



Test Monitoring Center

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412-365-1000

ASTM Test Monitoring System Reference Oils

Release 20150217

This information was compiled using data from various sources. Part I contains oil code(s), viscosity grade, performance classification(s), year introduced, and average test performance for each reference oil by test area. Part II presents reference oil field data, where available, by test area. Part III contains the *Policies for the Use and Analysis of ASTM Test Monitoring System Reference Oils*. Finally, Part IV is a compilation of reference oil analytical data as permitted in the policy statement.

The ASTM Test Monitoring Center wishes to acknowledge those companies that supply reference oils for the ASTM calibration system.

**ASTM Test Monitoring System
Reference Oils**

PART I

Performance Classification

Oil Code Cross-Reference

Test Performance

SEQUENCE IIIF

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data			
				Viscosity Increase @ 60h (Percent)	Viscosity Increase @ 80h (Percent)	Average Piston Varnish (Merit)	Weighted Piston Deposits (Merit)
1006	5W-30	SJ	1997	235	515	9.35	3.94
1008	5W-30	SJ	2000	68	124	9.74	4.52
433	5W-30	SL	2000	35	37	9.30	4.59

SEQUENCE IIIG

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data		
				Viscosity Increase (Percent)	Average Cam Plus Lifter Wear (Microns)	Weighted Piston Deposits (Merit)
434	5W-30	na ^b	2003	113	32	4.80
435	5W-20	na ^b	2003	178	33	3.59
438,538	5W-20	SL	2002	97	18	3.20

SEQUENCE IVA

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data
				Average Camshaft Wear (Microns)
1006	5W-30	SJ	1997	91.15
1007	5W-30	na ^b	1999	84.76
1009	5W-30	SL/GF-3	2002	18.76

SEQUENCE VG

Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data				
				Average Engine Sludge (Merit)	Rocker Cover Sludge (Merit)	Average Engine Varnish (Merit)	Average Piston Varnish (Merit)	Oil Screen Clogging (Percent)
TMC								
925	5W-30	SF	1987	6.49	7.43	8.56	7.38	53
1006	5W-30	SJ	1997	8.65	9.40	9.24	8.52	1
1007	5W-30	na ^b	1999	8.93	8.99	9.24	8.57	2
1009	5W-30	SL/GF-3	2002	7.94	9.29	8.99	7.79	8

SEQUENCE VIB

Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data	
				FEI1 (Percent)	FEI2 (Percent)
TMC					
538,438	5W-20	SL	2002	2.02	1.53
539	10W-30	SL/GF-3	2002	0.91	0.38
1006	5W-30	SJ	1997	1.40	0.50
1008	5W-30	SJ	1998	1.96	1.30

SEQUENCE VID

Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data	
				FEI1 (Percent)	FEI2 (Percent)
TMC					
540	5W-20	GF-4	2008	1.32	1.04
541	10W-30	GF-4	2008	0.87	0.710
542	0W-20	GF-5	2008	1.49	0.80
1010	5W-20	GF-5	2010	1.34	1.10

SEQUENCE VIII

Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data	
				Total Bearing Weight Loss (Milligrams)	10-Hour Stripped Viscosity (Centistokes)
TMC					
704	10W-30	SF	1990	8.3	10.27
1006	5W-30	SJ	1997	17.5	9.37
1009	5W-30	SL/GF-3	2002	13.8	9.51

1M-PC

Oil Code		Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data	
					Top Groove Fill (Percent)	Weighted Total Demerits (Demerit)
TMC						
873		40	CD	1993	41.0	232.5

1K

Oil Code		Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data				
					Top Groove Fill (Percent)	WDK (Demerit)	Top Land Heavy Carbon (Percent)	Brake Specific Oil Consumption (g/KW-hr)	EOT Oil Consumption (g/kW-hr)
TMC	CRC								
809,1001	217	15W-40	SE/CD	1990	17.5	216.4	0.8	0.268	1.711
810,1003	212	15W-40	CD	1990	55.3	261.3	5.9	0.375	0.407
811		15W-40	SF/CE	1990	27.3	327.7	1.4	0.267	1.208

1N

Oil Code		Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data			
					Top Groove Fill (Percent)	WDN (Demerit)	Top Land Heavy Carbon (Percent)	Oil Consumption (g/kW-hr)
TMC	CRC							
809,1001	217	15W-40	SE/CD	1990	33.9	198.1	2.9	0.322
810,1003	212	15W-40	CD	1990	70.8	273.3	11.8	0.540
811		15W-40	SF/CE	1990	24.7	281.5	0.4	0.223
1004		15W-40	SH/CG-4/ CF/CF-4/CD	1993	23.9	190.7	0.2	0.148

1P

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data				
				Top Groove Carbon (Demerit)	Top Land Carbon (Demerit)	Average Oil Consumption (g/hr)	WDP (Demerit)	EOT Oil Consumption (g/hr)
1004	15W-40	SH/CG-4/CF/CF-4/CD	1993	29.5	28.1	6.2	319.6	7.8
1005	15W-40	na ^b	1997	28.7	30.9	6.5	285.3	5.0

1R

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data				
				Top Groove Carbon (Demerit)	Top Land Carbon (Demerit)	Initial Oil Consumption (g/hr)	WDP (Demerit)	EOT Oil Consumption (g/hr)
820, PC-9A	15W-40	na ^b	2001	34.11	22.82	8.3	341.2	7.9
1005	15W-40	na ^b	1993	34.51	18.61	10.0	327.9	8.3

T-8/T-8E

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data		
				Viscosity Increase @ 3.8% Soot (cSt)	Relative Viscosity @ 4.8% Soot (50% DIN) (cSt)	Relative Viscosity @ 4.8% Soot (100% DIN) (cSt)
1005	15W-40	na ^b	1993	5.11	1.78	2.03

T-11

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data			
				Soot @ 4 cSt Viscosity Increase (Percent)	Soot @ 12 cSt Viscosity Increase (Percent)	Soot @ 15 cSt Viscosity Increase (Percent)	MRV Viscosity (cP)
820, PC-9A	15W-40	na ^b	2001	3.95	5.92	6.51	14981

T-12

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data				
				Cylinder Liner Wear (Micrometres)	Top Ring Weight Loss (Milligrams)	Oil Consumption (g/h)	Delta Pb EOT (ppm)	Delta Pb 250-300 hr (ppm)
821, PC10E	15W-40	na ^b	2005	15.1	62.0	59.9	22	8

ROLLER FOLLOWER WEAR TEST

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data
				Avg. Roller Follower Shaft Wear (Mils)
1004	15W-40	SH/CG-4/CF/CF-4/CD	1993	0.44
1005	15W-40	na ^b	1997	0.20

ISB

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data	
				Average Camshaft Wear (Micrometres)	Average Tappet Weight Loss (Milligrams)
831, PC10B	15W-40	na ^b	2005	42.5	97.2

ISM

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced	Engine Test Data			
				Crosshead Wear @ 3.9% Soot (Milligrams)	Oil Filter ΔP (kPa)	Average Sludge (Merit)	Injector Adjusting Screw Wear @ 3.9% Soot (Milligrams)
830, PC-9E	15W-40	na ^b	2001	5.1	11.4	9.00	29.5

C13

Oil Code		Viscosity	Performance	Year ^a	Engine Test Data			
					Top Groove Carbon	Top Land Carbon	Oil Consumption Delta	2nd Ring Top Carbon
TMC	CRC	Grade	Class	Introduced	(Demerits)	(Demerits)	(g/h)	(Demerits)
831, PC10B		15W-40	na ^b	2005	46.02	21.87	30.35	17.86

ENGINE OIL AERATION TEST

TMC Oil Code	Viscosity Grade	Performance Class	Year ^a Introduced	Engine Test Data
				Average Engine Oil Aeration (Percent)
1004	15W-40	SH/CG-4/CF/CF-4/CD	1993	9.46
1005	15W-40	na ^b	1997	7.80

L-33-1

TMC Oil Code	Viscosity Grade	Year ^a Introduced	Gear Rig Test Data
			Total Rust (Merit)
123	90	1995	8.74
151	80W-90	1993	9.64
155	90	2006	9.58

L-37

TMC Oil Code	Viscosity Grade	Year ^a Introduced	Gear Rig Test Data							
			Pinion Ridging (Merit)		Pinion Rippling (Merit)		Pinion Pitting/Spalling (Merit)		Pinion Wear (Merit)	
			Lubrited Gears	Non-Lubrited Gears	Lubrited Gears	Non-Lubrited Gears	Lubrited Gears	Non-Lubrited Gears	Lubrited Gears	Non-Lubrited Gears
128	80W-90	1993	7.74	8.30	6.88	7.67	8.84	9.80	5.82	6.44
151	80W-90	2000	6.43	9.14	8.60	8.86	9.49	9.56	6.00	6.64
152	75W-90	2004	6.16	9.64	9.28	9.44	9.33	9.92	6.25	8.16
153	75W-90	2004	6.85	9.09	7.87	8.71	9.46	9.87	6.88	7.60
155	90	2006	8.76	9.84	8.64	9.52	9.46	9.93	5.81	7.88

L-42

Oil Code	Viscosity Grade	Year ^a Introduced	Gear Rig Test Data					
			Coast Side Pinion Scoring (Percent)					
TMC			Batch P8L123	Batch P8L205	Batch P8L737	Batch P8L327	Batch P8L604	Batch P4L806
114	90	1994	23.2	23.4	20.2	--	--	--
115	80W-90	2003	23.2	23.4	20.2	25.3	25.3	--
116	80W-90	2005	22.9	22.9	--	22.9	22.9	25.1

L-60-1

TMC Oil Code	Viscosity Grade	Year ^a Introduced	Gear Rig Test Data				
			Viscosity Increase (Percent)	Pentane Insolubles (Percent)	Toluene Insolubles (Percent)	Average Carbon/Varnish (Merit)	Average Sludge (Merit)
131	90	1991	75.9	2.56	0.92	1.05	9.48
148	80W-90	1993	37.0	0.39	0.26	8.31	9.53
151	80W-90	1993	37.3	2.12	1.30	8.59	9.42

HIGH TEMPERATURE CYCLIC DURABILITY TEST

Oil Code	Viscosity Grade	Year ^a Introduced	Gear Rig Test Data
			Cycles to Unsynchronized Shifts (Number of Cycles)
TMC			
150	80W-90	1993	24271
151	80W-90	1993	74489
155	90	2006	74489

FOOTNOTES

- a Indicates the year of introduction of the reference oil into the Test Monitoring System.
- b na = Information not available.

**ASTM Test Monitoring System
Reference Oils**

PART II

Field Data

FIELD DATA
ASTM Test Monitoring System Reference Oils

TEST	SEQUENCE II			SEQUENCE IIIE		SEQ. III (400 SERIES) SEQ. VE (900 SERIES)	
	1A	7I	8C	72A 472	404	424 924	425 925
OIL	1A	7I	8C	72A 472	404	424 924	425 925
Type of Service	Short Trip			Field	Taxicab	Taxicab	
No. of Vehicles per Oil					100,000 mi.	60,000 - 100,000 mi.	
Vehicle Mileage							
Engine Model and Size					3.8L - V6 BUICK	3.8L - V6 CHEVY	
Oil Change Interval, Miles					5,000 mi	7,500 mi	
Filter Change Interval, Miles					5,000 mi	7,500 mi.	
Fuel						Unleaded	
Deposits & Wear							
Rust	9.7	7.7	5.2				
Ring Land Deposits					--	4.8	5.6
Piston Skirt Varnish					5.9	7.4	6.9
Sludge					9.4	9.2	8.5
Cam & Lifter Wear				Unacceptable			
Avg. (10 - 4 IN.)					32-111	58	76
Max. (10 - 4 IN.)					81-175	164	200
Viscosity Increase, %					20-170	--	--

FIELD DATA
ASTM Test Monitoring System Reference Oils

TEST	SEQUENCE VE					
OIL	200			200		200
Type of Service	Taxicab			Taxicab		Taxicab
No. of Vehicles per Oil	2	2	2	2	3	3
Vehicle Mileage	60,000	104,000	70,000	105,000	50,000	60,000
Engine Model and Size	350 CID Chevy V-8			225 CID Six Cyl. Dodge		3.8L Chevy V-6
Oil Change Interval, Miles	12,000		3,000		7,500	7,500
Filter Change Interval, Miles	12,000		3,000		7,500	7,500
Fuel	Leaded	Unleaded	Leaded	Unleaded	Unleaded	Unleaded
Deposits & Wear						
Sludge	5.8	5.6	8.4	9.3	9.4	9.7
Varnish	5.5	4.8	5.8	6.0	7.5	5.5
Piston Skirt Varnish	7.2	7.2	6.6	6.6	6.4	6.1
Cam & Lifter Wear Avg. (10 -3 IN.)	20.4	5.8	10.2	5.2	8.0	5.3

FIELD DATA
ASTM Test Monitoring System Reference Oils

TESTS	SEQUENCE V (900 SERIES) L-38 (700 SERIES)										
	901 702	907 703	903	911	915	916	914	921		923	
Type of Service	Taxicab		Taxicab		Factory Full Oils		Taxicab	Taxicab	Highway	Delivery Vans	
No. of Vehicles	5	5	3	3	20	Field Service	5	4	4	2	2
Vehicle Mileage	48,000		45,000		Up To 63,000		57,000	83,000		45,000	
Engine Model and Size	Ford L-6 4.1L (240 CID)		Chrysler L-6 3.7L (225 CID)		Ford Engines	Ford Engines	Chevrolet L-6 4.2L (250 CID)	Plymouth L-6 3.7L (225 CID)	Chrysler V-8 7.2 (440 CID)	Ford L-6 4.9L (300 CID)	
Oil Change Interval, Miles	6,000		6,000		5,000 & 10,000		12,000	6,000		6,000	15,000
Filter Change Interval Miles	12,000		6,000		5,000 & 10,000		12,000	6,000		6,000	15,000
Fuel	Unleaded		Leaded		Unleaded	Unleaded	Unleaded	Leaded		Unleaded	
Deposits & Wear											
Sludge	9.7	9.1	8.5	6.1	7.9+	Good	8.7	8.5	8.7	9.6	9.6
Varnish	7.8	6.4	4.9	3.6	4.5+	History	6.3	6.7	5.8	9.2	8.7
Piston Shirt Varnish	7.4	7.3	5.6	5.9	5.6+	In Field Service	6.3	6.2		8.8	7.7
Average Wear											
Cam (10 -3 IN.)	1.2	2.1	2.0*	3.4*	Border-line		2.8	1.8*		Low	Low
Lifter (10 -3 IN.)	1.4	2.5			Fail		0.2				

* Cylinder Bore Wear

FIELD DATA
ASTM Test Monitoring System Reference Oils

TESTS	SEQUENCE V (900 SERIES)													
	SEQUENCE III (400 SERIES)													
OIL	923	924 424	923	924 424	924 424	925 425	925-2 425-2	926	927	923	928	929	930	930-1
Type of Service	Taxicab		Suburban Police		Taxicab		Taxicab	Taxicab		Short Trip Commuter (European)			Taxicab	Taxicab
No. of Vehicles per Oil	2	2	3	2	2	2	3	3	2	2	4	2	5	4
Vehicle Mileage	50,000		23,000- 48,000	30,000- 57,000	60,000		105,000	62,000		18,000			100,000	105,000
Engine Model and Size	Chevrolet 1981 V-6 3.8L (229 CID)		Ford V-8 5.8L (351 CID)	Ford V-8 5.8L (351 CID)	Chevrolet 1983 V-6 3.8L (229 CID)		Chevrolet 1995 V-8 4.3L (260 CID)	Chevrolet 1983 V-6 3.8L (229 CID)		Ford L-4 1.3L CVH (79 CID)			GM 1990 V-6 4.3L (260 CID)	Chevrolet 1996 V-8 4.3L (260 CID)
Oil Change Interval, Miles	7500		3,500	3,500	7,500 to 8,500		10,000	7,500		None			7,500	12,000
Filter Change Interval Miles	7,500		3,500	3,500	7,500 to 8,500		10,000	7,500		None			7,500	9,000
Fuel	Unleaded		Unleaded	Unleaded	Unleaded		Unleaded	Unleaded		Leaded			Unleaded	Unleaded
Deposits & Wear														
Sludge (Average)	7.6	9.3	6.8**	9.3	9.2	8.5	8.82	9.5	7.6	6.4	9.2	6.2	9.57	9.18
Sludge (Rocker Cover)													9.28	
Varnish	5.3	5.7			5.7	5.0	5.61	5.0	4.5				6.27	5.66
Piston Skirt Varnish	7.3	6.5			7.4	6.9	6.08	5.9	5.8				6.28	6.42
Cam & Lifter Wear										Mean of Top Cover Valve Deck & Oil Pan				
Avg. (10-3 IN.)	2.1*	1.1*			5.8	7.6		5.0	3.2					
Max. (10-3 IN.)					16.4	20.0		10.5	7.2					

* Camshaft only

** All engines lost oil pressure due to sludge blocking oil screen.

ASTM 5 CAR TEST DATA

	MAKE		TYPICAL MODEL		ENGINE TYPE		DISPLACEMENT IN LITERS	
	1. Ford		Mustang		L-4		2.3	
	2. Ford		LTD		V-8		5.0	
	3. Chevrolet		Citation		V-6		2.8	
	4. Buick		Century		V-6		3.8	
	5. Plymouth		Volare		L-6		3.7	
OIL	502	513	515	516	517	518	519	521
Number of Car Tests	1	3	2	5	3	3	2	2
Vehicle Mileage	>10,000							
Oil Change Interval Miles	2,000							
Filter Change Interval Miles	2,000							
Fuel	AMOCO 91							
5 Car Test Result Combined FE %	3.25	1.95	2.70	1.19	2.22	2.70	2.70	3.10
Sequence VI								
EFEI %	3.17	2.18	2.79	0.74	2.13	2.23	2.50	3.10

FIELD DATA

ASTM Test Monitoring System Reference Oils

TEST	SG CATEGORY TESTS
OIL	1002*
TYPE OF SERVICE	TAXICAB
VEHICLE MILEAGE	60,000
ENGINE MODEL AND SIZE	4.3L CHEVY V-8
OIL CHANGE INTERVAL, MILES	7,500
DEPOSIT AND WEAR	
SLUDGE	8.33
VARNISH	4.43
AVG. RING WT. LOSS (grams)	0.698
AVG. CAM LOBE WEAR (in x 10,000)	4.3
AVG. LIFTER WEAR (in x 10,000)	4.8
AVG. MAIN BEARING WT. LOSS (grams)	0.162
AVG. CYLINDER BORE WEAR (in x 10,000)	19.2
AVG. MAIN BEARING JOURNAL WEAR (in x 10,000)	2.4
AVG. CRANKSHAFT ROD JOURNAL WEAR (in x 10,000)	3.2
AVG. ROD BEARING WT. LOSS (grams)	0.147

* 1002 DI package blended in an alternate Category I base stock. Viscosity grade is 5W-30.

FIELD DATA

ASTM Test Monitoring System Reference Oils

TEST	SJ CATEGORY TESTS
OIL	1006
TYPE OF SERVICE	TAXICAB
NUMBER OF VEHICLES	4
VEHICLE MILEAGE	105,000
ENGINE MODEL AND SIZE	CHEVROLET 4.3L V-8
OIL CHANGE/FILTER CHANGE INTERVAL, MILES	12,000/9,000
FUEL	UNLEADED
DEPOSITS	
SLUDGE (AVERAGE)	9.38
VARNISH	5.92
PISTON SKIRT VARNISH	5.96

ASTM Test Monitoring System Reference Oils

PART III

**Policies for the Use and Analysis
of ASTM Test Monitoring System Reference Oils**

**POLICIES FOR THE USE AND ANALYSIS OF
ASTM TEST MONITORING SYSTEM REFERENCE OILS**

The primary use of ASTM Test Monitoring System reference oils is for calibration of test stands used to conduct tests monitored by the ASTM Test Monitoring Center (TMC) at laboratories participating in the ASTM Test Monitoring System. The System shall attempt to provide reference oils for other testing purposes provided that such use does not interfere with test stand calibration. Redistribution of reference oil samples, including retains, is not permitted without TMC approval. Full data reporting is required for each reference oil test unless specifically authorized by the TMC. These reference oil samples shall not be analyzed for physical or chemical properties beyond what is permitted in the ASTM test procedure for which a sample is designated. The following policies are divided into three categories of reference oil use: Test Stand Calibration, New Test Development, and Bench Performance Test Development and Correlation.

Test Stand Calibration

Each reference oil sample distributed by the TMC for test stand calibration bears a CMIR code and a test area designation. These samples are to be used only for test stand calibration. No alternative use of these oil samples is permitted without TMC approval. The TMC will decode reference oil samples for use in diagnosing problems on a normally calibrated stand or for use in evaluating new stands and new laboratories when an intention to enter the ASTM Test Monitoring System has been indicated. Samples will also be available for industry test programs for fuel batch and hardware approval. All test data are to be reported to the TMC. The TMC will publish, with the permission of the supplier, the following physical and chemical properties for each batch of crankcase reference oil:

Property	Method
Metals (Ca, Mg, Mo, Zn, P, Ba, Na, S, B)	ASTM D 5185
Kinematic Viscosity @ 40°C and 100°C	ASTM D 445
HTHS @ 150°C	ASTM D 4683
CCS	ASTM D 5293
MRV	ASTM D 4684
Scanning Brookfield	ASTM D 5133
Shear Stability Index	ASTM D 6278
Sulfated Ash	ASTM D 874
TBN	ASTM D 4739
Volatility	ASTM D 6417

The cost per gallon of reference oil used for test stand calibration is established by the ASTM Executive Committee according to the *Regulations Governing the ASTM Test Monitoring System*.

New Test Development

Reference oil samples are available for use in the development of new tests that are intended to become ASTM standard methods. These uses include primary hardware screening by test developers as well as industry approved designed experiments for estimating levels of test discrimination and precision. A request for such reference oil samples shall be made to the TMC and shall include the specific oil(s) with estimated quantities needed and a description of the intended use of the oil(s). The cost per gallon of reference oil used for new test development shall be the same as the cost estimated for test stand calibration.

Bench Performance Test Development and Correlation

Crankcase reference oil samples in one-gallon quantities are available for use in the development and correlation of bench performance tests. A written request for such reference oil samples shall be submitted to the TMC and shall include the specific oil(s) needed and a description of the intended use of the oil(s). Availability is limited to one gallon/reference oil/year/company. Analyses of physical or chemical properties of these samples are limited to those types and methods published by the TMC (see list in Test Stand Calibration section). The supplier(s) of the specific reference oil(s) must also have granted permission of these analyses to be performed. Users are urged to share any data obtained using these reference oil samples with the TMC and the appropriate ASTM surveillance panel(s). The cost per gallon of reference oil used for bench performance test development and correlation shall be ten (10) times the cost established for test stand calibration. Gear reference oils are only available for ASTM bench performance test development and correlation.

ASTM Test Monitoring System Reference Oils

PART IV

Reference Oil Analytical Data

REFERENCE OIL ANALYTICAL DATA

Oil	Vis Grade	D5480*	D6417	D5133	D5133	D4683(HTHS)	D3945**	D6278	D4684
		mass %	area %	Deg C @30,000 cP	Deg C @40,000 cP	cP @150 Deg C	Vis. Loss %	Vis. Loss%	cP / Deg C
300	5W-30	--	6.5	-36.2	-37.6	2.87		20.2	21900 @ -35 NYS
433	5W-30	3.7	--	-33.7	-35.2	3.12	14.55	--	yield stress/-35
433-1	5W-30	--	5.4	-33.3	-34.9	3.12	12.34	--	yield stress/-35
433-2	5W-30	--	--	--	--	--		--	--
434	5W-30	--	5.1	-35.4	-37.0	2.91	7.19	--	21,800/-35
434-1	5W-30	--	5.5	--	--	--	--	--	--
434-2	5W-30	--	6.0	-37.0	-38.6	2.99	--	2.66	20300 @ -35 NYS
436	5W-20		4.1	-35.0	-36.3	2.54*	--	13.24	15200 @ -35 NYS
538 (438)	5W-20	--	3.9	-39.3	-39.3	2.56	15.02	--	13,800/-35
538-1(438-1)	5W-20		5.1	-38.2	-40.0	2.59	--	10.96	14600 @ -35 NYS
539	10W-30	--	6.1	-25.4	-27.7	2.99	13.97	--	23,600/-30
540	5W-20	--	5.7	-37.0	-38.0	2.68	12.05	--	19,000/-35
541	10W-30	--	4.4	-33.2	-34.9	3.05	16.22	--	3,500/-30
541-1	10W-30	--	--	--	--	--	--	--	--
542	0W-20	--	5.3	-36.2	-37.3	2.71	15.74	--	32,700/-40
542-1	0W-20	--	--	--	--	--	--	--	--
542-2	0W-20	--	--	--	--	2.69	--	--	25000 @ -40 NYS
704-1	10W-30	13.8	--	-15.4	-17.4	3.20	9.66	--	yield stress/-25
811-1	15W-40	8.0	--	-28.7	-30.1	3.91	21.75	--	7,500/-20
811-2	15W-40	9.0	--	-27.4	-28.9	3.77	21.55	--	10,400/-20
820 (PC-9A)	15W-40	--	11.6	-25.7	-27.5	4.27	9.77	--	27500/-25
820-2	15W-40	--	8.3	-25.8	-27.6	4.11	10.42	--	25,600/-25
820-3	15W-40	--	7.0	-25.8	-27.6	4.15	8.58	--	23,600/-25
821 (PC10E)	15W-40	--	5.6	-26.1	-27.9	4.15	3.63	--	22,400/-25
830 (PC-9E)	15W-40	--	7.9	-18.6	-19.3	4.27	9.16	--	yield stress/-25
831-1	15W40	--	--	--	--	4.21	--	--	--
831-2	15W-40	--	--	--	--	4.24	--	--	--
830-2	15W-40	--	6.7	-26.1	-27.8	4.23	14.67	--	24,600/-25
925-3	5W-30	16.1	--	-25.8	-27.1	2.66	29.2	--	37,900/-30
940	5W-30	--	6.6	-35.9	-37.5	3.02	--	14.99	28600 @ -35 NYS
1001	15W-40	14.1	--	-26.8	-28.5	3.64	2.53	--	8,900/-20
1004-2	15W-40	8.6	--	-27.0	-28.5	4.10	17.71	--	9,600/-20
1004-3	15W-40	7	--	-26.6	-28.2	4.07	18.74	--	11,500/-20
1005	15W-40	9.6	--	-26.5	-28.0	4.31	20.64	--	9,000/-20
1005-1	15W-40	--	14.7	-26.9	-28.4	4.34	20.23	--	17,700/-25
1005-4	15W-40	--	--	--	--	--	--	--	--
1005-5	15W-40	--	--	--	--	--	--	--	17400 @ -25 NYS
1006	5W-30	18.5	--	-34.5	-35.9	3.03	17.16	--	54,200/-35
1006-1	5W-30	--	20.5	-34.7	-36.3	3.00	10.67	--	49,000/-35
1006-2	5W-30	--	20.2	-34.4	-35.9	3.04	15.6	--	52,400/-35
1007	5W-30	6.0	--	-35.4	-37.0	3.13	11.19	--	9,500/-30
1009	5W-30	--	6.0	-31.1	-33.5	3.01	--	18.08	59,200/-35
1010	5W-20	--	4.6	--	--	2.59	--	14.79	9000/-35
1010-1	5W-20	--	--	--	--	--	--	--	12700 @ -35 NYS

* D5480 dropped replaced by D6417

** Modified or D6278

*** GI reached before these points GI=4.1 @16.0 C

Oil	Vis Grade	D5185								
		Ba ppm	B ppm	Ca ppm	Mg ppm	Mo ppm	P ppm	Na ppm	Zn ppm	S wt%
300	5W-30	<1	49	2041	6	112	648	<1	752	0.193
433	5W-30	1	67	2095	<1	112	976	<5	1030	0.237
433-1	5W-30	<1	62	2047	4	110	933	<5	1010	0.229
433-2	5W-30	--	56	2068	--	98	929	--	1063	0.312
434	5W-30	<1	<1	1871	4	54	732	<5	780	0.233
434-1	5W-30	<1	<1	2098	3	59	756	<1	826	--
434-2	5W-30	<1	<1	2058	5	51	778	<1	877	0.239
436	5W-20	<1	119	2150	6	185	805	<1	896	0.224
538 (438)	5W-20	<1	89	1400	555	<1	937	<5	1024	0.394
538-1(438-1)	5W-20	<1	82	1400	587	--	914	<1	1055	0.384
539	10W-30	<1	3	1795	6	54	980	<5	1057	0.232
540	5W-20	<1	114	1597	7	150	753	431	828	0.239
541	10W-30	<1	359	2085	8	43	785	9	863	0.381
541-1	10W-30	<1	342	2184	8	41	773	<1	883	0.380
542	0W-20	<1	91	1887	7	485	769	14	912	0.240
542-1	0W-20	<1	69	1886	5	482	749	10	898	0.222
542-2	0W-20	<1	69	1811	5	502	749	<1	900	0.224
704-1	10W-30	0	0	2349	4	0	963	20	1103	0.308
811-1	15W-40	0	173	33	1151	0	1072	0	1137	0.677
811-2	15W-40	0	214	5	1444	0	1361	10	1419	0.601
820 (PC-9A)	15W-40	<1	410	3473	12	<1	1309	6	1437	0.405
820-2	15W-40	<1	406	3532	15	<1	1317	<5	1438	0.425
820-3	15W-40	<1	392	3423	11	<1	1215	<5	1366	0.476
821 (PC10E)	15W-40	<1	<1	1529	659	<1	1123	<5	1263	0.390
821-1	15W-40	--	--	1560	700	--	1152	--	1299	0.391
821-2	15W-40	--	--	1520	687	--	1125	--	1311	0.364
821-3	15W-40	--	--	1546	646	--	1173	--	1299	0.366
821-4	15W-40	--	--	1534	645	--	1172	--	1322	0.352
822	15W40	--	256	2192	--	14	951	--	1063	0.295
830 (PC-9E)	15W-40	<1	146	3108	297	<1	1219	<5	1302	0.330
830-1	15W40	--	119	2692	253	--	935	--	1107	--
830-2	15W-40	<1	149	3145	298	<1	1232	<5	1315	0.338
831	15W-40	<1	100	2069	75	--	773	<1	847	0.256
831-1	15W-40	<1	105	2068	77	<1	780	<1	862	0.246
831-2	15W-40	<1	98	2046	90	<1	750	4	824	0.246
925-3	5W-30	<1	45	5	1426	<1	878	16	956	0.425
940	5W-30	2	--	2399	4	39	762	5	840	0.313
1001	15W-40	0	0	2070	7	0	1139	8	1244	0.418
1004-2	15W-40	0	141	2078	8	99	871	0	979	0.516
1004-3	15W-40	0	151	2275	7	110	998	3	1101	0.535
1005	15W-40	0	217	586	1256	0	1314	2	1306	0.512
1005-1	15W-40	<1	240	546	1278	<1	1273	5	1343	0.510
1005-4	15W-40	<1	252	545	1255	--	1204	9	1394	0.660
1005-5	15W-40	<1	250	529	1200	--	1204	<1	1431	0.567
1006	5W-30	0	123	1115	474	0	960	159	1049	0.506
1006-1	5W-30	<1	135	1084	498	<1	972	180	1047	0.492
1006-2	5W-30	<1	137	1084	513	<1	992	181	1065	0.490
1007	5W-30	0	57	74	1552	1	992	<25	1053	0.275
1009	5W-30	<1	<1	1790	3	54	983	<5	1044	0.238
1010	5W-20	<1	246	2070	8	40	751	<1	828	0.271
1010-1	5W-20	<1	200	2050	8	40	840	<1	860	0.280

Oil	Vis Grade	Vis@40 Deg C	Vis@100 Deg C	CCS	Sul Ash	TBN
		cSt	cSt	cP / Deg C	wt%	mgKOH/g
300	5W-30	61.80	10.42	5735/-30	--	5.93
433	5W-30	59.9	10.3	2388/-25	0.94	6.78
433-1	5W-30	59.9	10.3	5538/-30	1.02	6.67
433-2	5W-30	63.2	10.6	5831/-30	--	6.56
434	5W-30	57.4	10.1	4542/-30	1.05	5.76
434-1	5W-30	60.6	10.4	4618/-30	--	5.18
434-2	5W-30	61.9	10.5	5006/-30	--	6.28
436	5W-20	45.80	8.16	4839/-30	--	6.43
538 (438)	5W-20	48.8	8.7	4027/-30	0.99	6.34
538-1(438-1)	5W-20	47.5	8.6	3678/-30	--	5.89
539	10W-30	69.1	10.3	5430/-25	0.81	5.42
540	5W-20	49.0	8.6	5843/-30	--	6.10
541	10W-30	70.3	10.7	5515/-25	--	6.33
541-1	10W-30	69.5	10.7	5324/-25	--	6.19
542	0W-20	48.2	8.8	5706/-35	--	5.46
542-1	0W-20	48.0	8.8	5972/-35	--	5.49
542-2	0W-20	47.2	8.8	6101/-35	--	5.35
704-1	10W-30	71.7	10.9	3214/-20	0.96	7.61
811-1	15W-40	100.8	14.2	2840/-15	0.74	7.23
811-2	15W-40	100.9	13.7	2741/-15	0.94	7.26
820 (PC-9A)	15W-40	116.6	15.2	6013/-20	1.59	9.48
820-2	15W-40	115.1	15.1	5727/-20	1.64	9.86
820-3	15W-40	116.8	15.1	6591/-20	--	9.82
821 (PC10E)	15W-40	118.9	15.6	6984/-20	1.03	8.84
821-1	15W-40	116.3	15.3	7094/-20	1.04	8.86
821-2	15W-40	121.6	15.9	6884/-20	1.06	8.84
821-3	15W-40	117.6	15.8	6689/-20	1.02	8.90
821-4	15W-40	120.0	15.9	6837/-20	1.07	9.01
822-1	15W-40	120.8	14.9	5958/-20	--	6.76
822-2	15W-40	120.2	14.8	5872/-20	0.92	6.74
830 (PC-9E)	15W-40	113.9	15.3	6056/-20	--	10.99
830-2	15W-40	120.8	16.2	5538/-20	1.56	10.40
831	15W-40	109.9	14.8	6781/-20	0.88	7.19
831-1	15W-40	106.0	14.7	6497/-20	0.94	6.99
831-2	15W-40	107.6	14.7	6450/-20	0.85	7.59
925-3	5W-30	72.0	11.3	2569/-25	0.73	6.90
940	5W-30	62.7	10.5	5867/-30	--	6.40
1001	15W-40	98.0	13.8	3250/-15	0.92	7.55
1004-2	15W-40	106.0	14.6	3283/-15	0.88	6.14
1004-3	15W-40	109.2	14.6	3314/-15	0.94	5.94
1005	15W-40	116.6	15.8	2966/-15	1.00	8.06
1005-1	15W-40	120.1	15.8	3128/-15	1.11	8.02
1005-2	15W-40	119	15.7	3281/-15	0.77	6.10
1005-3	15W-40	116	15.46	5453/-20	0.95	7.56
1005-4	15W-40	119.3	15.76	5679/-20	1.08	8.23
1005-5	15W-40	114.8	15.47	5294/-20	1.02	6.07
1006	5W-30	59.8	10.1	3081/-25	0.79	6.50
1006-1	5W-30	59.0	10.1	6424/-30	0.83	6.90
1006-2	5W-30	58.8	10.1	6328/-30	0.77	6.99
1007	5W-30	61.6	10.2	2894/-25	0.81	6.94
1009	5W-30	63.7	10.5	6235/-30	0.82	5.46
1010	5W-20	45.8	8.5	3340/-30	1.01	6.56
1010-1	5W-20	51.27	9.33	3706/-30	--	6.45