

1P – D 6681
Final Report Cover Sheet

Method
Version
Conducted For

| | |
|--|--|
| | V = Valid |
| | I = Invalid |
| | N = Results Cannot be Interpreted as Representative of Oil Performance (Non-Reference Oil) and Shall Not be Used in Determining an Average Test Result Using Multiple Test Criteria. |

| | |
|-------------------------|---------------|
| Test Number | |
| Test Stand: | Engine Run #: |
| EOT Time: | EOT Date: |
| Oil Code ^A : | |
| Formulation/Stand Code: | |
| Alternate Codes: | |

In my opinion this test _____ been conducted in a valid manner in accordance with the ASTM Test Method D 6681 and the appropriate amendments through the information letter system. The remarks included in this report describe the anomalies associated with this test.

^A CMIR or Non-Reference Oil Code

Submitted By: _____

Testing Laboratory

Signature

Typed Name

Title

**1P
Form 1
Test Report Summary**

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

| | | |
|------------------------|--------------------|-----------------------|
| Start Date: | Total Test Length: | TMC Oil Type: |
| Lab Internal Oil Code: | | Engine Serial Number: |

| | Correction Effective Date | WDP | TGC | TLC | Oil Consumption g/h | Transformed Oil Consumption | EOTOC g/h | Tranformed EOTOC |
|---|---------------------------|-----|-----|-----|---------------------|-----------------------------|-----------|------------------|
| Unadjusted Lab Rating | | | | | | | | |
| Industry Correction (If Any) | | | | | | | | |
| Subtotal | | | | | | | | |
| Lab Severity Adjustment (If Any) ^B | | | | | | | | |
| Total | | | | | | | | |

| | Correction Effective Date | WDP | TGC | TLC | Oil Consumption g/h | Transformed Oil Consumption | EOTOC g/h | Tranformed EOTOC |
|-------------------------------|---------------------------|-----|-----|-----|---------------------|-----------------------------|-----------|------------------|
| Test Target Mean ^A | | | | | | | | |
| Test Target STD ^A | | | | | | | | |
| API Limit ^B Pass | | | | | | | | |

| | Referee Lab | WDP | TGC | TLC | |
|-----------------|-------------|-----|-----|-----|--|
| Referee Ratings | | | | | |

| | Top | Int. 1 | Oil | Piston Crown | Piston Skirt | Liner |
|----------------------------------|-----|--------|-----|--------------|--------------|-------|
| Ring Loss of Side Clearance (mm) | | | | | | |
| Ring End Gap Increase (mm) | | | | | | |
| Is the Ring Stuck? | | | | | | |
| Scuffed Area % | | | | | | |
| Average Wear Step (µm) | | | | | | |
| % Bore Polish | | | | | | |

Notes: ^A Reference oil tests or as requested by test sponsor
^B Non-reference oil tests only

**1P
Form 2
Operational Summary**

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

| Controlled Parameters | Operating Parameter | Quality Index Threshold | EOT Quality Index | Process | | | Total Data Points | | |
|-----------------------|----------------------|-------------------------|-------------------|---------|--------|---------|----------------------|------------------|-------------------------------|
| | | | | Units | Target | Average | Samples ^A | BQD ^B | Over/Under Range ^C |
| | | | | | | | | | |
| | Engine Speed | 0.00 | | r/min | 1800 | | | | |
| | Fuel Flow | 0.00 | | g/min | 185 | | | | |
| | Humidity | 0.00 | | g/kg | 17.8 | | | | |
| | Coolant Flow | 0.00 | | L/min | 75 | | | | |
| | Temperature | | | | | | | | |
| | Coolant Out | 0.00 | | °C | 90 | | | | |
| | Oil To Manifold | 0.00 | | °C | 130 | | | | |
| | Inlet Air | 0.00 | | °C | 60 | | | | |
| | Fuel Into Head | 0.00 | | °C | 42 | | | | |
| | Pressures | | | | | | | | |
| | Oil To Manifold | 0.00 | | kPa | 415 | | | | |
| | Inlet Air (Absolute) | 0.00 | | kPa | 272 | | | | |
| | Exhaust (Absolute) | 0.00 | | kPa | 265 | | | | |
| | Fuel From Head | 0.00 | | kPa | 275 | | | | |

| NON-CONTROLLED PARAMETERS | Operating Parameter | Process | | | Total Data Points | | |
|---------------------------|---------------------|---------|----------------------------|---------|----------------------|------------------|-------------------------------|
| | | Units | Typical Range ^D | Average | Samples ^A | BQD ^B | Over/Under Range ^C |
| | | | | | | | |
| | Intake Air Flow | kg/h | 312-378 | | | | |
| | Power | kW | 53-57 | | | | |
| | Torque | Nm | 248-301 | | | | |
| | Blowby | L/min | 20-56 | | | | |
| | Temperature | | | | | | |
| | Coolant In | °C | 85-88 | | | | |
| | Coolant Delta T | °C | 2-6 | | | | |
| | Oil Cooler In | °C | 128-131 | | | | |
| | Heating Oil | °C | 165 maximum | | | | |
| | Exhaust | °C | 463-492 | | | | |
| | Pressures | | | | | | |
| | Crankcase | kPa | 0.09-0.3 | | | | |
| | Coolant to Jug | kPa | 64-92 | | | | |

^A Total number of data points taken as determined from test length and procedural specified sampling rate.

^B Number of Bad Quality Data points not used in the calculation of the statistical measures.

^C Number of points clipped by over/under range limits of the statistical measures.

^D Gathered from 1P Matrix Test data.

1P
Form 3
Assembly Measurements and Parts Record

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

| Assembly Measurements and Parts Record | |
|--|--|
| Injector Setting (GO / NO-GO) | |
| Was Timing Initialized? (YES/NO) | |
| Piston/Head Clearance mm | |
| Cam Gear Backlash mm | |
| Desired Fuel Timing °BTC | |
| Intake Valve Open °ATC | |
| Injector Plunger Lift mm @ 72° | |
| Intake Valve Lift mm @ 456° | |
| Exhaust Valve Lift mm @ 247° | |

| | Part Number | Serial Number | Date Code | Inspection Code |
|--------------------|-------------|---------------|-----------|-----------------|
| Liner | A | B | B | |
| Top Ring | C | E | | |
| Intermediate Ring | C | E | | |
| Oil Ring | C | E | | |
| Piston Crown | D | D | F | G |
| Piston Skirt | H | I | | |
| Fuel Injector | J | K | | |
| ECM EPROM | | | | |
| Piston Cooling Jet | | | | |

^A On liner O.D.

^B On liner O.D. (NNAN)

^C On box label

^D On top of piston

^E On paper envelope containing the ring

^F Number below "E" located on piston top

^G Number below "E" located on piston top

^H On bottom surface skirt

^I On bottom surface under pin bore

^J On top surface of plunger

^K On top surface of plunger

**1P
Form 4
Piston Rating Summary**

| | | | | | | | | | | | |
|---|--|---------------------------|-----------|-------------|--------|-----------------|---------|---------------------|-----------------------------|-----------|-------------------|
| Test Identification | | Lab: | EOT Date: | End Time: | Stand: | Run #: | Method: | | | | |
| Formulation/Stand Code: | | | | Oilcode: | | | | | | | |
| Test Fuel: | | Fuel Batch: | | Date Rated: | | Rater Initials: | | Verified By: | | | |
| Last Stand Reference Information | | Date Completed: | | Stand: | | Run: | | TMC Oil Code: | | | |
| | | WDP | | TGC | | TLC | | Oil Consumption g/h | Transformed Oil Consumption | EOTOC g/h | Transformed EOTOC |
| | | Last Reference this Stand | | | | | | | | | |
| | | Industry Average | | | | | | | | | |
| Industry STD | | | | | | | | | | | |

| Total Piston Ratings Summary | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------------|----------|------|-------|------------|-------|------|-------|------------------------|-------|------|-------|----------------------------|----------------|--------|------|---------------------------------|------|------|------|-------------|------|-------------|--|
| | Grooves | | | | | | | | Lands | | | | Deposit Factor | Groove | | Lands | | | | Oil Cooling | | Under Crown | |
| | No. 1 | | No. 2 | | No. 1 | | No. 2 | | No. 3 | | No. 3 | | | No. 4 | | A, % | | DEM. | | A, % | | DEM. | |
| | A, % | DEM. | A, % | DEM. | A, % | DEM. | A, % | DEM. | A, % | DEM. | A, % | DEM. | | A, % | DEM. | A, % | DEM. | A, % | DEM. | A, % | DEM. | | |
| C A R B O N | HC - 1.0 | | | | | | | | | | | | 7.5 | | | | | | | | | | |
| | MC - 0.5 | | | | | | | | | | | | | | | | | | | | | | |
| | LC - .25 | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | | | | | | | | | | |
| V A R I S H | 8 - 9 | | | | | | | | | | | | 4.5 | | | | | | | | | | |
| | 7 - 7.9 | | | | | | | | | | | | | | | | | | | | | | |
| | 6 - 6.9 | | | | | | | | | | | | | | | | | | | | | | |
| | 5 - 5.9 | | | | | | | | | | | | | | | | | | | | | | |
| | 4 - 4.9 | | | | | | | | | | | | | | | | | | | | | | |
| | 3 - 3.9 | | | | | | | | | | | | | | | | | | | | | | |
| | 2 - 2.9 | | | | | | | | | | | | | | | | | | | | | | |
| | 1 - 1.9 | | | | | | | | | | | | | | | | | | | | | | |
| | >0 - 0.9 | | | | | | | | | | | | | | | | | | | | | | |
| | Clean | | | | | | | | 0 | | | | | Clean | | 0 | | 0 | | | | 0 | |
| Total | | | | | | | | | | | | | | | | | | | | | | | |
| Rating | | | | | | | | | | | | | | | | | | | | | | | |
| Location Factor | | 2 | | 3 | | 1 | | 3 | | 20 | | 20 | | 60 | | 0.5 | | 1 | | | | | |
| Ind. Rating | | | | | | | | | | | | | | | | | | | | | | | |
| WDP | | | | TGC | | | | Top Land Carbon | | | | Unweighted Deposits | | | | Top Land Flaked Carbon % | | | | | | | |

1P
Form 4A
Piston Rating Worksheet

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

1P
Form 5
Supplemental Piston Deposits (Groove Sides and Rings)

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode: | | | |

| Deposit Type | | | Carbon | | | Varnish | | | | | | | | | |
|------------------------------------|---|----|--------|----|----|---------|---------|---------|---------|---------|---------|---------|---------|------|-------|
| | | | HC | MC | LC | 8 - 9 | 7 - 7.9 | 6 - 6.9 | 5 - 5.9 | 4 - 4.9 | 3 - 3.9 | 2 - 2.9 | 1 - 1.9 | >0 - | Clean |
| Groove Top and Bottom | 1 | T | | | | | | | | | | | | | |
| | | B | | | | | | | | | | | | | |
| | 2 | T | | | | | | | | | | | | | |
| | | B | | | | | | | | | | | | | |
| | 3 | T | | | | | | | | | | | | | |
| | | B | | | | | | | | | | | | | |
| Top Bottom and Back of Rings | 1 | T | | | | | | | | | | | | | |
| | | B | | | | | | | | | | | | | |
| | | BK | | | | | | | | | | | | | |
| | 2 | T | | | | | | | | | | | | | |
| | | B | | | | | | | | | | | | | |
| | | BK | | | | | | | | | | | | | |
| | 3 | T | | | | | | | | | | | | | |
| | | B | | | | | | | | | | | | | |
| | | BK | | | | | | | | | | | | | |

| Additional Deposit & Condition Ratings | |
|--|--|
| Piston Crown | |
| Piston Skirt | |
| Rings | |
| Liner | |

**1P
Form 5A
Referee Rating**

| | | | |
|-----------------------------------|----------------|-------------|---------|
| Test Identification | | | |
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run: | | |
| Formulation/Stand Code: | | | |
| Oilcode: | | | |
| Referee Rating Information | | | |
| Company: | Rating Number: | Date Rated: | Rater: |

| Total Piston Ratings Summary | | | | | | | | | | | | | | | | | | | | |
|---|----------------|---------|------|------------|------|-------|------|------------|------|----------------|--------|----------------------------|-------|------|-------|---------------------------------|---------------------|------|-------------|------|
| | Deposit Factor | Grooves | | | | Lands | | | | Deposit Factor | Groove | | Lands | | | | Oil Cooling Gallery | | Under Crown | |
| | | No. 1 | | No. 2 | | No. 1 | | No. 2 | | | No. 3 | | No. 3 | | No. 4 | | A,% | DEM. | A,% | DEM. |
| | | A,% | DEM. | A,% | DEM. | A,% | DEM. | A,% | DEM. | | A,% | DEM. | A,% | DEM. | A,% | DEM. | A,% | DEM. | A,% | DEM. |
| C A R B O N | HC - 1.0 | | | | | | | | | | | | | | | | | | | |
| | MC - 0.5 | | | | | | | | | | | | | | | | | | | |
| | LC - .25 | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | | | | | | | |
| V A R I A T I O N | 8 - 9 | | | | | | | | | | | | | | | | | | | |
| | 7 - 7.9 | | | | | | | | | 7.5 | | | | | | | | | | |
| | 6 - 6.9 | | | | | | | | | | | | | | | | | | | |
| | 5 - 5.9 | | | | | | | | | | | | | | | | | | | |
| | 4 - 4.9 | | | | | | | | | 4.5 | | | | | | | | | | |
| | 3 - 3.9 | | | | | | | | | | | | | | | | | | | |
| | 2 - 2.9 | | | | | | | | | | | | | | | | | | | |
| | 1 - 1.9 | | | | | | | | | 1.5 | | | | | | | | | | |
| | >0 - 0.9 | | | | | | | | | | | | | | | | | | | |
| | Clean | | 0 | | 0 | | 0 | | 0 | | | 0 | | 0 | | 0 | | 0 | | 0 |
| Total | | | | | | | | | | | | | | | | | | | | |
| Rating | | | | | | | | | | | | | | | | | | | | |
| Location Factor | | 2 | | 3 | | 1 | | 3 | | 20 | | 20 | | 60 | | 0.5 | | 1 | | |
| Ind. Rating | | | | | | | | | | | | | | | | | | | | |
| WDP | | | | TGC | | | | TLC | | | | Unweighted Deposits | | | | Top Land Flaked Carbon % | | | | |

**1P
Form 8
Ring Measurements**

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

All Ring Measurements Are Made Using Metric Feeler Gages

| Ring Gaps (mm) | Top | Intermediate | Oil |
|-----------------------|----------------------|----------------------|--------------------|
| Specifications | 0.724 \pm 0.076 mm | 0.673 \pm 0.076 mm | 0.51 \pm 0.13 mm |
| Pre-Test | | | |
| Post-Test | | | |
| Increase | | | |

| Ring Side Clearance* | | A | B | C | D | Average | Minimum | Specification |
|----------------------|-----------|---|---|---|---|---------|---------|---------------|
| Top | Pre-Test | | | | | | | 0.13+0.04 mm |
| | Post-Test | | | | | | | |
| | LSC | | | | | | | |
| Int. | Pre-Test | | | | | | | 0.18+0.04 mm |
| | Post-Test | | | | | | | |
| | LSC | | | | | | | |
| Oil | Pre-Test | | | | | | | 0.07 +0.02 mm |
| | Post-Test | | | | | | | |
| | LSC | | | | | | | |

* Notes:

1. Write "STUCK" in place of dimension when applicable.
2. Write "<0.038 mm " for clearance when applicable.
3. Write ">" before calculated decrease or average decrease values that incorporate a "<0.038 mm" in calculation.
4. LSC: Loss of Side Clearance
5. MIN: Intermediate and Oil Ring minimum side clearance is measured 360° around piston.

**1P
Form 9
Liner Measurements**

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

| Liner Surface Finish (Micrometer) | | | |
|--|------------|--------------|--|
| Distance From Top | Transverse | Longitudinal | Average |
| 130 mm | | | |
| 50 mm | | | |
| 25 mm | | | |
| | | | Total Average (Spec: 0.4-0.8 μ m) |

| %Liner Bore Polish - Grid (Add T/AT Values From Grid) | |
|--|--|
| Thrust | |
| Anti thrust | |
| Total | |

| Liner Bore Measurement (137.154mm minimum) | | | | |
|---|--------------|------------|------------------------------------|---|
| Before Test - Diameter (Dial Bore Gage) | | | | |
| Bore Height | Longitudinal | Transverse | Out of Round (0.038 mm maximum) | |
| 250 mm | | | | |
| 210 mm | | | | |
| 170 mm | | | | |
| 130 mm | | | | |
| 50 mm | | | | |
| 25 mm | | | | |
| 15 mm | | | | |
| Taper (0.050 max) | | | | |
| After Test - (Surface Profile) | | | | |
| | Longitudinal | | Transverse | |
| | Front | Rear | T | A |
| Wear Step @ 15mm | | | | |

1P
Form 10
Characteristics of the Data Acquisition System

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

| Parameter (1) | Sensing Device (2) | Calibration Frequency (3) | Record Device (4) | Observation Frequency (5) | Record Frequency (6) | Log Frequency (7) | System Response (8) |
|-----------------------------|-----------------------|------------------------------|----------------------|------------------------------|-------------------------|----------------------|------------------------|
| Operation Conditions | | | | | | | |
| Engine Speed (r/min) | | | | | | | |
| Engine Power (kW) | | | | | | | |
| Fuel Flow (g/min) | | | | | | | |
| Humidity (g/kg) | | | | | | | |
| Temperatures (°C) | | | | | | | |
| Coolant Out | | | | | | | |
| Coolant In | | | | | | | |
| Oil to Manifold | | | | | | | |
| Oil Cooler In | | | | | | | |
| Inlet Air | | | | | | | |
| Exhaust | | | | | | | |
| Fuel to Head | | | | | | | |
| Pressures (kPa) | | | | | | | |
| Oil To Manifold | | | | | | | |
| Inlet Air | | | | | | | |
| Exhaust | | | | | | | |
| Fuel to Head | | | | | | | |
| Crankcase | | | | | | | |
| Flows (L/min) | | | | | | | |
| Blowby | | | | | | | |
| Coolant Flow | | | | | | | |

Legend:

- (1) Operating Parameter
- (2) The type of device used to measure temperature, pressure or flow
- (3) Frequency at which the measurement system is calibrated
- (4) The type of device where data is recorded
 - LG – Hand log sheet
 - DL – Automatic data logger
 - C/M – Computer, using manual data entry

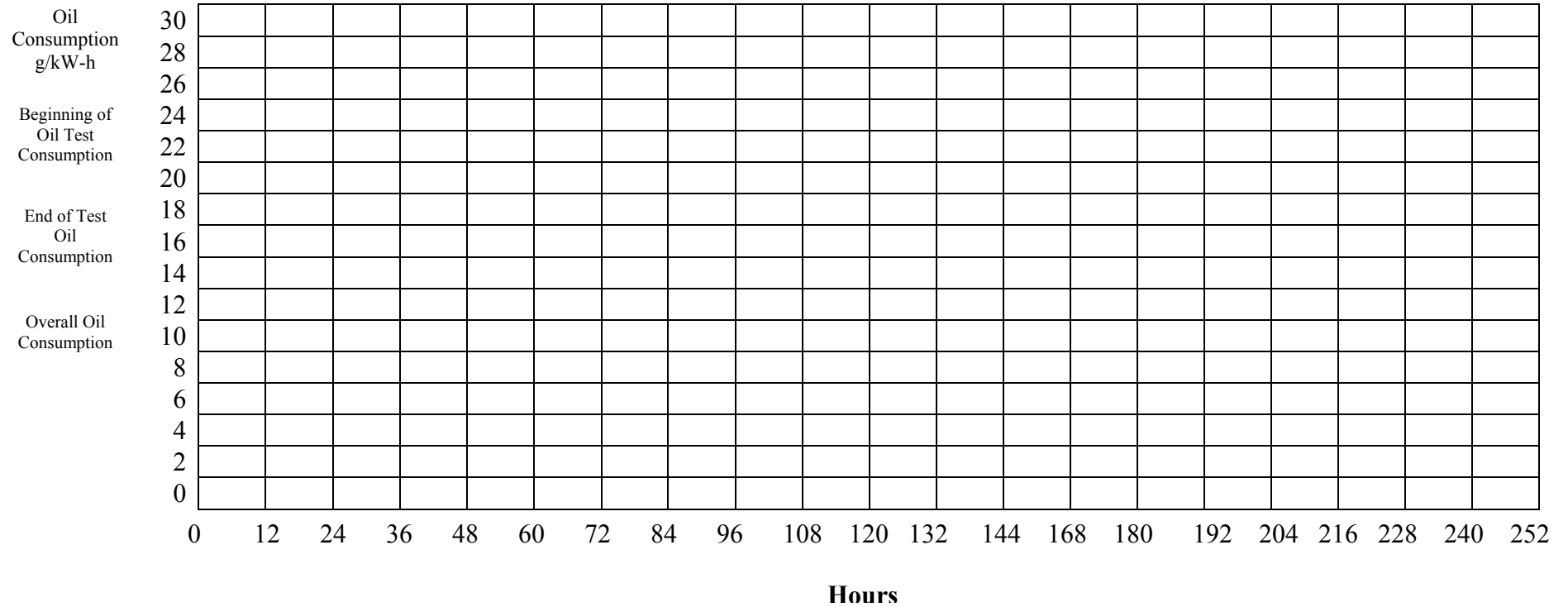
- (5) Data area observed but only recorded if off specification
- (6) Data are recorded but are not retained at EOT
- (7) Data are logged as permanent record, note specify if:
 - SS – Snapshot taken at specified frequency
 - AG/X average of x data points at specified frequency
- (8) Time for the output to reach 63.2% of final value for step change at input

1P
Form 11
Engine Operational Data Plots

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

1P
Form 13
Oil Consumption Plot

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |



1P
Form 14
Piston Ring and Liner Photographs

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

Refer to Appendix A14 for example of Photo Layout

1P
Form 16
Fuel Batch Analysis

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

1P
Form 17
TMC Control Chart Analysis
(Reference Oil Tests Only)

| | | | |
|-------------------------|-------------|-----------|---------|
| Lab: | EOT Date: | End Time: | Method: |
| Stand: | Run Number: | | |
| Formulation/Stand Code: | | | |
| Oilcode/CMIR: | | | |

1P
Form 18
American Chemistry Council Code of Practice
Test Laboratory Conformance Statement

| | | | | |
|--------------------------|--|------------|--|-----------|
| Test Laboratory | | | | |
| Test Sponsor | | | | |
| Formulation / Stand Code | | | | |
| Test Number | | | | |
| Start Date | | Start Time | | Time Zone |

Declarations

No. 1 All requirements of the ACC Code of Practice for which the test laboratory is responsible were met in the conduct of this test. Yes _____ No _____ *

No. 2 The laboratory ran this test for the full duration following all procedural requirements; and all operational validity requirements of the latest version of the applicable test procedure (ASTM or other), including all updates issued by the organization responsible for the test, were met.
 Yes _____ No _____ *

If the response to this Declaration is “No”, does the test engineer consider the deviations from operational validity requirements that occurred to be beyond the control of the laboratory?
 Yes _____ * No _____

No 3. A deviation occurred for one of the test parameters identified by the organization responsible for the test as being a special case. Yes _____ * No _____ *(This currently applies only to specific deviations identified in the ASTM Information Letter System)*

Check Appropriate Conclusion

| | |
|--|---|
| | Operational review of this test indicates that the results should be included in the Multiple Test Acceptance Criteria calculations. |
| | *Operational review of this test indicates that the results should not be included in the Multiple Test Acceptance Criteria calculations. |

Note: *Supporting comments are required for all responses identified with an asterisk.*

| Comments |
|-----------------|
| |
| |
| |
| |

Signature

Date

Typed Name

Title