

ISO 3722, *Hydraulic fluid power — Fluid sample containers — Qualifying and controlling cleaning methods*

ISO 4021, *Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system*

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 Description of turbine oils

Steam- and gas-turbines oils consist of highly refined hydrocarbon-origin base stocks in which additives are added to provide or to improve oxidation stability, as well as rust-protection properties, corrosion-protection properties (mainly for copper and copper containing materials). Additional foam suppressants can be added to limit the foaming tendency. However, care should be taken to avoid adding too much foam suppressant, which can have detrimental effect on air release properties. Demulsifiers can also be used to improve the water-shedding properties, but this should not be a common practice.

To formulate turbines oils, base stocks of API groups I and II are used with success; for special applications, e.g. high-temperature gas turbines, API groups III, III+ and IV base stocks can also be used. But in most instances, API group I and group II base stocks are largely sufficient for most applications. The refining degree of group I and group II base stocks vary from one producer to another. Hydrogen treatment is essential to get a good response to the antioxidants and to obtain good water-shedding and air-release properties.

Numerous technologies are available to provide the necessary performance in terms of oxidation stability, and rust and corrosion protection. Combination of phenol- and amine-type antioxidants, associated with proper rust inhibitors (either ashless or ash containing) and copper corrosion inhibitors, are commonly used.

For some applications, mainly when the turbine is coupled to gears, extreme-pressure additives are required. These extreme-pressure additives shall be chosen so as to not impair the oxidation stability.

The use of viscosity modifiers (viscosity index improvers) is prohibited.

All new oils shall comply with ISO 8068, which includes requirements with respect to the most important properties, as follows:

- oxidation stability;
- low tendency to sludge forming;
- rust-protection properties;
- copper corrosion-protection properties;
- foaming tendency;
- air-release ability;
- water-shedding characteristics.

However, all these properties cannot be expected to remain unchanged for the life of the oil.

The oil unavoidably undergoes deterioration; some deterioration can be tolerated without prejudice to the safety and efficiency of the system. Good monitoring procedures are necessary to determine when the oil characteristics have reached the condemning limits, i.e. critical values for the most important characteristics that can be deleterious to the function of the installation.

5 Factors affecting the service life

5.1 General

The following factors can affect the service life of turbine lubricating oils:

- oil system design;
- condition of the oil system at start-up;
- original oil quality;
- system operating temperature and duty cycle;
- contamination rates and oil purification provisions;
- oil make-up rates.

5.2 Oil system design

Most modern turbine-lubricating systems are very similar in design, especially for the larger units. The usual practice is to pressurize feed oil directly from main pump oil. To maintain reliability, after start-up of

the turbine, the main pump is directly actuated by the turbine rotor. The oil is pumped from a reservoir of sufficient capacity to ensure a residence time of about 10 minutes for the turbine oil, so as to allow complete air release by the oil. The rest of the circulating system consists of an oil cooler, a strainer, a purification and filtration system, an oil tank vapour extractor and hydrogen removing units. The purification equipment includes centrifuging to remove water and is of utmost importance for achieving satisfactory oil lives.

For the larger turbines, high-pressure hydraulic pumps (up to 50 MPa outlet pressure) are used to lift the turbine shaft to allow for turning.

5.3 Conditions of the oil system at start-up

The individual components of a turbine lubrication system are usually delivered on-site before the system is installed. These components are generally pre-cleaned and delivered with a protection system to prevent corrosion or contamination ingress. The length of on-site storage and the means taken to preserve the integrity of the protection of the internal surfaces of the lubricating system will affect the amount of contamination introduced prior to use. During the installation of the lubricating-oil system components, attention should be paid to minimizing openings in the system and to maintaining cleanliness. Guidance on contamination control, flushing and purification can be sought from the equipment supplier or other industry experts.

Turbine-oil system contamination before start-up can consist of preservatives, paint, rust particles and various types of solid matter which range from dust, weld and metal chips, to rags, bottles and cans. Minute amounts of remaining preservatives can largely impair the water shedding and air release properties; the remaining particles can induce filter clogging and abrasive wear.

5.4 Original oil quality

Use of a high-quality oil is the best assurance for achieving long service life. The turbine oil shall meet the generally available recognized standards, e.g. ISO 8068^[2] and the requirements of the turbine manufacturer.

It is advisable to obtain typical test data from the oil supplier. Upon receipt of the first oil charge, a sample of oil should be taken and tests should be conducted to confirm the typical test data. Another sample should be collected after 2 h to 24 hours of initial operation and tested for all parameters listed in [Table 5](#) the analytical data obtained will be used as a base line for future comparison with information on used oil. Recommended tests for new oil are given in [8.4](#).

When new turbine oil is to be mixed with a charge of a different composition, preliminary tests should be made to ensure that there will be no loss of expected properties due to incompatibility. The preliminary tests should include functional tests such as water-shedding properties; foaming and air-release properties and checks for formation of insoluble matter. Turbine oil compatibility assessments such as ASTM D7155 may be used.

5.5 System operating temperature

The most important factors affecting the anticipated service life of a given oil in a turbine system are the operating conditions within the system. Air (oxygen), elevated temperatures, metals and water are always present to some extent in the oil systems. All these conditions promote oil degradation.

Many turbine-oil systems are provided with oil coolers to control the temperature. In many cases, oil bulk temperature is maintained below 60 °C, which promotes moisture condensation. However, even with low bulk temperatures, hot spots can be localized in bearings, at gas seals or in throttle-control mechanisms. This can cause significant oil degradation and will eventually cause the oil in the system to show signs of deterioration.

Under the higher-temperature conditions found in gas and steam turbines, oxidation of the oil can be accelerated by thermal-oxidative cracking, giving rise to the production of viscous resins and deposits, particularly at the point of initiation.