



AEROSPACE RECOMMENDED PRACTICE

ARP5088™**REV. C**

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Superseding ARP5088B

Test Method for the Determination of Total Acidity in Polyol Ester and Diester Gas Turbine Lubricants by Automatic Potentiometric Titration

RATIONALE

As a part of the SAE Five-Year Review process, several modifications have been incorporated including ASTM water purity, autosampler carousel language, and reduced solvent size.

1. SCOPE

The test method describes the procedure for determination of the total acid number (TAN) of new and degraded polyol ester and diester-based gas turbine lubricants by the potentiometric titration technique. The method was validated to cover an acidity range of 0.05 to 6.0 mg KOH g⁻¹. The method may also be suitable for the determination of acidities outside of this range and for other classes of lubricants.

1.1 Purpose

The TAN can be used to assist in the assessment of a lubricant during condition monitoring and for quality assurance/specification verification.

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2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610 832-9585, www.astm.org.

ASTM D1193 Standard Specification for Reagent Water

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Documents

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2.1.2 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 3696 Water Purity

2.2 Definitions

2.2.1 TOTAL ACID NUMBER (TAN)

The quantity of base, expressed in milligrams of potassium hydroxide per gram of sample, is required to titrate the sample potentiometrically to an aqueous pH 11 end point.

2.2.2 CLEAN OIL/LUBRICANT

A sample of oil with a TAN less than 1.5 mg KOH g⁻¹. Most new oils and lightly stressed used oils will fall into this category. It is highly recommended that a sample size of 20 g is used for samples falling into this TAN range. However, it is recognized that the volume of samples available from service or laboratory tests may make this impractical, in which case the 2.5 g sample size may be used. Based on the 2013 round robin, the 2.5 g sample size resulted in higher variability and slightly lower TAN values (~0.1 mg KOH g⁻¹) compared to using a 20 g sample size.

2.2.3 DEGRADED OIL/LUBRICANT

A sample of oil with a TAN of 1.5 mg KOH g⁻¹ or greater. Most highly stressed oils will fall into this category, particularly samples from laboratory oxidation tests and static engine tests. A sample size of 2.5 g shall be used for samples falling into this TAN range.

3. TEST REQUIREMENTS

3.1 Outline of Method

The test sample is dissolved in a mixture of toluene and propan-2-ol containing a small amount of water and titrated potentiometrically with alcoholic potassium hydroxide using a glass indicating electrode and a silver/silver chloride reference electrode. The cell voltage corresponding to the aqueous pH 11 buffer is taken as the end point.

3.2 Apparatus

3.2.1 Potentiometric Titration Apparatus

An automatic titrimer capable of titrating to a fixed end point using either variable or fixed titrant increments.

The burette shall have a maximum size of 10 mL and a dispensing accuracy of ±0.01 mL.

3.2.2 Glass Indicating Electrode

Pencil type; a glass electrode specifically designed for nonaqueous titrations is recommended.

3.2.3 Reference Electrode

Pencil type; silver/silver chloride electrode filled with the lithium chloride electrolyte (see 3.3.4). Other electrodes, which can be shown to give equivalent performance on the samples to be tested, may be used provided they are filled with the lithium chloride electrolyte (see 3.3.4).

The electrode shall be made of glass and shall be provided with a movable joint in the form of a sleeve or plug to facilitate easy washing of the reference electrolyte cell. A double junction design is preferable with the electrolyte cells filled with the lithium chloride electrolyte (see 3.3.4).

3.2.3.1 Combination Electrodes

The glass indicating electrode and the silver/silver chloride reference electrode may be contained in one housing. The combination electrode requires only one electrode to be maintained instead of two. The combination electrode shall be suitable for nonaqueous titrations, shall have a sleeve diaphragm/junction on the reference compartment, and shall be filled with the lithium chloride electrolyte (see 3.3.4).

3.2.4 Titration Vessel

The vessel shall have a capacity of 100 to 250 mL and be inert to the reagents. Vessel size maybe dependent on the titration solvent amount utilized for blank and sample analysis in 5.5.

3.2.5 Stirrer

A stirrer with variable speeds and fitted with a propeller or paddle of chemically inert material. The stirrer must be electrically grounded (earthed).

NOTE: Some types of apparatus may be sensitive to interference by static electricity when the apparatus is approached by the operator. In these cases, the titration vessel should be surrounded with a close-fitting cylinder of copper gauze which is electrically grounded (earthed). Refer to the equipment manufacturer if in doubt.

3.2.6 Autosampler Carousel (Optional)

An autosampler carousel-type titration stand may be used for staging multiple samples for analysis. The number of sample vessels that can be utilized by an autosampler varies, depending on the volume capacity of the vessels being used. The use of an autosampler can increase the throughput and efficiency in the analysis of multiple samples in a given set.

3.3 Reagents/Materials

Use only reagents of recognized analytical grade (where available) and water conforming to ISO 3696 Grade 3 or ASTM D1193 Type I, II, or III.

3.3.1 Aqueous pH 4, pH 7, and pH 11 buffer solutions.

NOTE: These solutions must be replaced at regular intervals consistent with their stability or when contamination is suspected. Information relating to their stability should be obtained from the manufacturer.

3.3.2 Ethanol [98% min v/v] (C₂H₅OH).

3.3.3 Lithium chloride (LiCl).

3.3.4 Lithium chloride reference electrolyte.

Prepare a 1 M or 2 M solution of the lithium chloride (see 3.3.3) in the ethanol (see 3.3.2). Commercially available solutions may be used where available.

NOTE: Potassium chloride electrolyte must not be used to fill single junction reference electrodes or to fill the outer cell of a double junction reference electrode. The use of other electrodes could affect the precision. It is desirable to reserve the electrode for nonaqueous titrations.

3.3.5 Potassium hydrogen phthalate (KHC₈H₄O₄).

3.3.6 Potassium hydroxide (KOH).