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AIRCRAFT RECOMMENDED PRACTICE BALL-ON-CYLINDER (BOC) AIRCRAFT TURBINE FUEL LUBRICITY TESTER

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1. **INTRODUCTION AND BACKGROUND:** In recent years an increasing percentage of lower grade crude oils (higher sulfur content) have been used to make aircraft fuels. Stringent federal requirements against polluting high sulfur fuels has caused several refineries to remove the sulfur by hydrogen refining techniques. The resulting fuels have a very poor lubricity and are already creating numerous excessive friction and wear problems in the field for fuel system components. Use of the BOC tester is going to become increasingly essential to monitor lubricity of fuels for development and production test of fuel system components to make sure that fuels are neither too "squeaky" nor too slippery. Use in the field to screen for excessively "squeaky" fuel is also a possibility.

The Ball-On-Cylinder (BOC) lubricity tester is a device used to rate the relative lubricity of aviation turbine fuels and similar fluids by measuring the wear scar which is generated on a stationary loaded ball when rubbing against a fuel-wetted, rotating cylinder. The size of the wear scar is a measure of the test fuel's lubricity and provides a basis for predicting the likelihood of future friction or wear problems.

The original tester was designed by Exxon Research and Engineering Company of Linden, New Jersey, based on the "Fuery Ball-On-Cylinder Test Machine".

2. **PRIMARY TEST EQUIPMENT** (Ref. Figure 1 Schematic)

Test Ball Spec:

Material	AISI 52100 Steel (AMS 6444)
Hardness	64-66 Rc
Surface Finish	Grade 25EP (extra polish)
Dimensions	12.7 mm dia. ball
Reference	ASTM D-2596, ASTM D-2783 (4 ball tester)

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MAP 1794

Test Cylinder Spec:

Material	AISI 52100 Steel (AMS 6444)
Hardness	Quench & temper to 20-22 Rc
Surface Finish	0.1-0.22 μ m AA
Dimensions	44.450 mm $\pm$.000/- .254 mm dia.

3. IDENTIFICATION OF TEST CYLINDERS AND BALLS:

- 3.1 Cylinders should be numbered consecutively, starting with number 10. The number should appear on one of the ends of each cylinder and should be permanent. Track numbering will start with #1 at the end opposite the set screw end of the cylinder. Successive track positions should be micrometer-set with sufficient spacing to separate adjacent tracks; suggested spacing is 1 mm.
- 3.2 Numbering of each test ball may be done and recorded on the test data sheet along with the cylinder wear track number for future reference.

4. SUMMARY OF OPERATING CONDITIONS FOR BOC TESTER:

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| 4.1 Ball Load | Standard Load = 1000 g |
| 4.2 Cylinder Speed | 240 $\pm$ 2 RPM |
| 4.3 Test Duration | 30 minutes |
| 4.4 Fuel Volume | 40 to 50 ml (the fuel should not contact the shaft) |
| 4.5 Test Fluid Temperature | 25°C $\pm$ 1° |
| 4.6 Supply Air | Should contain less than 0.1 PPM hydrocarbons and a dewpoint less than -28°C. |
| 4.7 Purge Air | (See test notes) RH @ 25°C $\pm$ 1° |
| 4.8 Pretreatment of Fuel in Reservoir: | Bubble 0.03 m ³ /h to 0.22 m ³ /h |
| Purge air through fuel | in the reservoir for 15 to 30 minutes. |
| 4.9 Purge Air Flow During Test: | Flow 0.03 m ³ /h to 0.22 m ³ /h purge air over fuel sample |

5. CLEANING PROCEDURES: CAUTION: Great care must be taken to adhere strictly to cleanliness requirements and to the specified cleaning procedures. (A specific contamination problem may have no effect on a "good" fuel but could make a "bad" fuel look "good"). Test parts after cleaning must be protected from contamination by wearing clean throw-away "lint-free" cotton gloves. Care must be used to avoid contaminating cleaned parts by using clean gloves when handling any of the test pieces. Different sets of gloves for different operations are preferred.

5.1 Cylinders - Initial Clean-up:

- 5.1.1 Wash with lab detergent and water. Use soft bristle brush. Avoid scratching polished surface with a metal brush handle.
- 5.1.2 Rinse thoroughly with distilled water.
- 5.1.3 Air dry.
- 5.1.4 Clean in soxhlet extractor using a 50/50 mixture of isopropyl alcohol and toluene or xylene. Reflux for 15 cycles or two hours, whichever is the greater.
- 5.1.5 Dry in vacuum dessicator for 8 hours.
- 5.1.6 Store in dessicator.

5.2 Balls:

- 5.2.1 Rinse with solvent to remove bulk of oil coating.
- 5.2.2 Follow steps 5.1.4 through 5.1.6.

5.3 Reservoir:

- 5.3.1 Remove reservoir for cleaning after each run.
- 5.3.2 Clean reservoir with solvent (clay filtered iso-octane).
- 5.3.3 Blow dry with hydrocarbon-free air nitrogen or dry with vacuum.

5.4 Cylinder on Spindle (between runs)

- 5.4.1 Remove as much test fluid as possible from cylinder using suction or by wiping with tissue.
- 5.4.2 Rinse with solvent. (Clay filtered iso-octane).
- 5.4.3 Dry with hydrocarbon free air.