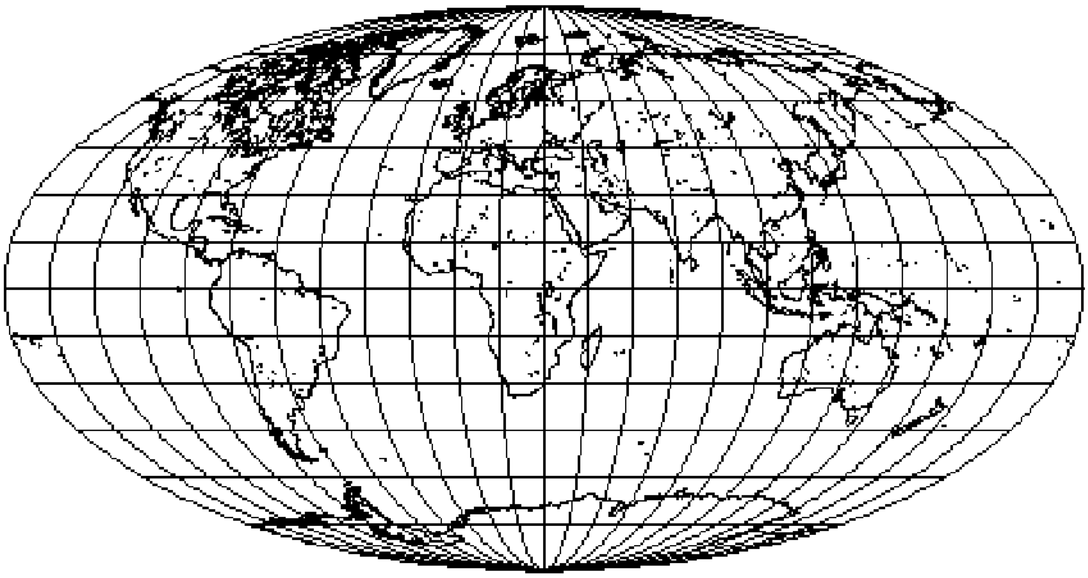
INTERNATIONAL LUBRICANT STANDARDIZATION AND APPROVAL COMMITTEE



ILSAC GF-4 STANDARD FOR PASSENGER CAR ENGINE OILS

January 14, 2004

Jointly developed and approved by

Japan Automobile Manufacturers Association, DaimlerChrysler Corporation, Ford Motor Company and General Motors Corporation.

JAMA DAIMLERCHRYSLER Ford Motor Company GM

THE ILSAC MINIMUM PERFORMANCE STANDARD FOR PASSENGER CAR ENGINE OILS – ILSAC GF-4

The Japan Automobile Manufacturers Association, Inc. and representatives from DaimlerChrysler Corporation, Ford Motor Company and General Motors Corporation, through an organization called the International Lubricants Standardization and Approval Committee (ILSAC), jointly developed and approved an ILSAC GF-4 minimum performance standard for gasoline-fueled passenger car engine oils.

This standard specifies the minimum performance requirements (both engine sequence and bench tests) and chemical and physical properties for those engine oils that vehicle manufacturers deem necessary for satisfactory equipment performance and life.

In addition to meeting the requirements of the standard, it is the oil marketer's responsibility to be aware of and comply with all applicable legal and regulatory requirements on substance use restrictions, labeling, and health and safety information when marketing products meeting the GF-4 standard. It is also the marketer's responsibility to conduct its business in a manner which represents minimum risk to consumers and the environment.

The ultimate assessment of an engine oil's performance must include a variety of vehicle fleet tests which simulate the full range of customer driving conditions. The engine sequence tests listed in this document have been specified instead of fleet testing to minimize testing time and costs. This simplification of test requirements is only possible because the specified engine sequence tests have been judged to be predictive of a variety of vehicle tests.

The relationships between engine sequence tests and vehicle fleet tests are judged valid based only on the range of base oils and additive technologies investigated - generally those which have proven to have satisfactory performance in service, and which are in widespread use at this time. The introduction of base oils or additive technologies which constitute a significant departure from existing practice requires sufficient supporting vehicle fleet testing data to ensure there is no adverse effect to vehicle components or to emission control systems. This vehicle fleet testing should be conducted in addition to the other performance requirements listed in this specification.

Engine oil compatibility with sealing materials and gaskets is not controlled by performance tests in this specification. However, an SAE Committee on Automotive Rubber Specifications (CARS) has established a slate of reference elastomers (see SAE J2643) which may be used for testing of different base oils and additive technologies which constitute a significant departure from existing materials. The CARS committee has also established an ASTM reference oil (Service Oil 105) which should be considered as an aggressive oil and could also be used as a reference. ILSAC recommends that additive or base oil technologies that exceed the aggression of this reference oil be revised or adequately field tested to ensure no chance of customer seal failures when placed in commercial service.

It is the responsibility of any individual or organization introducing a new technology to perform this vehicle fleet testing, and the responsibility of the oil marketer to ensure the above testing of new technology was satisfactorily completed. No marketer can claim to be acting in a reasonable and prudent manner if the marketer knowingly uses a new technology based only on the results of engine sequence testing without verifying the suitability of the new technology in vehicle fleet testing which simulates the full range of customer operation.

The ILSAC GF-4 Minimum Performance Standard includes tests for which Viscosity Grade Read Across and Base Oil Interchange Guidelines have been developed by the appropriate groups. It should be pointed out, however, that when oil marketers use the Guidelines, they do so based on their own judgment and at their own risk. The use of any guidelines does not absolve the marketer of the responsibility for meeting all specified requirements for any products the marketer sells in the marketplace which are licensed as ILSAC GF-4 with the API.

ILSAC GF-4 REQUIREMENTS

1. FRESH OIL VISCOSITY REQUIREMENTS

1.a SAE J300

Oils shall meet all of the requirements of SAE J300. Viscosity grades are limited to SAE 0W, 5W, and 10W multigrade oils.

1.b Gelation Index: ASTM D 5133

	12 maximum

To be evaluated from –5°C to the temperature at which 40,000 cP is attained or –40°C, or 2 Celsius degrees below the appropriate MRV TP-1 temperature (defined by SAE J300), whichever occurs first.

2. ENGINE TEST REQUIREMENTS

2.a Wear and Oil Thickening: ASTM Sequence IIIG Test

Kinematic Viscosity Increase @ 40°C, %	150 maximum
Average Weighted Piston Deposits, merits	3.5 minimum
Hot Stuck Rings	None
Average Cam plus Lifter Wear, µm	60 maximum

2.b Aged Oil Low Temperature Viscosity: ASTM Sequence IIIGA Test

Evaluate the EOT oil from the ASTM Sequence IIIGA test with ASTM D 4684 (MRV TP-1)	The D 4684 viscosity of the EOT sample must meet the requirements of the original grade or the next higher grade.

2.c Wear, Sludge, and Varnish Test: Sequence VG, ASTM D 6593

Average Engine Sludge, merits	7.8 minimum
Average Rocker Cover Sludge, merits	8.0 minimum
Average Engine Varnish, merits	8.9 minimum
Average Piston Skirt Varnish, merits	7.5 minimum
Oil Screen Sludge, % area	20 maximum
Oil Screen Debris, % area	Rate and report
Hot Stuck Compression Rings	None
Cold Stuck Rings	Rate and report
Oil Ring Clogging, % area	Rate and report
Follower Pin Wear, cyl #8, avg, µm	Rate and report[a]
Ring Gap Increase, cyl #1 & #8, avg, µm	Rate and report[a]

[a]ASTM Surveillance Panel will review statistics annually.

2.d <u>Valvetrain Wear: Sequence IVA, ASTM D 6891</u>

Average Cam Wear (7 position average), µm	90 maximum

2.e <u>Bearing Corrosion: Sequence VIII, ASTM D 6709</u>

Bearing Weight Loss, mg	26 maximum

2.f <u>Fuel Efficiency: Sequence VIB*, ASTM D 6837</u>

SAE 0W-20 and 5W-20 viscosity grades:
- 2.3% FEI 1 minimum after 16 hours aging
- 2.0% FEI 2 minimum after 96 hours aging

SAE 0W-30 and 5W-30 viscosity grades:
- 1.8% FEI 1 minimum after 16 hours aging
- 1.5% FEI 2 minimum after 96 hours aging

SAE 10W-30 and all other viscosity grades not listed above:
- 1.1% FEI 1 minimum after 16 hours aging
- 0.8% FEI 2 minimum after 96 hours aging

*All FEI 1 and FEI 2 values determined relative to ASTM Reference Oil BC.

3. BENCH TEST REQUIREMENTS

3.a <u>Catalyst Compatibility</u>

Phosphorus Content, ASTM D 4951	0.08% (mass) maximum
Sulfur Content, ASTM D 4951 or D 2622	
SAE 0W and 5W multigrades	0.5% (mass) maximum
SAE 10W multigrades	0.7% (mass) maximum

3.b <u>Wear</u>

Phosphorus Content, ASTM D 4951	0.06% (mass) minimum

3.c <u>Volatility</u>

Evaporation Loss, ASTM D 5800	15% maximum, 1 h at 250°C (Note: Calculated conversions specified in D 5800 are allowed.)
Simulated Distillation, ASTM D 6417	10% maximum at 371°C

3.d High Temperature Deposits, TEOST MHT

Deposit Weight, mg	35 maximum

3.e Filterability

EOWTT, ASTM D 6794	
with 0.6% H_2O	50% maximum flow reduction
with 1.0% H_2O	50% maximum flow reduction
with 2.0% H_2O	50% maximum flow reduction
with 3.0% H_2O	50% maximum flow reduction

Test formulation with highest additive (DI/VI) concentration. Read across results to all other base oil/viscosity grade formulations using the same or lower concentration of the identical additive (DI/VI) combination. Each different DI/VI combination must be tested.

EOFT, ASTM D 6795	50% maximum flow reduction

3.f Foaming Characteristics, ASTM D 892 (Option A)

	Tendency	Stability*
Sequence I	10 mL maximum	0 mL maximum
Sequence II	50 mL maximum	0 mL maximum
Sequence III	10 mL maximum	0 mL maximum

*After 10-minute settling period

3.g High Temperature Foaming Characteristics, ASTM D 6082 (Option A)

Tendency	Stability*
100 mL maximum	0 mL maximum

*After 1-minute settling period

3.h Shear Stability, Sequence VIII, ASTM D 6709

10-hour stripped KV @ 100°C	Kinematic viscosity must remain in original SAE viscosity grade.

3.i Homogeneity and Miscibility, ASTM D 6922

Shall remain homogeneous and, when mixed with SAE reference oils, shall remain miscible.

3.j Engine Rusting, Ball Rust Test , ASTM D 6557

Average Gray Value	100 minimum

4. APPLICABLE DOCUMENTS

4.a SAE Standard, Engine Oil Viscosity Classification - SAE J300, _SAE Handbook_.

4.b SAE Standard, Standard Reference Elastomers (SRE) for Characterizing the Effects on Vulcanized Rubbers, Proposed Draft 2003-5 - SAE J2643, _SAE Handbook_

4.c ASTM Annual Book of Standards, Volume 5, Petroleum Products and Lubricants, current edition.

4.d ASTM Sequence IIIG Test Research Report.

4.e M. Batko and D. F. Florkowski, “Low Temperature Rheological Properties of Aged Crankcase Oils,” SAE Paper 2000-01-2943.

4.f M. Batko and D. F. Florkowski, “Lubricant Requirements of an Advanced Designed High Performance, Fuel Efficient Low Emissions V-6 Engine,” SAE Paper 01FL-265.