



# 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 <sup>a</sup> 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 <sup>a</sup> Introduced |
|--------------|-----------------|----------------------------|------------------------------|
| 434          | 5W-30           | na <sup>b</sup>            | 2003                         |
| 435          | 5W-20           | na <sup>b</sup>            | 2003                         |
| 438          | 5W-20           | SL                         | 2002                         |

### SEQUENCE IIIH

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

### SEQUENCE IVA

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

### SEQUENCE IVB

| TMC Oil Code | Viscosity Grade | Performance Classification | Year <sup>a</sup> Introduced |
|--------------|-----------------|----------------------------|------------------------------|
| 300          | 5W-30           | na <sup>b</sup>            | 2015                         |
| 1011         | 0W-16           | GF-5                       | 2017                         |
| 1012         | 5W-20           | na <sup>b</sup>            | 2017                         |

### SEQUENCE VG

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

**SEQUENCE VIB**

| Oil Code<br>TMC | Viscosity<br>Grade | Performance<br>Classification | Year <sup>a</sup><br>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<br>TMC | Viscosity<br>Grade | Performance<br>Classification | Year <sup>a</sup><br>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<br>TMC | Viscosity<br>Grade | Performance<br>Classification | Year Introduced |
|-----------------|--------------------|-------------------------------|-----------------|
| 940             | 5W-30              | na <sup>b</sup>               | 2018            |
| 1009            | 5W-30              | GF-3                          | 2017            |
| 1011            | 0W-16              | na <sup>b</sup>               | 2015            |

### Sequence IX

| Oil Code TMC | Viscosity Grade | Performance Classification | Year Introduced |
|--------------|-----------------|----------------------------|-----------------|
| 221          | 0W-16           | na <sup>b</sup>            | 2015            |
| 222          | 10W-30          | na <sup>b</sup>            | 2015            |
| 224          | 5W-30           | na <sup>b</sup>            | 2018            |

### Sequence X

| Oil Code TMC | Viscosity Grade | Performance Classification | Year Introduced |
|--------------|-----------------|----------------------------|-----------------|
| 270          | 5W-30           | GF-5                       | 2015            |
| 271          | 5W-30           | na <sup>b</sup>            | 2015            |
| 1011         | 0W-16           | na <sup>b</sup>            | 2015            |

### Sequence VIE

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

### Sequence VIF

| Oil Code<br>TMC | Viscosity<br>Grade | Performance<br>Classification | Year <sup>a</sup><br>Introduced |
|-----------------|--------------------|-------------------------------|---------------------------------|
| 542             | 0W-20              | GF-5                          | 2008                            |
| 543             | 0W-16              | GF-5                          | 2015                            |
| 1011            | 0W-16              | GF-5                          | 2015                            |

### SEQUENCE VIII

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

**1M-PC**

| Oil Code<br>TMC | Viscosity<br>Grade | Performance<br>Classification | Year <sup>a</sup><br>Introduced |
|-----------------|--------------------|-------------------------------|---------------------------------|
| 873             | 40                 | CD                            | 1993                            |

**1K**

| Oil Code |     | Viscosity<br>Grade | Performance<br>Classification | Year <sup>a</sup><br>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<br>Grade | Performance<br>Classification | Year <sup>a</sup><br>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/<br>CF/CF-4/CD        | 1993                            |



**1P**

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

**1R**

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

**COAT**

| TMC Oil Code | Viscosity Grade | Performance Classification | Year <sup>a</sup> 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 <sup>a</sup> Introduced |
|--------------|-----------------|----------------------------|------------------------------|
| 1005         | 15W-40          | na <sup>b</sup>            | 1993                         |

**T-11**

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

**T-12/ T-12A**

| TMC Oil Code | Viscosity Grade | Performance Classification | Year <sup>a</sup> Introduced |
|--------------|-----------------|----------------------------|------------------------------|
| 821, PC10E   | 15W-40          | na <sup>b</sup>            | 2005                         |

**T-13**

| TMC Oil Code | Viscosity Grade | Performance Classification | Year <sup>a</sup> Introduced |
|--------------|-----------------|----------------------------|------------------------------|
| 823, PC11A   | 10W-30          | na <sup>b</sup>            | 2015                         |

### ROLLER FOLLOWER WEAR TEST

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

### ISB

| TMC Oil Code | Viscosity Grade | Performance Classification | Year <sup>a</sup> Introduced |
|--------------|-----------------|----------------------------|------------------------------|
| 831, PC10B   | 15W-40          | na <sup>b</sup>            | 2005                         |

### ISM

| TMC Oil Code | Viscosity Grade | Performance Classification | Year <sup>a</sup> Introduced |
|--------------|-----------------|----------------------------|------------------------------|
|              | 830, PC-9E      | 15W-40                     | na <sup>b</sup>              |

### C13

| Oil Code   |     | Viscosity Grade | Performance Class | Year <sup>a</sup> Introduced |
|------------|-----|-----------------|-------------------|------------------------------|
| TMC        | CRC | Grade           | Class             | Introduced                   |
| 831, PC10B |     | 15W-40          | na <sup>b</sup>   | 2005                         |

### ENGINE OIL AERATION TEST

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

### DD13

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

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

| TMC Oil Code | Viscosity Grade | Year <sup>a</sup> Introduced |
|--------------|-----------------|------------------------------|
| 123          | 90              | 1995                         |
| 151          | 80W-90          | 1993                         |
| 155          | 90              | 2006                         |

**L-33-1**  
**Gear Version AAM K2XX**

| TMC<br>Oil Code | Viscosity<br>Grade | Year <sup>a</sup><br>Introduced |
|-----------------|--------------------|---------------------------------|
| 123             | 90                 | 1995                            |
| 155             | 90                 | 2006                            |

**L-37**

| TMC<br>Oil Code | Viscosity<br>Grade | Year <sup>a</sup><br>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<br>Oil Code | Viscosity<br>Grade | Year <sup>a</sup><br>Introduced |
|-----------------|--------------------|---------------------------------|
| 134             | 80W-90             | 2007                            |
| 152             | 75W-90             | 2004                            |
| 155             | 90                 | 2006                            |

**L-42**

| TMC<br>Oil Code | Viscosity<br>Grade | Year <sup>a</sup><br>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 <sup>a</sup> 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 <sup>a</sup> 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)<br>SEQ. VE (900 SERIES) |            |
|-------------------------------|-------------|-----|-----|----------------|--------------------|---|------------|
|                               | 1A          | 7I  | 8C  | 72A<br>472     | 404                | 424<br>924                                    | 425<br>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<br>BUICK | 3.8L - V6<br>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<br>Chevy V-8 |          |        |          | 225 CID<br>Six Cyl. Dodge | 3.8L<br>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)<br>L-38 (700 SERIES) |            |                                      |      |                   |                        |                                       |                                      |                                     |                                  |        |
|------------------------------|--|------------|--------------------------------------|------|-------------------|------------------------|---------------------------------------|--------------------------------------|-------------------------------------|----------------------------------|--------|
|                              | 901<br>702                                   | 907<br>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<br>63,000   |                        | 57,000                                | 83,000                               |                                     | 45,000                           |        |
| Engine Model and Size        | Ford<br>L-6<br>4.1L<br>(240 CID)             |            | Chrysler<br>L-6<br>3.7L<br>(225 CID) |      | Ford<br>Engines   | Ford<br>Engines        | Chevrolet<br>L-6<br>4.2L<br>(250 CID) | Plymouth<br>L-6<br>3.7L<br>(225 CID) | Chrysler<br>V-8<br>7.2<br>(440 CID) | Ford<br>L-6<br>4.9L<br>(300 CID) |        |
| Oil Change Interval, Miles   | 6,000  |            | 6,000                                |      | 5,000 &<br>10,000 |                        | 12,000                                | 6,000                                |                                     | 6,000                            | 15,000 |
| Filter Change Interval Miles | 12,000                                       |            | 6,000                                |      | 5,000 &<br>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<br>Field<br>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<br>424 | 923                              | 924<br>424                       | 924<br>424                                 | 925<br>425 | 925-2<br>425-2                             | 926  | 927 | 923                                       | 928 | 929 | 930                                 | 930-1                                      |
| Type of Service              | Taxicab                                    |            | Suburban Police                  |                                  | Taxicab                                    |            | Taxicab                                    | Taxicab                                    |     | Short Trip Commuter<br>(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-<br>48,000                | 30,000-<br>57,000                | 60,000                                     |            | 105,000                                    | 62,000                                     |     | 18,000                                    |     |     | 100,000                             | 105,000                                    |
| Engine Model and Size        | Chevrolet<br>1981 V-6<br>3.8L<br>(229 CID) |            | Ford<br>V-8<br>5.8L<br>(351 CID) | Ford<br>V-8<br>5.8L<br>(351 CID) | Chevrolet<br>1983 V-6<br>3.8L<br>(229 CID) |            | Chevrolet<br>1995 V-8<br>4.3L<br>(260 CID) | Chevrolet<br>1983 V-6<br>3.8L<br>(229 CID) |     | Ford<br>L-4<br>1.3L CVH<br>(79 CID)       |     |     | GM<br>1990 V-6<br>4.3L<br>(260 CID) | Chevrolet<br>1996 V-8<br>4.3L<br>(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<br>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     | --     | 3.9    | -36.4            | -37.8            | 3.03          | --          | -13.51     | 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  |
| 300-1        | 5W-30     | --     | --     | --               | --               | 3.04          | --          | --         | 36500@-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    |
| 1011-1 | 0W-16     | --     | --     | --               | --               | 2.28          | --          | --         | 18100@-40 NYS   |
| 1012   | 5W-20     |        |        |                  |                  | 2.68          |             |            | 9100@-35 NYS    |

| 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 |
| 1011-1 | 0W-16     | <1    | 235 | 2186 | 8    | 82  | 763  | <1  | 822  | --    |
| 1012   | 5W-20     | <1    | 106 | 2412 | 8    | 277 | 752  | <1  | 914  | --    |

| Oil          | Vis Grade | D445         |               | D5293<br>CCS | Sulf.<br>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    |
| 300-1        | 5W-30     | 60.8         | 10.25         | 5988/-30     | --           | 5.68    |
| 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    |
| 1011-1 | 0W-16     | 37.6         | 7.36          | 5153/-35   | --        | 6.66    |
| 1012   | 5W-20     | 47.5         | 8.38          | 4082/-30   | 1.04      | 7.32    |

