

Standard Test Method for Evaluating Lubricity of Diesel Fuels using the UMT in a ball-on-cylinder configuration.

ASTM D 6078-99

Summary of Test Method:

This test method evaluates the lubricity of middle distillate diesel fuels using a ball-on-cylinder lower drive on the Macro-tribometer model UMT. The lubricity of a fuel is evaluated by the minimum load that will produce a friction coefficient of 0.175 between a stationary ball and a fuel-wetted cylinder rotating at 525 rpm. The steel test cylinder (lower specimen) is assembled on the horizontal shaft of the lower drive. The cylinder is partially submerged in a bath of fuel test specimen. A chrome steel test ball (upper specimen) is held in a ball holder on the loading carriage. The UMT uses a servo controlled vertical carriage to load the ball against the cylinder with a constant force. The procedure uses a series of incremental test during which friction is continuously measured and the friction coefficient (COF) is calculated. The initial test begins with a 30 second break-in period at 525 pm and a load of 1 kg, then the load is automatically increased to 5.6 kg for 60 seconds. The load for the succeeding test is either decreased or increased depending on whether the COF exceeded 0.175 or not. The chart on the following page shows the tree for increasing or decreasing loads. Between tests the ball is replaced and a new test position on the cylinder is used. The applied load and COF will have been continuously recorded so that the last load value used will be the minimum load that will produce a friction coefficient of 0.175.

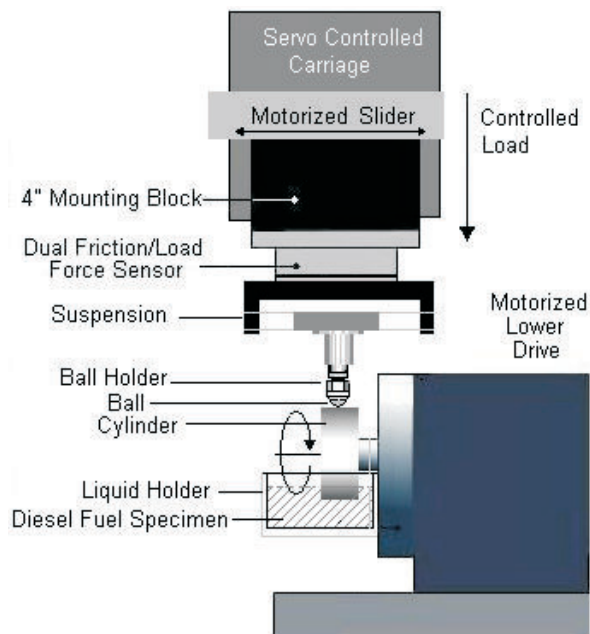
In addition to the dynamic load and COF, the UMT allows for monitoring during the test the actual friction force, and depth of wear. Optionally, it can measure additional parameters of contact acoustic emission, temperature, and humidity.

Test Parameters

Procedure	Liquid	Temperature	Humidity	Load	Speed	Duration
Increase load with each test.	50 ±1 mL	25 ±1° C	50 ±2% RH	1 kg – break-in 1.8 kg – min. 9.4 kg - max.	525 rpm	Break-in: 30 s Test: 60 s

UMT Hardware Configuration:

- 4" Mounting Block M30C366-2
- Model DFH-10 Dual Friction/Load Sensor range 0.1 to 10 kg
- Suspension for 10 kg Sensor AM30C417E-4
- Upper Specimen 10 mm Ball Holder for sensors mod. DFH AM30B1047
- Upper Specimen 10 mm Ball BM110006
- Lower Block-on-Ring Drive mod. B21M0
- Liquid Container for Block-on-Ring Drive mod. M30C207B-2
- Lower Specimen Test Ring BM121007
- Optional Additional Sensors
 - mod. AE-5 Contact Acoustic Emission Detector
 - mod. HT-100 Humidity and Temperature Measurement & Recording



UMT Software Test Setup:

UMT Options File:

Load the options file which contains settings for the block-on-ring drive and the 10 kg force/load sensor.

Test Sequence 1:

The *Condition for ending test* ($F_x/F_z > 0.175$) is entered in the *Test* tab of the sequence script.
The each Test Sequence should consist of 3 steps.

Step 1 is for settling time for the carriage to establish the initial normal load.

- General** - *Controlled Carriage/Load, Constant Force(Fz), Duration 10 sec.*
- Carriage** - *Force 1 kg*
- Spindle** - *Velocity is 0 revs/min.*
- Slider** - *idle.*

Step 2 is a 30-sec. Break-in period

- General** - *Controlled Carriage/Load, Constant Force(Fz), Duration 30 sec.*
- Carriage** - *Force 1 kg*
- Spindle** - *Velocity is 525 revs/min, Move-continuous*
- Slider** - *idle.*

Step 3 is the 60 sec. COF test period

- General** - *Controlled Carriage/Load, Constant Force(Fz) Duration 60 sec., Conditional stop.*
- Carriage** - *Force 5.8 kg*
- Spindle** - *Velocity is 525 revs/min, Move-continuous.*
- Slider** - *is idle.*

Test Sequence n:

The *Condition for ending test* ($F_x/F_z > 0.175$)

See LOAD CHART for force in Step 3. Go up if in previous test $COF < 0.175$. Go down if not.

Step 1 is for settling time for the carriage to establish the initial normal load.

- General** - *Controlled Carriage/Load, Constant Force(Fz), Duration 10 sec.*
- Carriage** - *Force 1 kg*
- Spindle** - *Velocity is 0 revs/min.*
- Slider** - *idle.*

Step 2 is a 30-sec. Break-in period

- General** - *Controlled Carriage/Load, Constant Force(Fz), Duration 30 sec.*
- Carriage** - *Force 1 kg*
- Spindle** - *Velocity is 525 revs/min, Move-continuous*
- Slider** - *idle.*

Step 3 is the 60 sec. COF test period

- General** - *Controlled Carriage/Load, Constant Force(Fz) Duration 60 sec., Conditional stop.*
- Carriage** - *Force See Chart*
- Spindle** - *Velocity is 525 revs/min, Move-continuous.*
- Slider** - *is idle.*

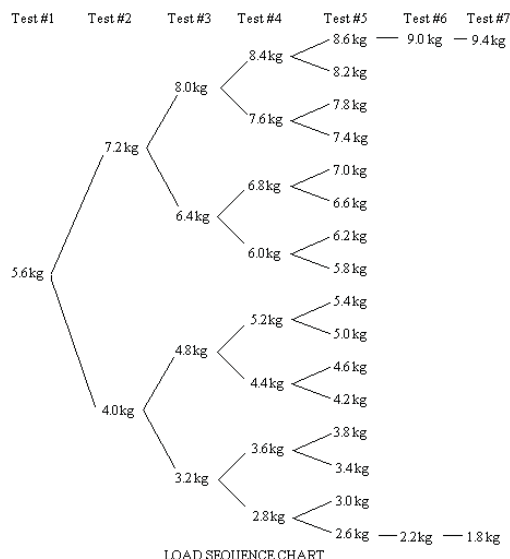
Data Collection:

The following should be checked under DataFile:

- Fx – Friction Force
- Fz – Normal Force
- COF – Coefficient of Friction
- T – Time
- Z1 – Carriage Position (Used to determine Wear Depth)
- AE input – Acoustic Emission (optional)
- Rh input - Relative Humidity
- Te input – Temperature (optional)

Report:

Use the Viewer program to plot test results. Report the lowest load that produced a COF greater than 0.175 during Step 3.



LOAD SEQUENCE CHART