



Test Monitoring Center

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Test Monitoring System Reference Oils

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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 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 calibration system.

**Test Monitoring System
Reference Oils**

PART I

Performance Classification

Oil Code Cross-Reference

**[For Test Performance Information Please Refer to
Lubricant Test Monitoring System Document](#)**

SEQUENCE IIIF

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
1006	5W-30	SJ	1997
1008	5W-30	SJ	2000
433	5W-30	SL	2000

SEQUENCE IIIG

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
434	5W-30	na ^b	2003
435	5W-20	na ^b	2003
438	5W-20	SL	2002

SEQUENCE IIIH

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
434-2	5W-30	na ^b	2003
436	5W-20	na ^b	2003
438-1	5W-20	SL	2002

SEQUENCE IVA

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
1006	5W-30	SJ	1997
1007	5W-30	na ^b	1999
1009 (not in ltms)	5W-30	SL/GF-3	2002

SEQUENCE VG

Oil Code TMC	Viscosity Grade	Performance Classification	Year ^a Introduced
925 (not in ltms)	5W-30	SF	1987
940			
1006	5W-30	SJ	1997
1007	5W-30	na ^b	1999
1009	5W-30	SL/GF-3	2002

SEQUENCE VIB

Oil Code TMC	Viscosity Grade	Performance Classification	Year ^a Introduced
538,438	5W-20	SL	2002
539	10W-30	SL/GF-3	2002
1006	5W-30	SJ	1997
1008	5W-30	SJ	1998

SEQUENCE VID

Oil Code TMC	Viscosity Grade	Performance Classification	Year ^a Introduced
540	5W-20	GF-4	2008
541	10W-30	GF-4	2008
542	0W-20	GF-5	2008
1010	5W-20	GF-5	2010

Sequence VH

Oil Code TMC	Viscosity Grade	Performance Classification	Year Introduced
940	5W-30	-	2018
1009	5W-30	GF-3	2017
1011	0W-16	-	2015

Sequence IX

Oil Code TMC	Viscosity Grade	Performance Classification	Year Introduced
221	0W-16	-	2015
222	10W-30	-	2015
224	5W-30	-	2018

Sequence X

Oil Code TMC	Viscosity Grade	Performance Classification	Year Introduced
270	5W-30	GF-5	2015
271	5W-30	-	2015
1011	0W-16	-	2015

Sequence VIE

Oil Code TMC	Viscosity Grade	Performance Classification	Year ^a Introduced
542	0W-20	GF-5	2008
544	5W-30	GF-5	2016
1010-1	5W-20	GF-5	2010

Sequence VIF

Oil Code TMC	Viscosity Grade	Performance Classification	Year ^a Introduced
542	0W-20	GF-5	2008
543	0W-16	GF-5	2015
1011	0W-16	GF-5	2015

SEQUENCE VIII

Oil Code TMC	Viscosity Grade	Performance Classification	Year ^a Introduced
704	10W-30	SF	1990
1006	5W-30	SJ	1997
1009	5W-30	SL/GF-3	2002

1M-PC

Oil Code TMC	Viscosity Grade	Performance Classification	Year ^a Introduced
873	40	CD	1993

1K

Oil Code		Viscosity Grade	Performance Classification	Year ^a Introduced
TMC	CRC			
809,1001	217	15W-40	SE/CD	1990
810,1003	212	15W-40	CD	1990
811		15W-40	SF/CE	1990

1N

Oil Code		Viscosity Grade	Performance Classification	Year ^a Introduced
TMC	CRC			
809,1001	217	15W-40	SE/CD	1990
810,1003	212	15W-40	CD	1990
811		15W-40	SF/CE	1990
1004		15W-40	SH/CG-4/ CF/CF-4/CD	1993

1P

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
1004	15W-40	SH/CG-4/CF/CF-4/CD	1993
1005	15W-40	na ^b	1997

1R

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
820, PC-9A	15W-40	na ^b	2001
1005	15W-40	na ^b	1993

COAT

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
832, PC-11G	15W-40	PC-11	2015
833, PC-11K	15W-40	PC-11	2015

T-8/T-8E

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
1005	15W-40	na ^b	1993

T-11

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
820, PC-9A	15W-40	na ^b	2001
822	15W-40	na ^b	2013

T-12/ T-12A

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
821, PC10E	15W-40	na ^b	2005

T-13

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
823, PC11A	10W-30	na ^b	2015

ROLLER FOLLOWER WEAR TEST

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
1004	15W-40	SH/CG-4/CF/CF-4/CD	1993
1005	15W-40	na ^b	1997

ISB

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
831, PC10B	15W-40	na ^b	2005

ISM

TMC Oil Code	Viscosity Grade	Performance Classification	Year ^a Introduced
830, PC-9E	15W-40	na ^b	2001

C13

Oil Code		Viscosity Grade	Performance Class	Year ^a Introduced
TMC	CRC	Grade	Class	Introduced
831, PC10B		15W-40	na ^b	2005

ENGINE OIL AERATION TEST

TMC Oil Code	Viscosity Grade	Performance Class	Year ^a Introduced
1004	15W-40	SH/CG-4/CF/CF-4/CD	1993
1005	15W-40	na ^b	1997

DD13

TMC Oil Code	Viscosity Grade	Performance Class	Year ^a Introduced
864 (OIL X)	5W-30	na ^b	2016
866 (OIL C)	10W-30	na ^b	2016

L-33-1 Gear Version V99.1 & V01.1

TMC Oil Code	Viscosity Grade	Year ^a Introduced
123	90	1995
151	80W-90	1993
155	90	2006

L-33-1
Gear Version AAM K2XX

TMC Oil Code	Viscosity Grade	Year ^a Introduced
123	90	1995
155	90	2006

L-37

TMC Oil Code	Viscosity Grade	Year ^a Introduced
128	80W-90	1993
134	80W-90	2007
151	80W-90	2000
152	75W-90	2004
153	75W-90	2004
155	90	2006

L-37-1

TMC Oil Code	Viscosity Grade	Year ^a Introduced
134	80W-90	2007
152	75W-90	2004
155	90	2006

L-42

TMC Oil Code	Viscosity Grade	Year ^a Introduced
113	90	2002
114	90	1994
115	80W-90	2003
116	80W-90	2005
117	80W-90	2013

L-60-1

TMC Oil Code	Viscosity Grade	Year ^a Introduced
131	90	1991
148	80W-90	1993
151	80W-90	1993
155	SAE 90	2004

HIGH TEMPERATURE CYCLIC DURABILITY TEST

TMC Oil Code	Viscosity Grade	Year ^a Introduced
150	80W-90	1993
151	80W-90	1993
154	SAE 90	2005
155	90	2006

FOOTNOTES

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

**Test Monitoring System
Reference Oils**

PART II

Field Data

FIELD DATA
Test Monitoring System Reference Oils

TEST	SEQUENCE II			SEQUENCE IIIIE		SEQ. III (400 SERIES) SEQ. VE (900 SERIES)	
	1A	7I	8C	72A 472	404	424 924	425 925
OIL							
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
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
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
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
										Mean of Top Cover Valve Deck & Oil Pan				
Cam & Lifter Wear														
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

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

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

Test Monitoring System Reference Oils

PART III

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

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

The primary use of Test Monitoring System reference oils is for calibration of test stands used to conduct tests monitored by the Test Monitoring Center (TMC) at laboratories participating in the 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 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.

Test Monitoring System Reference Oils

PART IV

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
221	0W-16	--	3.6	<-40.0	<-40.0	2.33	--	10.20	16500 @ -40 NYS
224	5W-30	--	--	--	--	3.03	--	--	21,100 <35
270	5W-30	--	6.1	-37.8	-39.5	2.89	--	19.06	18500 @ -35 NYS
271	5W-30	--	5.0	-36.0	-37.6	3.03	--	12.21	26900 @ -35 NYS
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
544	5W-30	--	5.00	--	--	3.02	--	--	17300@-35NYS
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
822-2	15W-40	--	7.0	-25.9	-27.7	--	--	9.47	
830 (PC-9E)	15W-40	--	7.9	-18.6	-19.3	4.27	9.16	--	yield stress@-25
830-2	15W-40	--	6.7	-26.1	-27.8	4.23	14.67	--	24,600@-25
831-1	15W40	--	--	--	--	4.21	--	--	--
831-2	15W-40	--	--	--	--	4.24	--	--	--

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
831-1	15W40	--	--	--	--	4.21	--	--	--
831-2	15W-40	--	--	--	--	4.24	--	--	--
831-3	15W-40	--	--	--	--	4.20	--	--	18,000/-25 NYS
831-4	15W-40	--	--	--	--	4.20	--	--	18,000/-25 NYS
832	15W-40	--	--	--	--	4.06	--	--	16400@-25NYS
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
1009-1	5W-30					3.08			-
1010	5W-20	--	4.6	--	--	2.59	--	14.79	9000@-35
1010-1	5W-20	--	--	--	--	--	--	--	12700 @ -35 NYS
1011	0W-16	--	--	--	--	2.38	--	--	20000@-40NYS

Oil	Vis Grade	D5185								
		mg/kg								wt. %
		Ba	B	Ca	Mg	Mo	P	Na	Zn	S
221	0W-16	<1	234	1689	7	80	717	<1	840	0.276
224	5W-30	--	<1	1418	805	55	730	<1	801	0.287
270	5W-30	<1	186	1767	7	67	616	<1	714	0.237
271	5W-30	<1	192	3	1779	26	723	<1	867	0.304
433	5W-30	1	67	2095	<1	112	976	<5	1030	0.237
433-1	5W-30	<1	56	2601	4	136	1052	<5	1164	--
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	82	1661	439	<1	995	<5	1056	0.99
538-1(438-1)	5W-20	<1	82	1400	587	--	914	<1	1055	0.384
539	10W-30	<1	<1	2050	<1	76	992	<5	1067	--
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	68	1918	5	483	769	10	904	0.210
542-2	0W-20	<1	69	1811	5	502	749	<1	900	0.224
544	5W-30	--	224	2047	--	80	750	--	899	0.294
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	218	8	1191	0	1195	11	1292	--
820 (PC-9A)	15W-40	<1	410	3473	12	<1	1309	6	1437	0.405
820-2	15W-40	<1	269	2975	15	<1	1063	<5	1147	--
820-3	15W-40	<1	399	3505	11	<1	1279	<5	1460	0.443
821 (PC10E)	15W-40	<1	<1	1529	659	<1	1123	<5	1263	0.390
821-1	15W-40	--	--	1491	655	--	1110	--	1277	--
821-2	15W-40	--	--	1520	687	--	1125	--	1311	0.364
821-3	15W-40	--	--	1562	664	--	1141	--	1298	0.363
821-4	15W-40	--	--	1534	645	--	1172	--	1322	0.352
822	15W40	--	255	2192	--	14	951	--	1063	1.03
823	10W-30	0	1	1056	1006	67	1132	0	1349	0.313
830 (PC-9E)	15W-40	<1	143	3225	294	<1	1269	<5	1350	--
830-1	15W40	--	119	2692	253	--	935	--	1107	--

Oil	Vis Grade	D5185								
		mg/kg								wt. %
		Ba	B	Ca	Mg	Mo	P	Na	Zn	S
830-2	15W-40	<1	147	2736	303	<1	1183	<5	1310	--
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
831-3	15W-40	<1	98	1994	86	<1	733	2	838	0.245
831-4	15W-40	<1	101	2089	86	<1	756	-	860	0.244
832	15W-40	<1	<1	1055	1019	67	1124	<1	1341	0.312
925-3	5W-30	<1	29	<1	1285	<1	1141	5	1238	--
940	5W-30	2	--	2366	4	39	744	5	834	0.313
1001	15W-40	0	0	2070	7	0	1139	8	1244	0.418
1004-2	15W-40	0	156	2035	0	97	1053	0	1256	0.502
1004-3	15W-40	0	142	2332	0	77	1016	3	1229	0.535
1005	15W-40	0	200	450	1147	0	1294	0	1476	0.536
1005-1	15W-40	<1	274	441	950	<1	1264	<1	1423	--
1005-4	15W-40	<1	256	544	1260	--	1162	9	1380	0.664
1005-5	15W-40	<1	250	529	1201	--	1201	<1	1433	0.568
1006	5W-30	0	99	1033	486	0	1007	150	1122	--
1006-1	5W-30	<1	106	846	495	<1	894	126	1156	--
1006-2	5W-30	<1	157	890	450	<1	1075	197	1274	--
1007	5W-30	0	50	82	991	1	1004	<5	1191	--
1009	5W-30	<1	<1	1773	0	70	998	<5	1051	--
1009-1	5W-30	<1	<1	1792	3	55	902	<5	1012	0.260
1010	5W-20	<1	246	2070	8	40	751	<1	828	0.271
1010-1	5W-20	<1	217	2054	8	40	761	<1	861	0.284
1011	0W-16	<1	232	2043	9	82	741	<1	876	0.295

Oil	Vis Grade	D445		D5293 CCS	Sulf. Ash	TBN
		cSt				
		Vis@40 Deg C	Vis@100 Deg C	cP / Deg C	wt%	mgKOH/g
221	0W-16	38.3	7.4	5101/-35	--	5.47
224	5W-30	56.5	10.13	4267	--	8.10
270	5W-30	57.3	9.8	5389/-30	--	5.99
271	5W-30	58.6	10.0	6350/-30	--	8.93
300	5W-30	61.4	10.5	5991/-30	--	5.93
433	5W-30	59.9	10.3	2388/-25	0.94	6.78
433-1	5W-30	60.2	10.3	5538/-30	1.02	3.00
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	45.3	8.16	5067/-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	48.2	8.9	5708/-35	--	5.34
542-2	0W-20	47.2	8.8	6101/-35	--	5.35
544	5W-30	57.7	10.4	3762/-39	--	6.75
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	116.9	15.3	7094/-20	1.04	8.86
821-2	15W-40	119.6	15.9	6711/-20	1.06	8.12
821-3	15W-40	117.6	15.8	6611/-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
823	10W-30	64.3	9.91	6264/-25	1.08	7.48
830 (PC-9E)	15W-40	113.9	15.3	3324/-15	--	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

Oil	Vis Grade	D445		D5293	Sulf. Ash	TBN
		cSt		CCS		
		Vis@40 Deg C	Vis@100 Deg C	cP / Deg C	wt%	mgKOH/g
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	8.86
831-3	15W-40	103.0	14.0	6205/-20	0.89	8.26
831-4	15W-40	103.4	13.94	6562/-20	0.85	7.61
832	15W-40	110.1	14.67	5704/-20	1.11	7.41
925-3	5W-30	72.0	11.3	2569/-25	0.73	6.90
940	5W-30	62.72	10.50	5867/-30	--	6.40
1001	15W-40	98.0	13.8	3250/-15	0.92	8.30
1004-2	15W-40	106.0	14.6	3283/-15	0.88	6.14
1004-3	15W-40	111.2	14.6	3314/-15	0.94	5.94
1005	15W-40	117.9	15.8	2966/-15	0.85	8.00
1005-1	15W-40	120.1	15.8	2863/-15	1.11	4.80
1005-2	15W-40	119	15.7	3281/-15	0.77	6.10
1005-3	15W-40	116.7	15.8	5480/-20	0.95	7.56
1005-4	15W-40	119.3	15.8	5679/-20	1.08	8.23
1005-5	15W-40	112.6	15.5	5299/-20	1.02	8.15
1006	5W-30	59.8	10.1	3081/-25	0.79	6.50
1006-1	5W-30	59.0	10.1	6056/-30	0.83	6.80
1006-2	5W-30	58.8	10.1	6424/-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
1009-1	5W-30	63.75	10.58	6115/-30	0.76	5.45
1010	5W-20	45.8	8.5	3340/-30	1.01	6.27
1010-1	5W-20	47.1	9.3	3706/-30	--	6.45
1011	0W-16	37.8	7.3	5380/-35	--	6.93