



AEROSPACE RECOMMENDED PRACTICE

ARP6255™

REV. A

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Superseding ARP6255

Aviation Lubricant Tribology Evaluator (ALTE) Method
to Determine the Lubricating Capability of Gas Turbine Lubricants

RATIONALE

The Aviation Lubricant Tribology Evaluator (ALTE) is a device designed to assess the relative lubricating performance of aviation turbine oils in the following scenarios: (1) A mixed lubrication situation combining hydrodynamic/EHD mechanisms and boundary layer mechanisms - "Mild wear"; (2) A lubrication situation wherein boundary layer films have broken down, and metal-to-metal contact has been initiated - "Severe wear". The aim of the ALTE is to produce test conditions which allow lubricants to be evaluated on a laboratory scale, in a timely manner without deviating greatly from representative wear mechanisms. The ARP was updated throughout to Rev. A, most notably to clarify the severe wear testing procedure and the report section, and to make various editorial corrections.

1. SCOPE

Employing "ball-on-ring" philosophy, a nonrotating steel ball is held in a vertically mounted chuck and, using an applied load, is forced against an axially mounted steel rotating ring. The test ring is rotated at a fixed speed while being partially immersed in a lubricant reservoir. This maintains the ring in a wet condition and continuously transports a lubricating film of test fluid to the ball and ring interface. The diameter of the wear scar generated on the test ball is used as a measure of the fluid's lubricating properties.

The apparatus can be used by adjusting the operating conditions to reproduce two different wear mechanisms. Therefore, the ALTE can assess a lubricant's performance in that regard. These mechanisms are described below.

1.1 Mild Wear Test

As the test ring rotates, the lubricant is continuously transported to the ball and ring interface. At this interface, under abrasive wear conditions, there is likely to be a mixed elastohydrodynamic, hydrodynamic, and boundary layer lubrication regime that allows contact of only the surface asperities of the ball and ring. Due to the difference in hardness of these asperities and motion of one surface relative to the other, abrasion and, hence, mild wear occurs (two-body abrasive wear). Hard wear debris carried from the ring to the wear scar area can result in three-body abrasive wear of the softer surface. Abrasive wear gives a characteristic surface topography consisting of long parallel grooves in the sliding direction.

The mild wear test produces a measurable wear scar on the top ball after 30 minutes of contact time. Measurements of the scar boundary in the X and Y directions can then be recorded so that the mean wear scar diameter at the defined load can be reported as per 13.1.

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1.2 Severe Wear Test

At a specific load, a transition from mild to severe wear can be observed. At this transition, a reduction and subsequent breakdown of boundary lubrication and film thickness occurs. This results in full metal-to-metal contact of the sliding surfaces, leading to adhesive wear and a large wear scar. If loading is increased beyond this transition point, then localized welding and eventual seizure will occur.

In the severe wear test, a series of 60-second runs with incrementally increasing loads are applied consecutively. The wear scar is measured after each test run and plotted against applied load until a significant increase in wear scar is identified from the data. The load at which a 1.5-mm mean wear scar would be expected can be interpolated from the graph. An example plot is given in Figure 1. Interpolating this example plot shows that the load at which the wear scar would be expected to exceed 1.5 mm is approximately 65 kg. This would be reported as the severe wear test result.

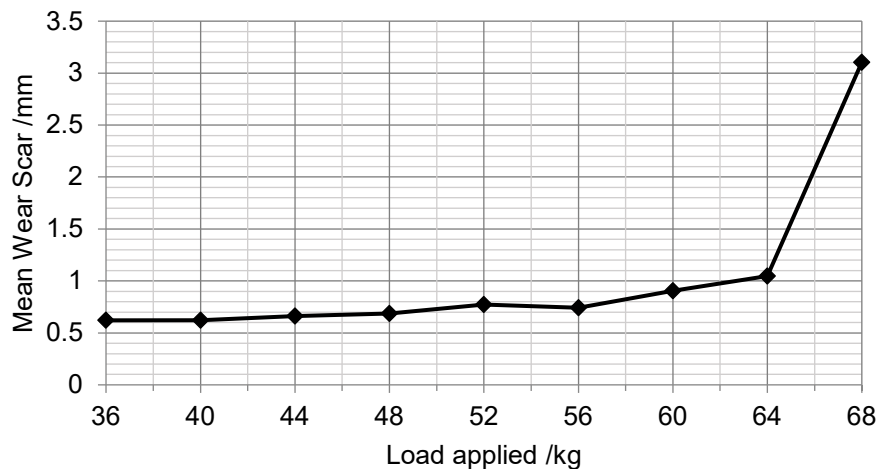


Figure 1 - An example of a plotted severe wear test

2. 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 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP5088 Test Method for the Determination of Total Acidity in Polyol Ester and Diester Gas Turbine Lubricants by Automatic Potentiometric Titration

2.2 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 D5001 Measurement of Lubricity of Aviation Turbine Fuels by Ball-on-Cylinder Lubricity Evaluator (BOCLE)

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

2.3 ISO Publications

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

ISO 3290-1 Rolling bearings - Balls - Part 1: Steel balls

2.4 Other Publications

Aviation Lubricant Tribology Evaluator (MkII), Operating Manual

Aviation Lubricant Tribology Evaluator (MkIII), Installation and Operation Manual

3. WARNING

This document may involve hazardous materials, operations, and equipment. This document does not purport to address all the safety problems associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

4. METHOD SUMMARY

4.1 Test Conditions

Table 1 - Test conditions

Parameter	Mild Wear	Severe Wear
Oil temperature, °C	150 ± 2	150 ± 2
Ball load, kg	4 to 20	30 to 100 ⁽¹⁾
Test duration, minutes	30 ± 0.10	1 ± 0.05
Rotation speed, rpm	220 ± 5	220 ± 5
Test lubricant volume, mL	40 ± 1	40 ± 1

⁽¹⁾ The applied ball load must not exceed the maximum safe capacity of the rig defined by the manufacturer. In order to perform the full range of testing required, this safe capacity should be at least 100 kg, as specified in 5.1.

4.2 Test Operation

A measured volume of the test lubricant is placed in the apparatus oil bath. The bath is then positioned such that the test ring is partially submerged in the lubricant. The lubricant is maintained at 150 °C throughout the test period. A load is applied to the pivot arm such that the required ball load is achieved; the load arm and support are arranged with a moment such that the ball load is four times that applied to the arm. The test ring is rotated, and the ball is lowered to contact the ring surface throughout the test period.

4.3 Assessment

The diameter of the wear scar generated at a given ball load is measured. Testing can be carried out to determine the load at which a specific wear scar diameter is obtained or, conversely, the wear scar diameter formed at a specific load.

5. APPARATUS

5.1 Aviation Lubricant Tribology Evaluator MkII or MkIII to the specifications tabulated below. These values represent the required upper limit of the equipment; however, the ALTE will also be required to operate below these values, depending on the specific test requirements. The tabulated values have been found to enable the user to determine the load required to generate a 1.5-mm wear scar diameter for the majority of current gas turbine lubricants.