



Designation: D6439 – 23

Standard Guide for Cleaning, Flushing, and Purification of Steam, Gas, and Hydroelectric Turbine Lubrication Systems¹

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INTRODUCTION

Optimum turbine system reliability requires a well designed lubricating system and use of a good lubricant that is free of contaminants. Achieving this requires use of proper purification methods to ensure that the oil is free of detrimental contaminants. In addition, it requires an ongoing monitoring program to ensure that the oil quality is within specifications and that corrective action is taken to minimize contaminant generation and ingress. The benefits of purification of an operating lubrication system can be significantly reduced if the lubricating systems are not initially cleaned to a level that will prevent component damage on initial start up after manufacturing or rebuilding.

Care and thorough cleaning are required to minimize and remove contaminants during fabrication, rebuilding, or installation, or combination thereof. Because contaminants will remain from these processes, it is necessary to flush and purify the system to remove them prior to startup. Ongoing purification is required to maintain pure oil during operation. In new systems, the emphasis is on the removal of contaminants introduced during manufacture, storage, field fabrication, and installation. In operational systems, the emphasis is on the removal of contaminants that are generated or carried in during operation, and by malfunctions that occur during operation or contaminants that are introduced during overhaul, or both.

1. Scope*

1.1 This guide covers types of contaminants, oil purification devices, contamination monitoring, contamination control during building or refurbishing of turbine systems, lubrication system flushing, and maintenance of pure lubrication oil.

1.2 To obtain maximum operating life and reliability, or lubricants and system, it is vital that the turbine lubrication system has pure oil. This guide is intended to aid the equipment manufacturer, installer, and turbine operator in coordinating their efforts to obtain and maintain clean lubrication and control systems. These systems may be on land or marine turbine generators and propulsion and mechanical drive equipment. This guide is generalized due to variations in the type of equipment, builder's practices, and operating conditions.

1.3 This guide primarily addresses petroleum based lubricating oil. For systems using nonpetroleum based fluids, this guide may not be appropriate. For nonpetroleum products, consult the equipment and fluid manufacturers.

¹ This guide is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.C0.01 on Turbine Oil Monitoring, Problems and Systems.

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1.4 This guide is applicable to both large and small lubrication systems. Some equipment specified herein, however, may not be appropriate for all systems. Moreover, in situations where specific guidelines and procedures are provided by the equipment manufacturer, such procedures should take precedence over the recommendations of this guide.

1.5 *This standard does not purport to address the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard

D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

D664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration

D974 Test Method for Acid and Base Number by Color-Indicator Titration

D2272 Test Method for Oxidation Stability of Steam Turbine Oils by Rotating Pressure Vessel

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

D4241 Practice for Design of Gas Turbine Generator Lubricating Oil Systems (Withdrawn 2008)³

D4248 Practice for Design of Steam Turbine Generator Oil Systems (Withdrawn 2008)³

D4378 Practice for In-Service Monitoring of Mineral Turbine Oils for Steam, Gas, and Combined Cycle Turbines

D4898 Test Method for Insoluble Contamination of Hydraulic Fluids by Gravimetric Analysis

D6304 Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration

D6810 Test Method for Measurement of Hindered Phenolic Antioxidant Content in Non-Zinc Turbine Oils by Linear Sweep Voltammetry

D6971 Test Method for Measurement of Hindered Phenolic and Aromatic Amine Antioxidant Content in Non-zinc Turbine Oils by Linear Sweep Voltammetry

D7155 Practice for Evaluating Compatibility of Mixtures of Turbine Lubricating Oils

D7546 Test Method for Determination of Moisture in New and In-Service Lubricating Oils and Additives by Relative Humidity Sensor

D7647 Test Method for Automatic Particle Counting of Lubricating and Hydraulic Fluids Using Dilution Techniques to Eliminate the Contribution of Water and Interfering Soft Particles by Light Extinction

D7843 Test Method for Measurement of Lubricant Generated Insoluble Color Bodies in In-Service Turbine Oils using Membrane Patch Colorimetry

D8112 Guide for Obtaining In-Service Samples of Turbine Operation Related Lubricating Fluid

F311 Practice for Processing Aerospace Liquid Samples for Particulate Contamination Analysis Using Membrane Filters

F312 Test Methods for Microscopical Sizing and Counting Particles from Aerospace Fluids on Membrane Filters

2.2 ISO Standards:⁴

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.

ISO 4406 Hydraulic Fluid Power—Fluids—Method for Coding Level of Contamination by Solid Particles

ISO 4572 Hydraulic Fluid Power—Filters—Multi-pass Method for Evaluating Filtration Performance

2.3 API Standard:⁵

API 614 Lubrication, Shaft-Sealing, and Control-Oil Systems for Special Purpose Applications

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this guide, refer to Terminology **D4175**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *adsorption, n*—removal of contaminants from oil by adhesion of the contaminant in an extremely thin layer of molecules to a fixed solid. The solid can be a fiber, a fine powder, or porous particles.

3.2.2 *centrifugation, n*—use of centrifugal force to separate contaminants from oils. Contaminants such as water and particulate are generally more dense than the oil and migrate to the outside of the centrifuge because of centrifugal force.

3.2.3 *cleaning, v*—direct removal of contaminant from any part of the system, generally with the system shut down or offline.

3.2.3.1 *Discussion*—Cleaning can include removal of contaminant by shoveling, sweeping, squeegee, vacuuming, wiping, displacing with clean, high pressure water blasting/jetting, dry compressed air; pressure steam and can be done with the aid of cleaning solutions.

3.2.4 *cleaning solution, n*—fluid used to aid in the removal of sludge and particulate matter in a system.

3.2.4.1 *Discussion*—Cleaning solutions may be classified as surface active oil soluble cleaners, detergent-based, or water based chemical cleaners.

3.2.5 *coalescence, n*—process of passing oil with free water through a fiber sheet, generally in a cartridge form, to cause smaller drops of water to join to form larger ones that can be more easily removed from the oil.

3.2.6 *coalescer, n*—device that uses coalescence (e.g. the aggregation of dispersed water to form sufficiently large droplets so that they fall out of oil-phase suspension) to separate water from oil.

3.2.6.1 *Discussion*—A coalescer generally consists of one or more coalescing cartridge(s) that include a hydrophobic barrier that hinders water from remaining dispersed in passing out with the oil as it passes from the unit. It may also contain a filter located upstream or downstream, or both, of the coalescing cartridge(s).

3.2.7 *displacement flush, n*—system flush using on-board turbine pumps designed to remove unwanted materials from installation or repair.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, <http://www.api.org>.