

**A16. Report Forms**  
**Sequence VIII Engine Evaluation of Engine Oils**

**Form 1**

VERSION 20000128 BETA

CONDUCTED FOR

*TSTSPON1*

*TSTSPON2*

<i>LABVALID</i>	V = VALID
	I = INVALID

<i>TSTOIL</i>	NR = Non-reference Oil Test
	RO = Reference Oil Test

Test Number			
Test Stand	Power Section	# of Runs on Power Section Since Calibration Test	Total Runs on Power Section
<i>STAND</i>	<i>ENGINE</i>	<i>ENRUNSR</i>	<i>TOTENRUN</i>
Date Completed: <i>DTCOMP</i>		Completion Time: <i>EOTTIME</i>	
Oil Code: <i>OILCODE</i>			
Formulation/Stand Code: <i>FORM</i>			
Alternate Codes:	<i>ALTCODE1</i>	<i>ALTCODE2</i>	<i>ALTCODE3</i>

In my opinion this test *OPVALID* been conducted in a valid manner in accordance with the Sequence VIII Test Method D6709 and the appropriate amendments through the information letter system. The remarks included in this report describe the anomalies associated with this test.

*SUBLAB*  
 \_\_\_\_\_  
 Testing Laboratory  
*SUBSIGIM*  
 \_\_\_\_\_  
 Signature  
*SUBNAME*  
 \_\_\_\_\_  
 Typed Name  
*SUBTITLE*  
 \_\_\_\_\_  
 Title

FIG. A16.1 Operational Validity Statement

## Form 2

### Sequence VIII Engine Evaluation of Engine Oils

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# Sequence VIII Engine Evaluation of Engine Oils

## Form 3

### Summary of Test Method

The Sequence VIII test is designed to evaluate crankcase lubricating oils for their copper and lead corrosion control capabilities. It also evaluates shear stability under high temperature operating conditions.

The Sequence VIII involves steady state operation of the single cylinder CLR oil evaluation engine. After a 4 hour break-in and a 1/2 hour flush, the engine is operated under constant speed, air-fuel ratio and fuel flow conditions for an additional 40 hours. Prior to each run, the engine is thoroughly cleaned, and pertinent measurements of the engine parts are taken. A new piston, piston rings, copper/lead connecting rod bearing are installed. The cylinder head is also reconditioned.

The key operating conditions for this procedure are as follows:

Parameter	Set Point
Duration	40 h
Speed	3150 ± 25 r/min
Load	Adjusted to provide proper fuel flow at the specified Air:Fuel ratio
Fuel Flow	2.25 ± 0.11 kg/h
Air:Fuel Ratio	13.43 ± 0.5
Coolant Temperature	
Jacket Out	93.5 ± 1°C
Jacket Delta	5.6 ± 1°C
Gallery Oil Temperature	135.0 or 143.5 ± 1°C <sup>B</sup>
Crankcase Off Gas	850 ± 28 SCL/h <sup>A</sup>

<sup>A</sup> Controlled by adding sufficient ambient air to rocker box to achieve an Off-Gas-Flow of 30 cfh.

<sup>B</sup> 135.0°C for SAE 5W, 10W; 143.5°C for SAE 20, 30, 40, 50 and multi-viscosity grade oils.

This test utilizes an unleaded fuel named "KA24E" which has a green identifying dye. It is supplied by Haltermann Products.

At the conclusion of the test, the engine is disassembled and the performance of the oil being tested is judged by the following:

- 1) by the weight loss of the copper/lead big end connecting rod bearing
- 2) by periodic oil sample analysis

**Sequence VIII Engine Evaluation of Engine Oils  
Form 4  
Test Results**

Laboratory	<i>LAB</i>	Oilcode	<i>OILCODE</i>
Date Completed	<i>DTCOMP</i>	Time Completed	<i>EOTTIME</i>
Test Number	<i>STAND / ENGINE / ENRUNSR / TOTENRUN</i>		
Formulation/Stand	<i>FORM</i>		

SAE Viscosity	<i>SAEVISC</i>	Test Oil Temperature (135.0° or 143.5°C)	<i>OILTEMP</i>
Laboratory Oil Code	<i>LABOCODE</i>	Date Started	<i>DTSTRT</i>
Test Fuel Type	<i>FUELTYPE</i>	Time Started	<i>STRTIME</i>
Test Fuel Lot	<i>FUELBTID</i>	Bearing Batch No.	<i>BEARBAT</i>
Bearing Storage Oil Lead, ppm <sup>A</sup>	<i>BEARLEAD</i>	Bearing Lot	<i>BEARLOT</i>
Test Length	<i>TESTLEN</i>	Industry Reference Oil Code <sup>A</sup>	<i>IND</i>

Bearing Weight Loss Summary	
Test Length @ Measurement, hours	<i>TST_H040</i>
Top Bearing Half, mg	<i>BWLTH040</i>
Bottom Bearing Half, mg	<i>BWLBH040</i>
Total, mg	<i>TBWLH040</i>
Industry Correction Factor	<i>BWL_CF</i>
Severity Adjustment (non-reference tests only)	<i>BWL_SA</i>
Final Bearing Weight Loss, mg	<i>BWLFNL</i>

Hours	Viscosity cSt @ 40°C	Viscosity cSt @ 100°C	Stripped Viscosity @ 100°C
New Oil	<i>VIS_HNEW</i>	<i>VISIHNEW</i>	
10	<i>VIS_H010</i>	<i>VISIH010</i>	<i>SVIS100</i>

Test Stand/Power Section Reference History					
Stand No.	<i>RSTAND</i>	Power Section No.	<i>ENGINE</i>	Runs on Power Section	<i>RTOTRUN</i>
Bearing Batch No.			<i>RBEARBAT</i>	Bearing Lot No.	<i>RBEARLOT</i>
Industry Reference Oil Code			<i>RIND</i>	Stripped Viscosity, cSt	<i>RSVIS100</i>
Completion Date			<i>RDTCOMP</i>	Completion Time	<i>REOTTIME</i>
Total Bearing Weight Loss, mg			<i>RTBWH040</i>	Final Bearing Weight Loss, mg	<i>RBWLFNL</i>
Oil Code			<i>ROILCODE</i>		

<sup>A</sup> Reference Oil Tests Only

FIG. A16.4 Test Results

**Sequence VIII Engine Evaluation of Engine Oils**  
**Form 5**  
**Operational Summary**

Laboratory	<i>LAB</i>	Oil Code	<i>OILCODE</i>
Date Completed	<i>DTCOMP</i>		
Test No.	<i>STAND / ENGINE / ENRUNSR / TOTENRUN</i>		
Formulation/Stand	<i>FORM</i>		

Test Parameter	Specification	Minimum	Maximum	Average
Speed, r/min	3150 ± 25	<i>IRPM</i>	<i>XRPM</i>	<i>ARPM</i>
Air/Fuel Ratio	13.43 ± 0.5:1	<i>IAFR</i>	<i>XAFR</i>	<i>AAFR</i>
Fuel Flow, kg/h	2.25 ± 0.11	<i>IFFLO</i>	<i>XFFLO</i>	<i>AFFLO</i>
Output, W	Record	<i>IPWR</i>	<i>XPWR</i>	<i>APWR</i>
Oil Heater Input, W (optional)	Record	<i>IOHTRIN</i>	<i>XOHTRIN</i>	<i>AOHTRIN</i>
Crankcase Off-Gas, L/h	850 ± 28	<i>ICCOG</i>	<i>XCCOG</i>	<i>ACCOG</i>
Temperatures	Specification	Minimum	Maximum	Average
Gallery Oil <sup>A</sup> , °C	143.5 or 135.0 ± 1	<i>IGALT</i>	<i>XGALT</i>	<i>AGALT</i>
Coolant-In, °C	Record	<i>ICOLIN</i>	<i>XCOLIN</i>	<i>ACOLIN</i>
Coolant-Out, °C	93.5 ± 1	<i>ICOLOUT</i>	<i>XCOLOUT</i>	<i>ACOLOUT</i>
Delta T Coolant, °C	5.6 ± 1	<i>ICOLDT</i>	<i>XCOLDT</i>	<i>ACOLDT</i>
Intake Air, °C	Record	<i>IINAIRT</i>	<i>XINAIRT</i>	<i>AINAIRT</i>
Pressures	Specification	Minimum	Maximum	Average
Oil, kPa	276 ± 14	<i>IOILPRS</i>	<i>XOILPRS</i>	<i>AOILPRS</i>
Intake Man. Vac., kPa	Record	<i>IIMNVAC1</i>	<i>XIMNVAC1</i>	<i>AIMNVAC1</i>
Exhaust, in. kPa	0 to 3.4	<i>IEXPR</i>	<i>XEXPR</i>	<i>AEXPR</i>
Crankcase Vac., kPa	0.50 ± 0.12	<i>ICCV</i>	<i>XCCV</i>	<i>ACCV</i>
Spark Advance, °BTDC	35 ± 1	<i>ISPKTIM</i>	<i>XSPKTIM</i>	<i>ASPKTIM</i>
Blowby, L/h	Record	<i>IBLOBY</i>	<i>XBLOBY</i>	<i>ABLOBY</i>

Oil Consumption <sup>B</sup>	Initial Oil Charge (ml)	New Oil Added (ml)	Oil Samples (ml)	Final Oil Drain (ml)
	<i>OILINIT</i>	<i>OILADD</i>	<i>OILSMPL</i>	<i>OILDRAIN</i>
Total Oil Consumption				<i>OILCON</i>

<sup>A</sup> (See Table 1 for Viscosity-Related Temperature.)

<sup>B</sup> Total Oil Consumption = (Initial Oil Charge + New Oil Added) - (Oil Samples + Final Oil Drain)

FIG. A16.5 Operational Summary

**Sequence VIII Engine Evaluation of Engine Oils  
Form 6  
Parts Measurement and Critical Parts Listing**

Laboratory	<i>LAB</i>	Oil Code	<i>OILCODE</i>
Date Completed	<i>DTCOMP</i>		
Test Number	<i>STAND / ENGINE / ENRUNSR / TOTENRUN</i>		
Formulation/Stand	<i>FORM</i>		

<b>Power Section Measurements, mm</b>				
Measurement	Specification	Minimum	Maximum	Average
Valve Stem Clearance in Guide, Inlet	0.0508 - 0.1016	<i>IVSCIN</i>	<i>XVSCIN</i>	<i>AVSCIN</i>
Valve Stem Clearance in Guide, Exhaust	0.0762 - 0.1270	<i>IVSCEX</i>	<i>XVSCEX</i>	<i>AVSCEX</i>
Connecting Rod Bearing Clearance	0.0610 - 0.0762	<i>ICRODCL</i>	<i>XCRODCL</i>	<i>ACRODCL</i>
Main Bearing Clearance, Front	0.0508 - 0.0762	<i>IMBCF</i>	<i>XMBCF</i>	<i>AMBCF</i>
Main Bearing Clearance, Rear	0.0508 - 0.0762	<i>IMBCR</i>	<i>XMBCR</i>	<i>AMBCR</i>
Connecting Rod Journal Out-of-Round	0.0254 Maximum		<i>XCRODOR</i>	

Runs on Liner	<i>LINRUN</i>	Liner may be used as long as the piston to liner clearance is in the specified range.
Piston to Liner Clearance	<i>PISLINCL</i>	0.0305 to 0.0635 mm

<b>Critical Parts Listing</b>	
Parts	I.D. Code
Crankshaft	<i>CRANKID</i>
Camshaft	<i>CAMSN</i>
Main Bearings	<i>MBEARID</i>
Camshaft Bearings	<i>CAMBRID</i>
Connecting Rod	<i>CRODID</i>
Piston	<i>PISTSN</i>
Cylinder Liner	<i>CLINID</i>

FIG. A16.6 Parts Measurement, Oil Analysis, and Critical Parts Listing

**Sequence VIII Engine Evaluation of Engine Oils  
Form 7  
Downtime Occurrences and Other Comments**

Laboratory	<i>LAB</i>	Oil Code	<i>OILCODE</i>
Date Completed	<i>DTCOMP</i>		
Test Number	<i>STAND</i>	<i>/ ENGINE</i>	<i>/ ENRUNSR</i> / <i>TOTENRUN</i>
Formulation/Stand	<i>FORM</i>		

Number of Downtime Occurrences			<i>DWNOCR</i>
Test Hours	Date	Downtime	Reasons
<i>DOWNR001</i>	<i>DDATR001</i>	<i>DTIMR001</i>	<i>DREAR001</i>
		<i>TOTLDOWN</i>	Total Downtime

Other Comments	
Number of Comment Lines	<i>TOTCOM</i>
<i>OCOMR001</i>	

FIG. A16.7 Downtime Occurrences and Other Comments

**Sequence VIII Engine Evaluation of Engine Oils**  
**Form 8**  
**Operational Outliers Occurrences**

Laboratory	<i>LAB</i>	Oil Code	<i>OILCODE</i>
Date Completed	<i>DTCOMP</i>		
Test Number	<i>STAND / ENGINE / ENRUNSR / TOTENRUN</i>		
Formulation/Stand	<i>FORM</i>		

Number of Operational Outliers Occurrences <i>OUTOCR</i>					
Test Hours	Parameter	Parameter Range	Reading	Time Out	Deviation Percentage
<i>OUT_R001</i>	<i>OUTPR001</i>	<i>OPARR001</i>	<i>OREDRO01</i>	<i>OTIMR001</i>	<i>ODP_R001</i>

FIG. A16.8 Operational Outliers Occurrences



**Sequence VIII Engine Evaluation of Engine Oils  
Form 9  
Deviations of Operational Parameters**

Laboratory	<i>LAB</i>	Oil Code	<i>OILCODE</i>
Date Completed	<i>DTCOMP</i>		
Test Number	<i>STAND</i>	<i>/ ENGINE</i>	<i>/ ENRUNSR</i> / <i>TOTENRUN</i>
Formulation/Stand	<i>FORM</i>		

<b>Primary Parameter</b>	Maximum Permitted Deviation Percentage	Calculated Total Deviation Percentage
Engine Oil Gallery Temperature	2.5%	<i>GALTDP</i>
Engine Coolant Outlet Temperature	2.5%	<i>COLOUTDP</i>
Engine Coolant Delta Temperature	2.5%	<i>COLDTDP</i>
Fuel Flow	2.5%	<i>FFLODP</i>
Crankcase Off Gas	2.5%	<i>CCOGDP</i>
Oil Pressure	2.5%	<i>OILPDP</i>
<b>Secondary Parameters</b>		
Engine Speed	5%	<i>RPMDP</i>
AFR	5%	<i>AFRDP</i>
Spark Advance	5%	<i>SPRKADP</i>
Exhaust	5%	<i>EXPRDP</i>
Crankcase Vacuum	5%	<i>CCVACDP</i>

FIG. A16.9 Deviations of Operational Parameters

**Sequence VIII Engine Evaluation of Engine Oils  
Form 10  
Data Acquisition System Details**

Laboratory	<i>LAB</i>	Oil Code	<i>OILCODE</i>
Date Completed	<i>DTCOMP</i>		
Test Number	<i>STAND / ENGINE / ENRUNSR / TOTENRUN</i>		
Formulation/Stand	<i>FORM</i>		

PARAMETER (1)	SENSING DEVICE (2)	CALIBRATION FREQUENCY (3)	RECORD DEVICE (4)	OBSERVATION FREQUENCY (5)	RECORD FREQUENCY (6)	LOG FREQUENCY (7)	SYSTEM RESPONSE (8)
<b>TEMPERATURES</b>							
OIL IN	<i>OILSENS</i>	<i>OILCALF</i>	<i>OILIRECD</i>	<i>OILIOBSF</i>	<i>OILIRECF</i>	<i>OILILOGF</i>	<i>OILISYSR</i>
COOLANT OUT	<i>COTSENS</i>	<i>COTCALF</i>	<i>COTRECD</i>	<i>COTOBSF</i>	<i>COTRECF</i>	<i>COTLOGF</i>	<i>COTSYSR</i>
COOLANT DELTA	<i>COLDSENS</i>	<i>COLDCALF</i>	<i>COLDRECD</i>	<i>COLDOBSF</i>	<i>COLDRECF</i>	<i>COLDLOGF</i>	<i>COLDSYSR</i>
<b>OTHER</b>							
FUEL FLOW	<i>FFLOSENS</i>	<i>FFLOCALF</i>	<i>FFLORECD</i>	<i>FFLOBSF</i>	<i>FFLORECF</i>	<i>FFLOLOGF</i>	<i>FFLOSYSR</i>
ENGINE SPEED	<i>RPMSSENS</i>	<i>RPMCALF</i>	<i>RPMRECD</i>	<i>RPMOBSF</i>	<i>RPMRECF</i>	<i>RPMLOGF</i>	<i>RPMSYSR</i>
AFR	<i>AFRSENS</i>	<i>AFRCALF</i>	<i>AFRRECD</i>	<i>AFROBSF</i>	<i>AFRRECF</i>	<i>AFRLOGF</i>	<i>AFRSYSR</i>
EXHAUST PRESSURE	<i>EXPRSENS</i>	<i>EXPRCALF</i>	<i>EXPRECD</i>	<i>EXPROBSF</i>	<i>EXPRECF</i>	<i>EXPRLOGF</i>	<i>EXPRSYSR</i>
CRANKCASE OFF GAS	<i>CCOGSENS</i>	<i>CCOGCALF</i>	<i>CCOGRECD</i>	<i>CCOGOBSF</i>	<i>CCOGRECF</i>	<i>CCOGLOGF</i>	<i>CCOGSYSR</i>
OIL	<i>OPSISENS</i>	<i>OPSIKALF</i>	<i>OPSIRECD</i>	<i>OPSIOBSF</i>	<i>OPSIRECF</i>	<i>OPSILOGF</i>	<i>OPSIYSR</i>
CRANKCASE VAC.	<i>CCVSENS</i>	<i>CCVCALF</i>	<i>CCVRECD</i>	<i>CCVOBSF</i>	<i>CCVRECF</i>	<i>CCVLOGF</i>	<i>CCVYSR</i>

**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 - HANDLOG SHEET  
 DL - AUTOMATIC DATA LOGGER  
 SC - STRIP CHART RECORDER  
 C/M - COMPUTER, USING MANUAL DATA ENTRY  
 C/D - COMPUTER, USING DIRECT I/O ENTRY
- (5) DATA ARE OBSERVED BUT ONLY RECORDED IF OFF SPEC
- (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
- (9) SEE ANNEX A11 FOR PROCEDURE TO DETERMINE SYSTEM RESPONSE OF THE CHARACTERISTICS OF THE ACQUISITION SYSTEM.

FIG. A16.10 Data Acquisition System Details