

Sequence VIB Test

(ASTM D 6837)

SPECIFICATIONS

ILSAC GF-3/GF-4 and API SL/SM.

OBJECTIVE

To measure the effects of automotive engine oils on the fuel economy of passenger cars and light-duty (3856 kg, 8500 lb or less gross vehicle weight) trucks equipped with a "low-friction" engine.

TEST FIXTURE

A 1993 4.6-liter Ford "modular" V-8 gasoline engine equipped with an external oil heating/cooling system and a "flying flush" system for changing oils without an engine shutdown is used for this test.

TEST PARAMETERS

Fuel consumption is measured at each of five speed/load/temperature test conditions for an SAE 5W-30 baseline oil (BC). The candidate oil is introduced and aged for 16 hours at Aging Phase I conditions and then fuel consumption is measured for each of the five test conditions. The candidate oil remains in the engine and is aged for 80 hours at Aging Phase II conditions and then fuel consumption is measured for each of the five test conditions and followed by a repeat of the BC oil at the five test conditions.

	Aging Stages		Test Stages				
	Phase I	Phase II	1	2	3	4	5
Speed, rpm	1500	2250	1500	800	800	1500	1500
Normal power, kw	15.39	23.10	15.39	2.18	2.18	15.39	15.39
Oil temp, °C	125	135	125	105	70	70	45
Coolant temp, °C	105	105	105	95	60	60	45

TEST PARTS EVALUATION

None. Test results are expressed as a percent change in kg of fuel consumed for the candidate oil after Aging Phase I and after Aging Phase II relative to the baseline oil (BC) before and after candidate oil.

USED LUBRICANT ANALYSIS

New oil and oil after Aging Phase II viscosity at 40°C and at 100°C is required.

PASS/FAIL CRITERIA

Fuel economy improvement, which equates to the fuel economy results obtained from vehicles representative of current production vehicles running under the current EPA testing cycles, is calculated by the following formula where units for BSFC are kg/kW-h:

Stage	Actual (kg/Kw-H)		Normal Power (kW)		Time Factor (h)		Fuel Cons. (kg)
1	BSFC	X	15.39	X	0.0802	=	
2	BSFC	X	2.18	X	0.0787	=	
3	BSFC	X	2.18	X	0.0848	=	
4	BSFC	X	15.39	X	0.0864	=	
5	BSFC	X	15.39	X	0.0699	=	
Total mass fuel consumption for all five stages =							

Compute the total fuel consumed as shown above for the BC oil before candidate; the candidate oil test stages after aging phase I; the candidate oil test stages after aging phase II; and the BC oil after candidate.

Compute the test oil fuel economy improvement (% FEI) as follows:

% FEI Test Oil Phase I =

$$\frac{[(BC \text{ before} \times 80\%) + (BC \text{ after} \times 20\%) - \text{Test Oil Phase I}]}{[(BC \text{ before} \times 80\%) + (BC \text{ after} \times 20\%)]} \times 100$$

% FEI Test Oil Phase II =

$$\frac{[(BC \text{ before} \times 10\%) + (BC \text{ after} \times 90\%) - \text{Test Oil Phase II}]}{[(BC \text{ before} \times 10\%) + (BC \text{ after} \times 90\%)]} \times 100$$

Pass/fail Criteria for ILSAC GF-3 and API SL
(Minimum % FEI vs ASTM BC)

SAE 0W-20 and 5W-20 viscosity grades:

- 2.0% minimum after 16 hours aging (Phase I FEI)
- 1.7% minimum after 96 hours aging (Phase II FEI)

SAE 0W-30 and 5W-30 viscosity grades:

- 1.6% minimum after 16 hours aging (Phase I FEI)
- 1.3% minimum after 96 hours aging (Phase II FEI)
- 3.0% FEI + FEI2

All other SAE multiviscosity grades:

- 0.9% minimum after 16 hours aging (Phase I FEI)
- 0.6% minimum after 96 hours aging (Phase II FEI)
- 1.6% FEI1 + FEI2

Pass/fail Criteria for ILSAC GF-4 and API SM
(Minimum % FEI vs ASTM BC)

SAE 0W-20 and 5W-20 viscosity grades:

- 2.3% minimum after 16 hours aging (Phase I FEI)
- 2.0% minimum after 96 hours aging (Phase II FEI)

SAE 0W-30 and 5W-30 viscosity grades:

- 1.8% minimum after 16 hours aging (Phase I FEI)
- 1.5% minimum after 96 hours aging (Phase II FEI)

All other SAE multiviscosity grades:

- 1.1% minimum after 16 hours aging (Phase I FEI)
- 0.8% minimum after 96 hours aging (Phase II FEI)

