


Reply to:

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**ASTM Sequence VG Operations and Hardware Sub panel Meeting**

**March 18, 2003**

**9:00 am – 5:00 pm**

**Detroit, Michigan**

**Meeting Secretary**

Beto Araiza took the minutes for this meeting.

**Motion and Action recorder**

Bill Buscher recorded action items and motions. (See Attachment 1)

**Approval of Minutes for September 17, 2002 Meeting**

Motion by Dan Worcester and seconded by Jerry Brys.

**Membership changes**

There were no memberships changes announced. Ron Walker was representing Valvoline for Tim Caudill. (See Attachment 2)

**Review of Actions Items from last Meeting**

Dan Worcester reported on the piston chamfers for the .1275, .2500, and .3750 pistons. The pistons need to be manufactured from Federal Mogul with a tighter specification on chamfers. TEI will order the 0.1275 and 0.3750 pistons with 0.400 mm  $\pm$  0.050 mm on chamfers. After the engine kits are delivered from Ford Power Products the pistons chamfers will be measured on the 0.2500 and 0.500 mm pistons. If piston chamfers are not within specifications the committee will take corrective actions in resolving any chamfer problem.

**VG Romeo / AER Matrix**

(A) Dan presented the VG Romeo/AER Matrix build information (See Attachment 3). Rich Grundza presented the Analysis of the Sequence VG Prove-Out Matrix by Philip Scinto (See Attachment 4). Bill Buscher presented data on VG fuel dilution wt. % and 4.6 Romeo Production Engines with Romeo Blocks/AER heads with bearing inserts (See attachment 5).

(B) TEI will coordinate a head build up at AER using AER heads. The target date for head rebuild will be at the end of May at AER.

(C) Dwight Bowden will continue polishing camshafts for VG testing.

(D) Camshaft bearing for the rebuilt heads will be available from TEI.

(E) Dan Worcester reported on two bore gauges to use for the VG camshaft bushing measurements. Mitutoyo part number MT80-568-XXX where XXX is the hole diameter that requires three 8" extensions, and the Fowler XT Holematic part number NA55-54566 XXX where XXX is the hole diameter. This gauge also requires three extensions.

(F) The matrix results from the VG Romeo engine in comparison to VG AER engine were determined to be within tolerances; however there were several build issues: (1) Some labs are taking the piston diameter measurements at center of pin bore, but according to Ford specifications the measurements need to be at 42 mm down from the top of piston. (2) Some labs are cleaning blocks using the power washer then air drying block while other labs are using the Pen-mule wash then spraying engines with 50/50 mix Stoddard solvent and EF-411. (3) Another topic was the difference in O2 sensors. Parts kits will come with the 9F422 sensor; however Dan said the FOSF-9P472-8A can work just as good as the 9F422 sensors. The difference is on the location of the sensors. Some labs have their sensors located at the elbow of the exhaust manifold while other labs have their sensor located at the straight end on the exhaust pipe. (4) Bill Buscher presented engine block preparation and honing procedures for the VG Romeo engines (See attachment 6). Labs are required to document build practices conducted with the 2000 model year hardware by May 2003 Surveillance Panel meeting. A VG engine build workshop will be scheduled during the summer in order to correct engine build differences.

(G) According to Dan there are a total of 112 AER engines available for testing. A redistribution of engines could last until the end of November 2003. Once all AER engines are exhausted all labs will be required to switch over to the Romeo engines. A small task force will be formed to address the issue of redistribution of VG AER engines between now and May's Surveillance Panel meeting in order to establish a system for redistribution.

(H) The Romeo engines will have 4 runs per block with TEI supplying the 0.1275 and 0.3750 piston, rings, and gasket kits. Ford Power Products will supply the 0.2500 and .5000 pistons, rings and gasket kits.

#### **VG Wear Measurements**

Mike Riley still needs VG reference blocks for cylinder bore measurements. All reference blocks need to be sent back to Ford Power Products. Gordon Farnsworth asked Mike to share the data from the cylinder bore measurements and piston and ring wear at the May Surveillance Panel meeting.

#### **Hardware for Sequence Testing**

Mike Riley reported on AER's commitment to sell engines to testing laboratories (See attachment 7) and VG engine hardware availability. (See attachment 7A)

#### **Old Business**

None

#### **New Business**

None

#### **Adjourn**

Motion by Dan Worcester seconded by Bill Buscher. The next meeting will be at the call of the chairman.

## AGENDA

### Sequence VG Operations & Hardware Subpanel Meeting

March 18, 2003 (9:00AM – 5:00 PM)

Detroit Marriott, Romulus MI

1. Secretary for the O&H Meetings
2. Motion and Action Recorders
3. Approval of Minutes for September 17, 2002 Meeting
4. Membership Changes
5. Review Action Items from Last Meeting D. Worcester
6. VG Romeo/AER Matrix D. Worcester
  - a. Matrix Results
  - b. Rebuild of Current AER Heads
  - c. Polished Cam Journals
  - d. Type of Cam Bearings
  - e. Cam Bore Measurements
  - f. Build Problems at Labs
  - g. VG Kit Parts
  - h. Runs per Block
7. VG Wear Measurements M. Riley
  - a. Cylinder Bore
  - b. Follower Pins and Ring Wear
8. Hardware for Sequence Tests M. Riley
9. Old Business
10. New Business
11. Adjourn

Sequence VG Operations & Hardware  
Subpanel Meeting  
March 18, 2003 (9:00AM – 5:00 PM)  
Detroit Marriott, Romulus MI

Motions and Action Items

1. Establish a formal system for final redistribution of 1994 model year Sequence VG hardware, referencing of test stands and introduction of 2000 model year Sequence VG hardware. Have system finalized by May 2003 surveillance panel meeting.
2. Measure piston diameter at 42mm down from top of piston. Calculate cylinder bore diameter as the average of the three transverse bore measurements. Target a piston to cylinder bore clearance of 0.020 – 0.046 mm.  
Jerry Brys/Bill Buscher, Passed unanimously.
3. Labs to document build practices for the Sequence VG test conducted with the 2000 model year hardware by May 2003 surveillance panel meeting. SwRI to establish as list of items to include.
4. Instruct AER to only use new valve springs and valve guides on rebuilt cylinder heads.
5. O&H chairman to issue a monthly update on quantity by lab of 1994 model year Sequence VG hardware still on-hand.
6. Ford to investigate if the pistons supplied in the kits are from one batch or multiple batches and ask piston supplier if they mark the batch code identification on the pistons.
7. Coordinate and schedule first AER cylinder head build for industry. Request that AER use their cores for the first build.
8. Recommend to the surveillance panel that the Sequence VG test conducted with the 2000 model year hardware utilizing four cylinder bore sizes be accepted as equivalent to the Sequence VG test conducted with the 1994 model year hardware. Recommend that the current reference oil targets will be utilized for the Sequence VG test conducted with the 2000 model year hardware.  
Bill Buscher/Dwight Bowden, Passed unanimously.

3/18/03

SEE VC O&amp;H SUBPANEL MEETING

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MIKE RILEY FORD MRILEY2@FORD.COM

# THE VG ROMEO MATRIX

03.18.2003

VG O & H PANNEL

DETROIT

# AER ENGINE SUPPLY

MAR	112	12
APR	100	12
MAY	88	12
JUN	76	12
JUL	64	12
AUG	52	12
SEP	40	12
OCT	28	12
NOV	16	12
DEC	4	

# GOING WITH F1, F4 HEADS

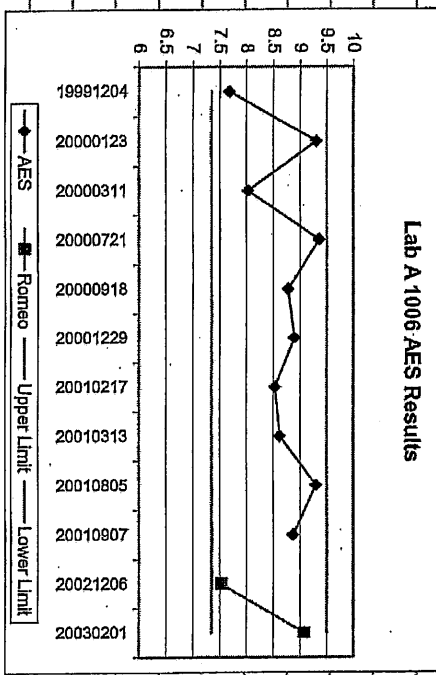
## • PRO'S

- CURRENT PCV PLUMBING SYSTEM
- CURRENT INTAKE MANIFOLD
- CURRENT 216 HR TEST LENGTH
- CURRENT SLUDGE RATING SITES
- CURRENT FUEL DILUTION
- CAM BEARINGS FIX OIL PRESSURE PROBLEM
- CON'S
- LONG TERM SUPPLY OF F1, F4 HEADS
- NEW F5, F8 HEADS ARE EXCESS, BUT KIT HEAD ORDER HAS BEEN CANCELLED
- REGULAR REBUILD OF HEADS AT OUTSIDE SOURCE

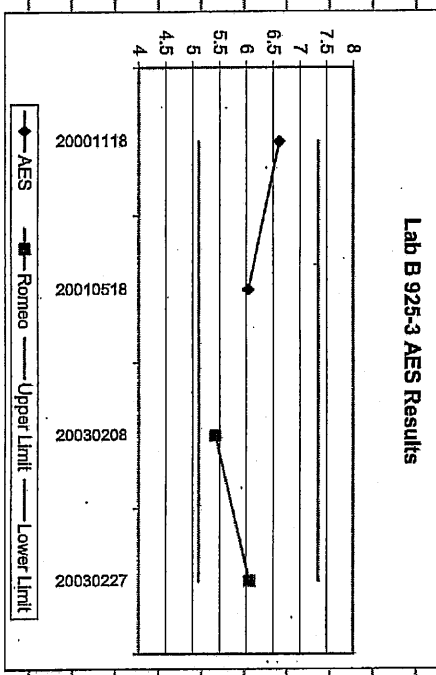


# MATRIX AES COMPARISON

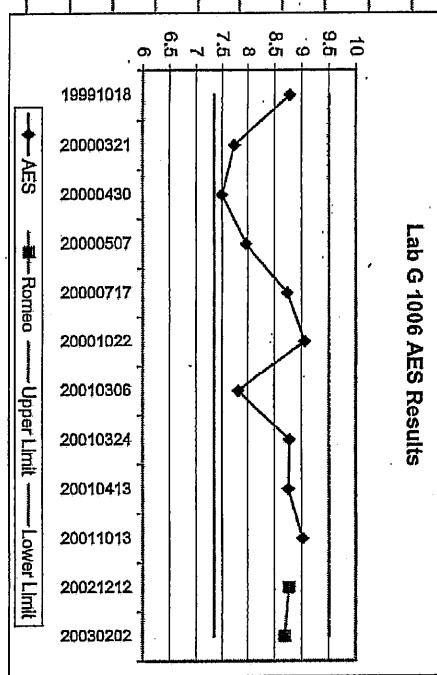
Lab A 1006 AES Results



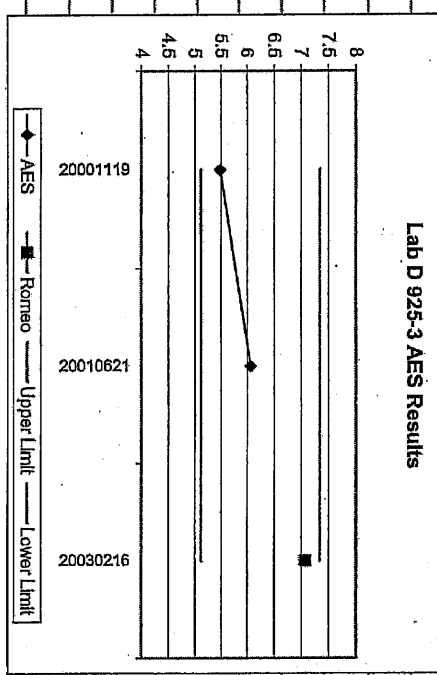
Lab B 925-3 AES Results



Lab G 1006 AES Results

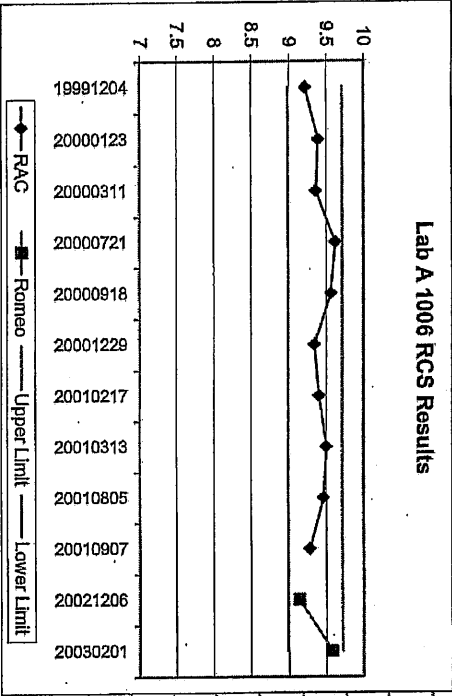


Lab D 925-3 AES Results

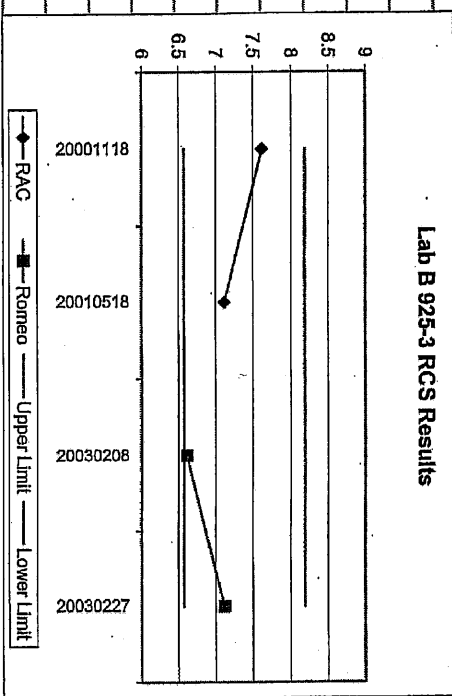


# MATRIX RCS COMPARISON

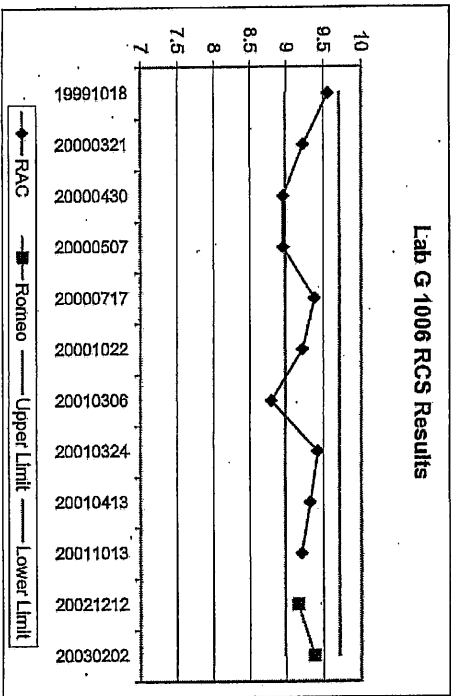
Lab A 1006 RCS Results



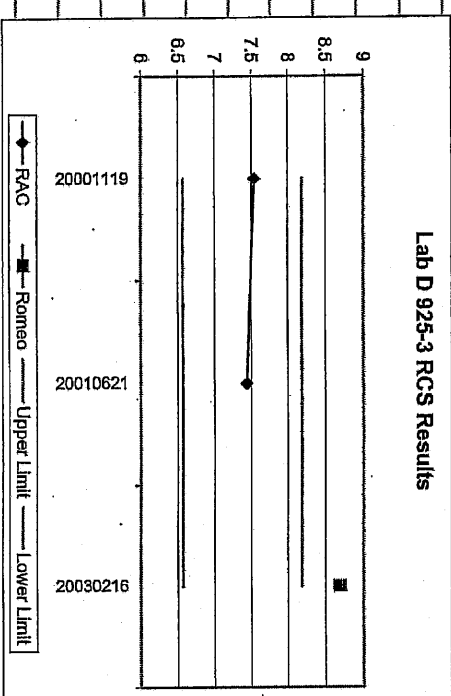
Lab B 925-3 RCS Results



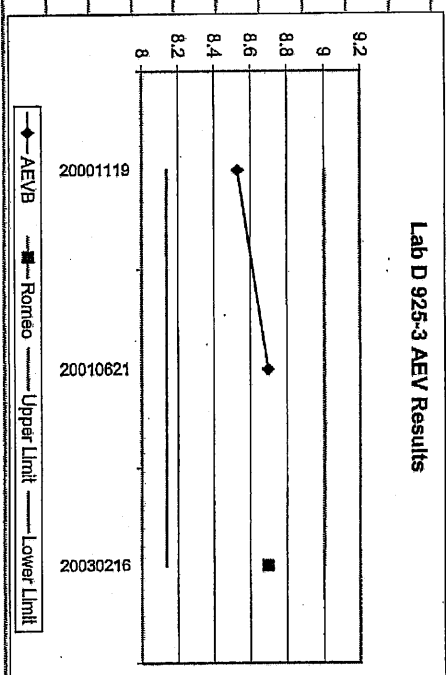
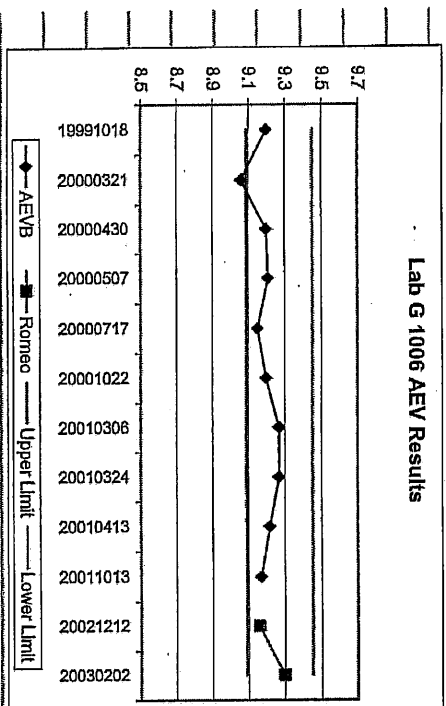
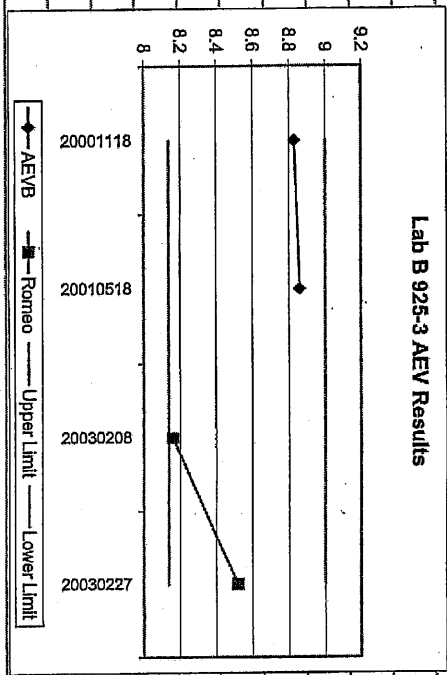
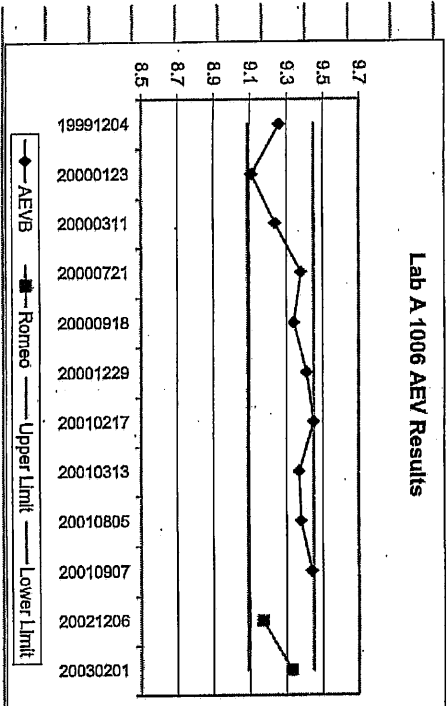
Lab G 1006 RCS Results



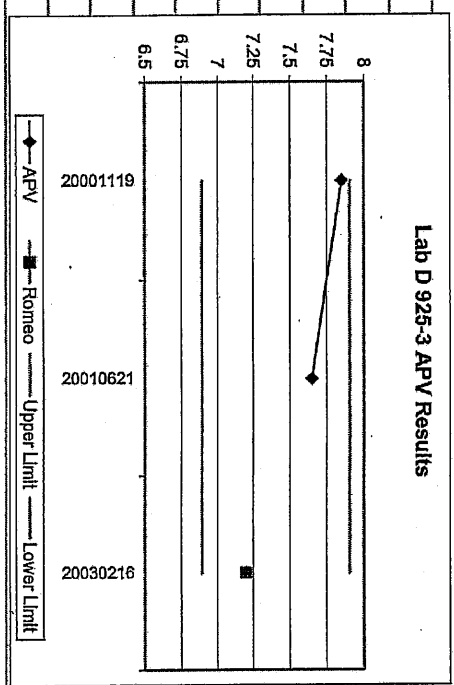
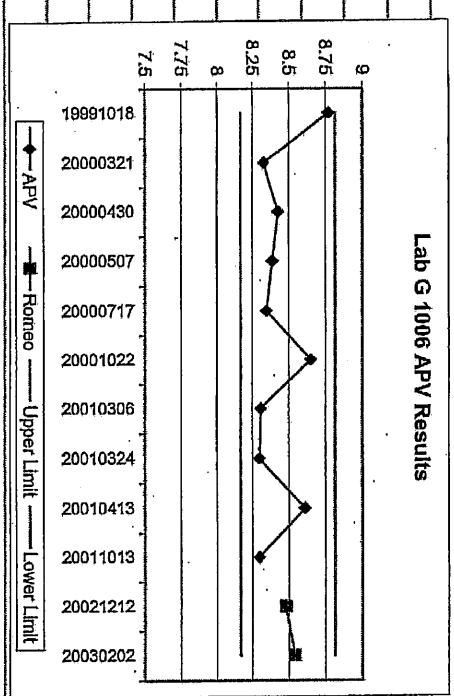
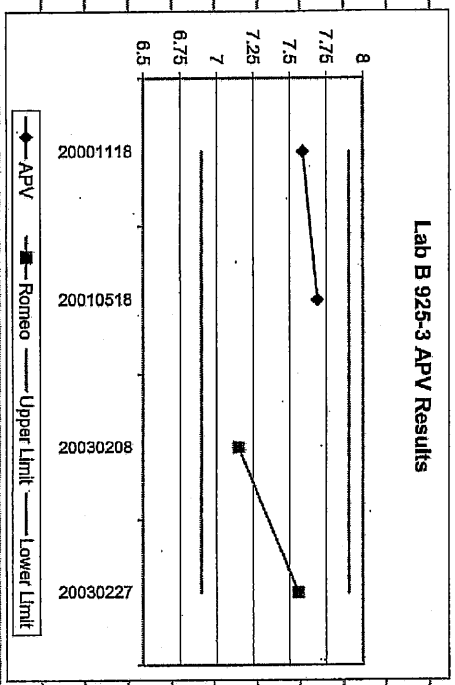
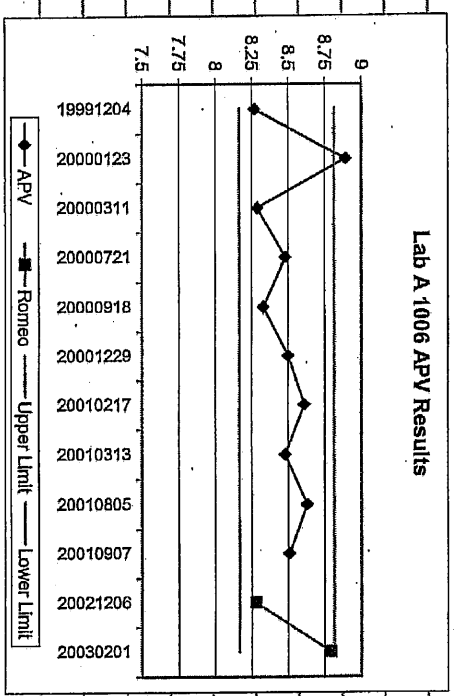
Lab D 925-3 RCS Results



# MATRIX AEV COMPARISON

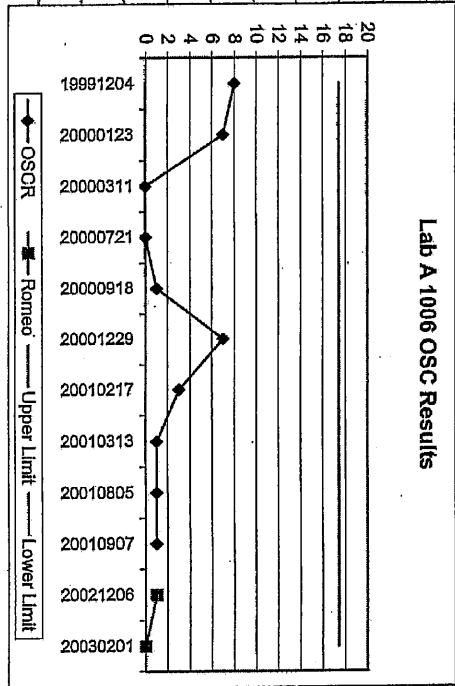


# MATRIX APV COMPARISON

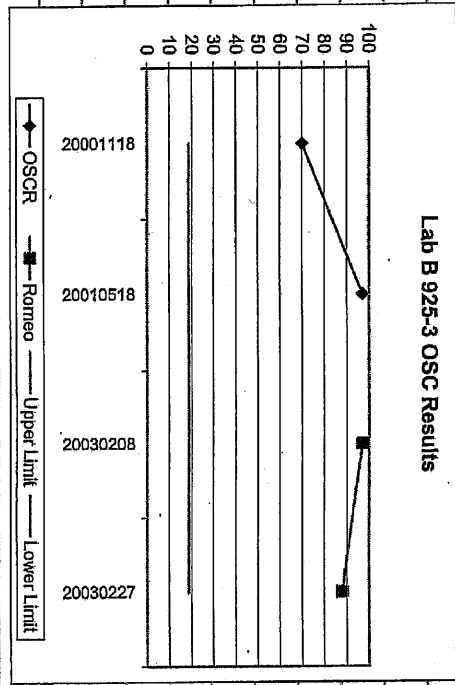


# MATRIX OSC COMPARISON

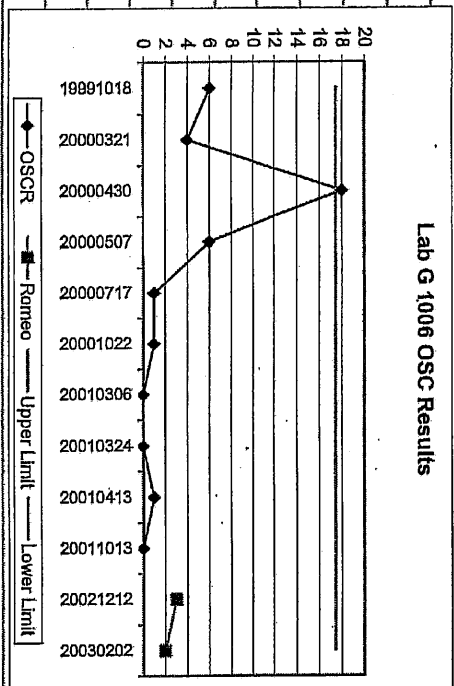
Lab A 1006 OSC Results



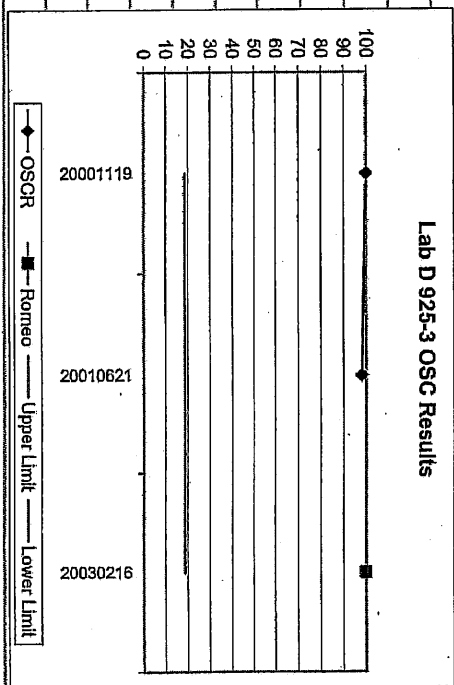
Lab B 925-3 OSC Results



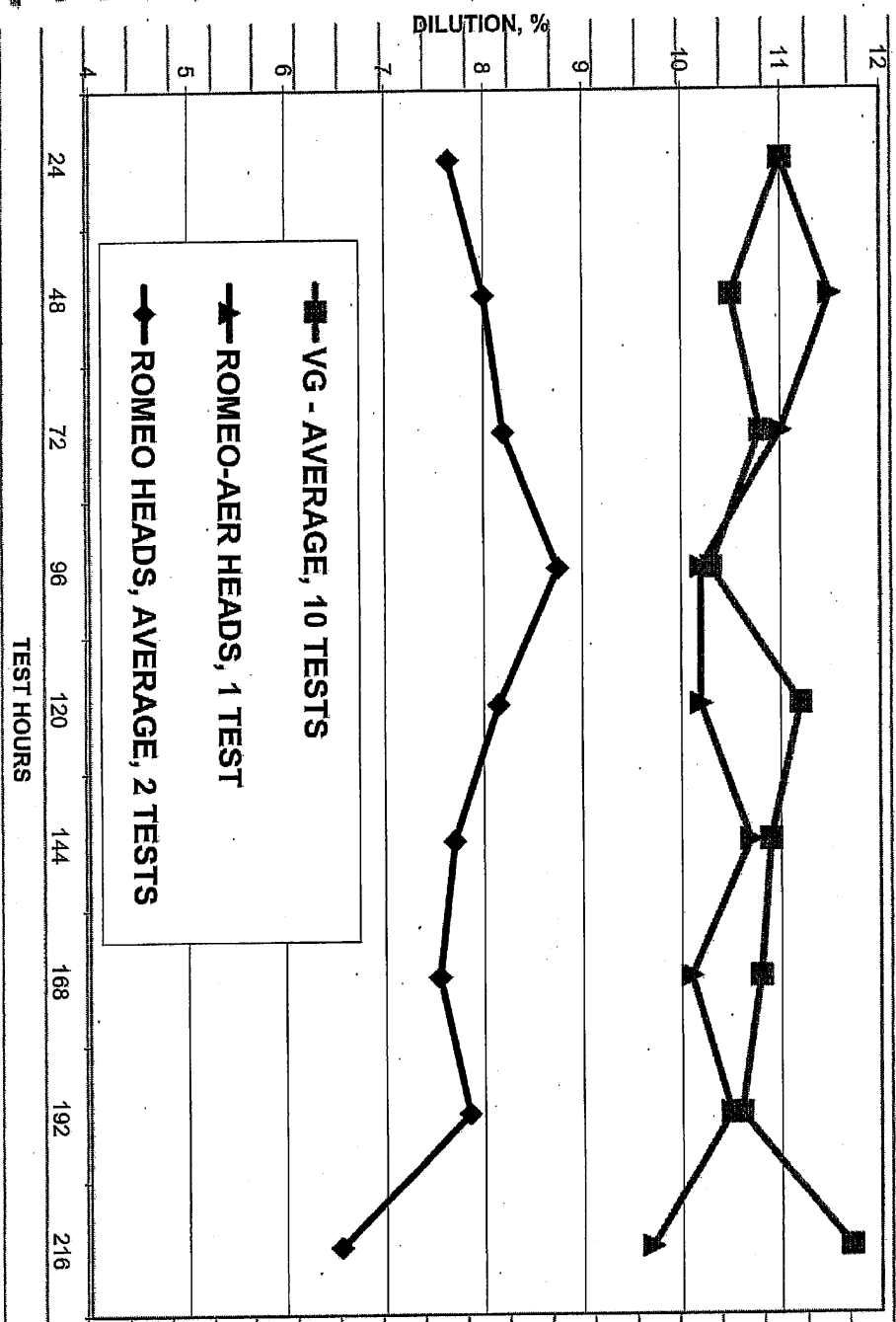
Lab G 1006 OSC Results



Lab D 925-3 OSC Results



# FUEL DILUTION



# BUILD ISSUES

- LOCATION TO MEASURE PISTON
- NEW DESIGN OF CAM BEARING
- BLOCK CLEANING AND SOAKS
- BLOCK HONING METHODS
- HEAD JOURNAL MEASUREMENTS
- RING GAPS FOR PISTON SIZES
- SCHEDULE FOR FIRST AER BUILD WORKSHOP FOR INDUSTRY

# MATRIX CONFIGURATION

- 10 TESTS, 5 LABS, 2 OHS, 2 PISTON SIZES [0.125 and 0.500mm OVERSIZE]
- REGULAR CONFERENCE CALLS ON RESULTS DURING MATRIX
- DUAL RATING AT SWRI AND PEAR
- EMAIL REPORTS ON TEST STATUS



# THANKS

- FORD HAS SUPPLIED ENGINES
- SWRI, PEAR, LUBRIZOL, ETHYL AND ASHLAND WILL RUN MATRIX TESTS
- HALTERMANN WILL SUPPLY MATRIX FUEL
- TEI WILL ACT AS CPD FOR KITS AND MATRIX PARTS

**LUBRIZOL**



Fluid technologies for a better world™

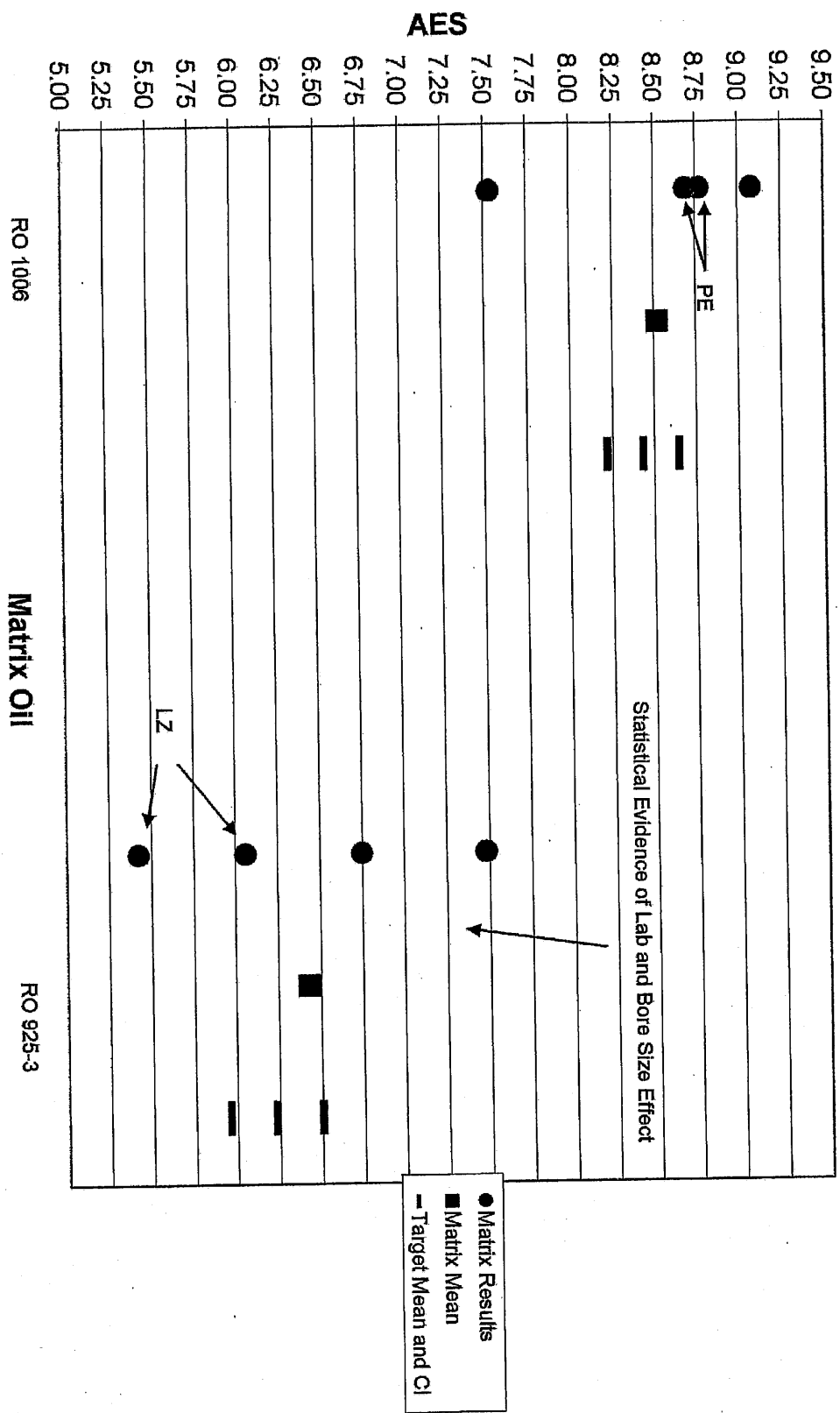
# **Analysis of the Sequence VG Prove-Out Matrix**

**Phillip R. Scinto  
March 17, 2003**

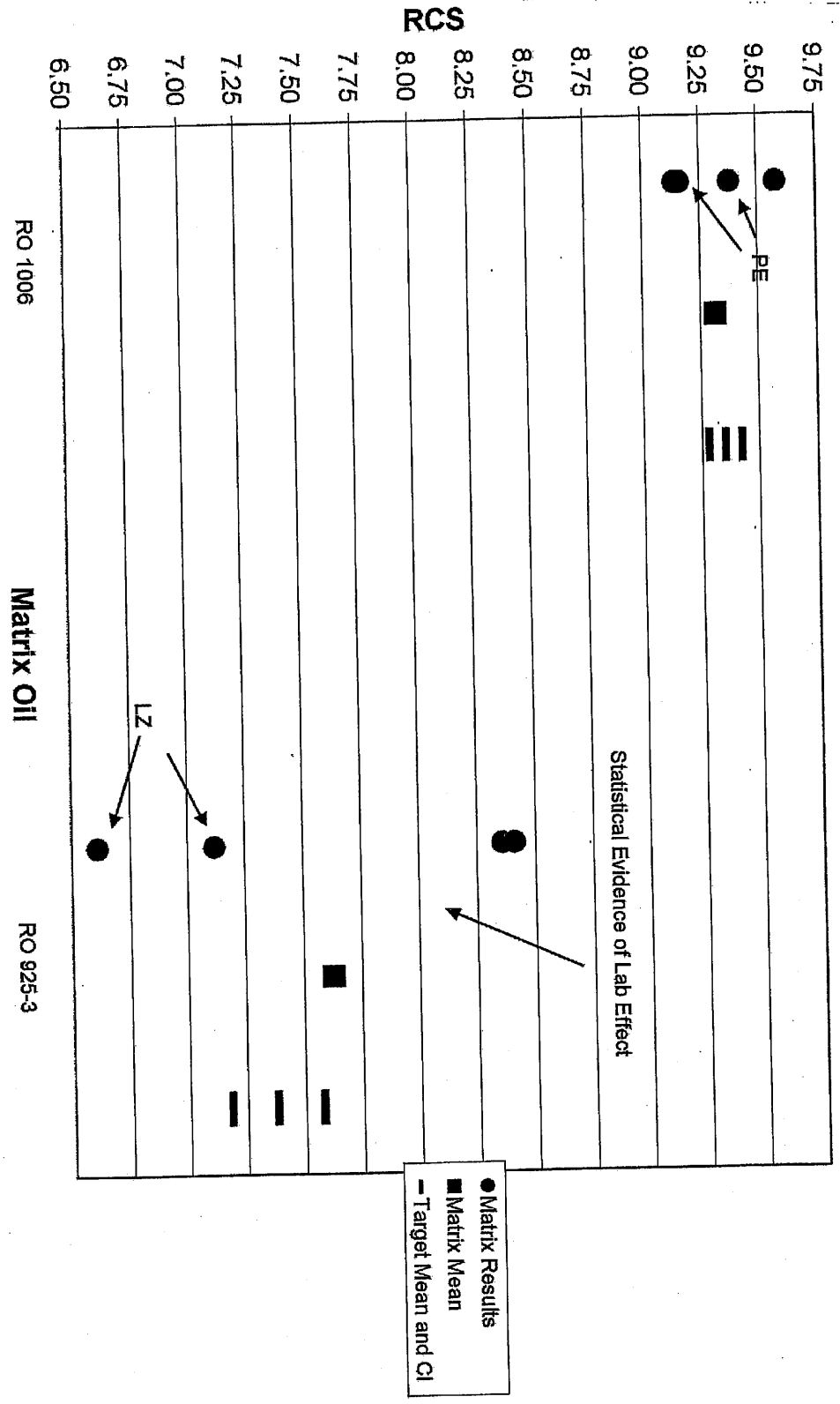
# Summary

- The 4.6L, V8 Ford Romeo Production Engine with Romeo Block and AER Heads with Bearing Inserts Maintains Discrimination Between Reference Oils 1006 and 925-3.
- There is Statistical Evidence of an Oil Dependent, Bore Size Effect in AES and AEV. Additional Designed Testing would be Necessary to Determine if this is a Real Effect.
- There is Statistical Evidence that there is a Mean Shift for Oil 925-3 in PSV. Note that this Conclusion may be Lab Dependent.
- There is Some Statistical Evidence that there is a Mean Shift for Oil 925-3 in OSC. Note that this Conclusion may be Lab Dependent.
- There is Statistical Evidence that the LZ and Ethyl Labs are Different in Terms of AES and RCS.
- The Test Result from Ashland was Removed as an Outlier.

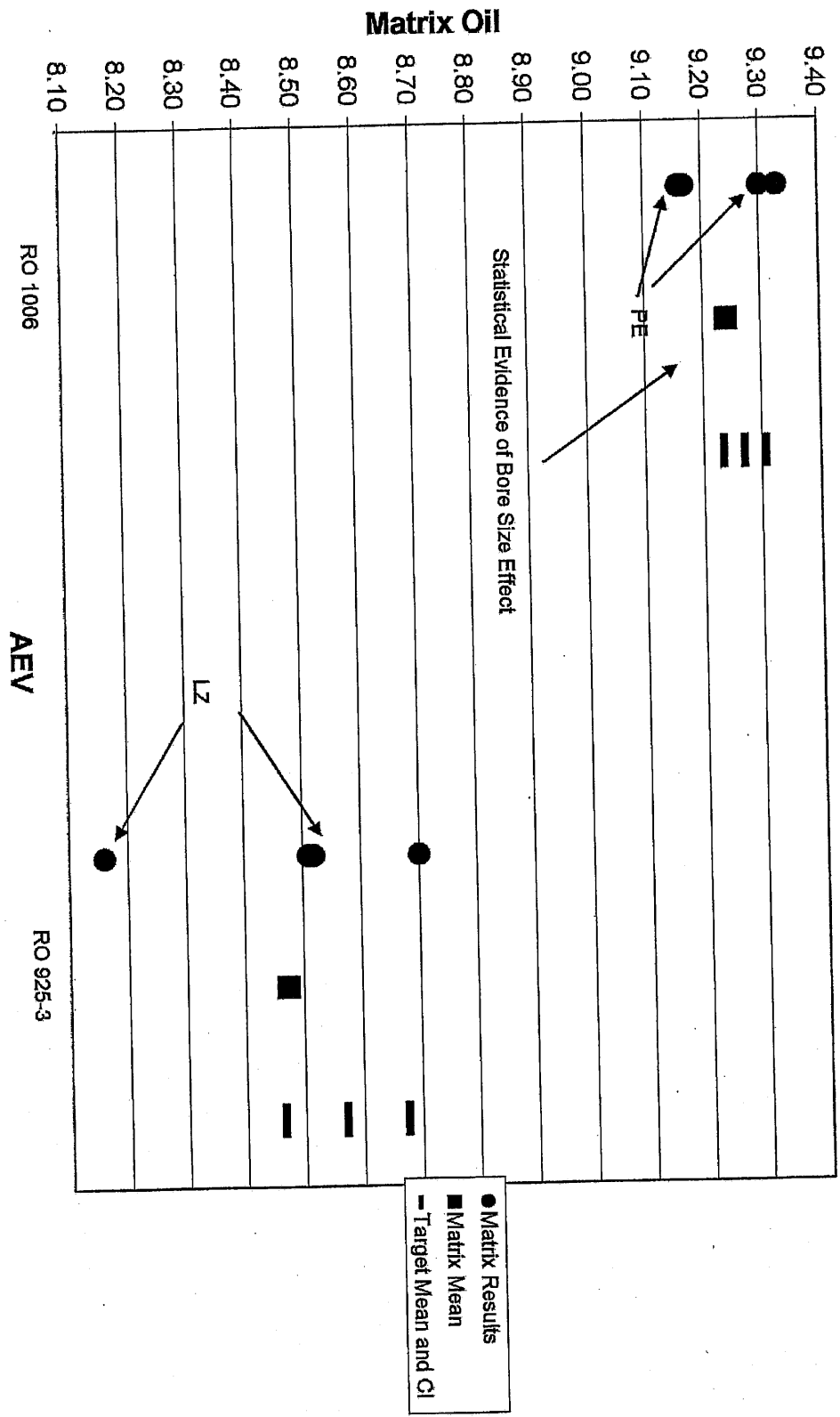
VG Prove-Out Matrix for Average Engine Sludge



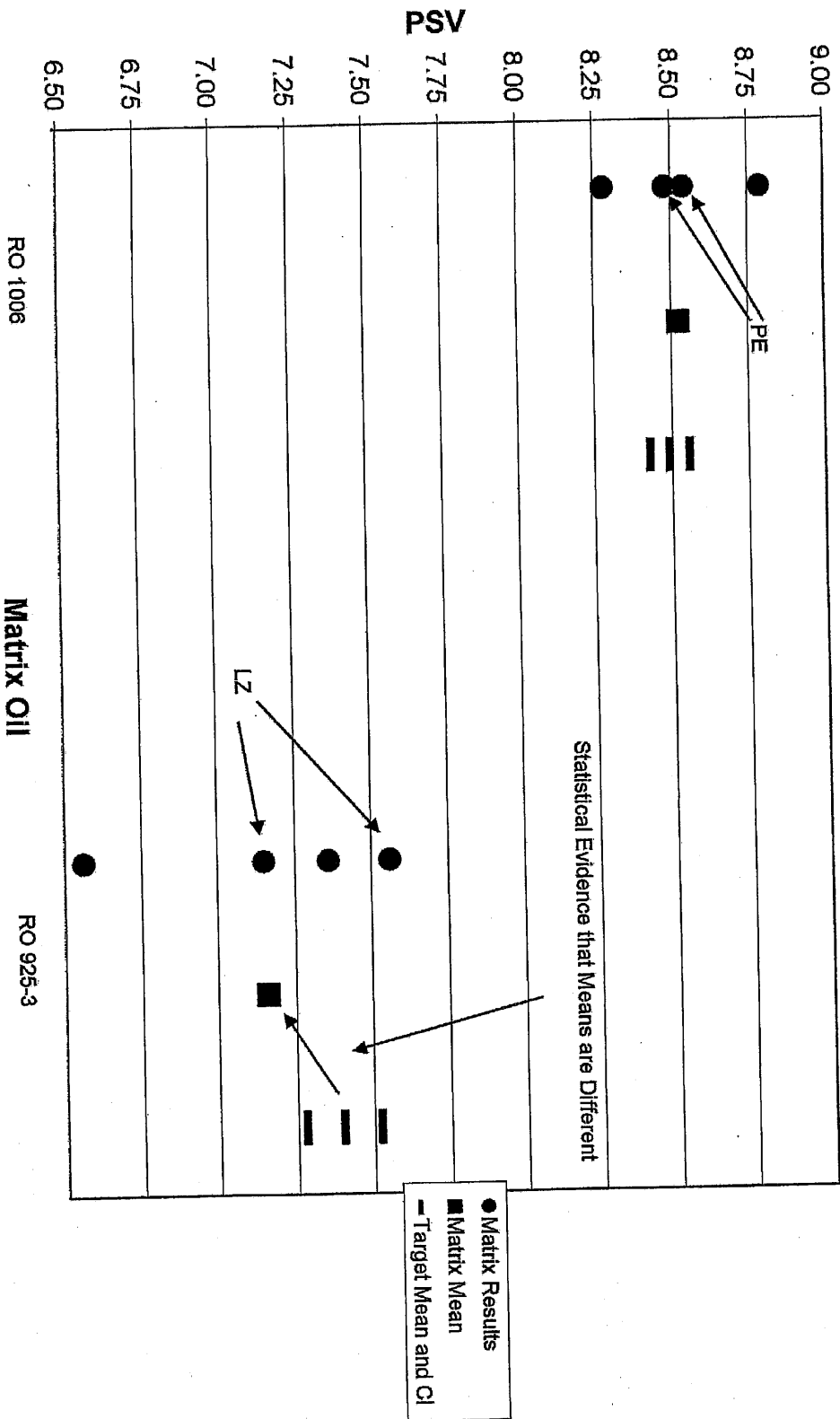
VG Prove-Out Matrix for Rocker Cover Sludge



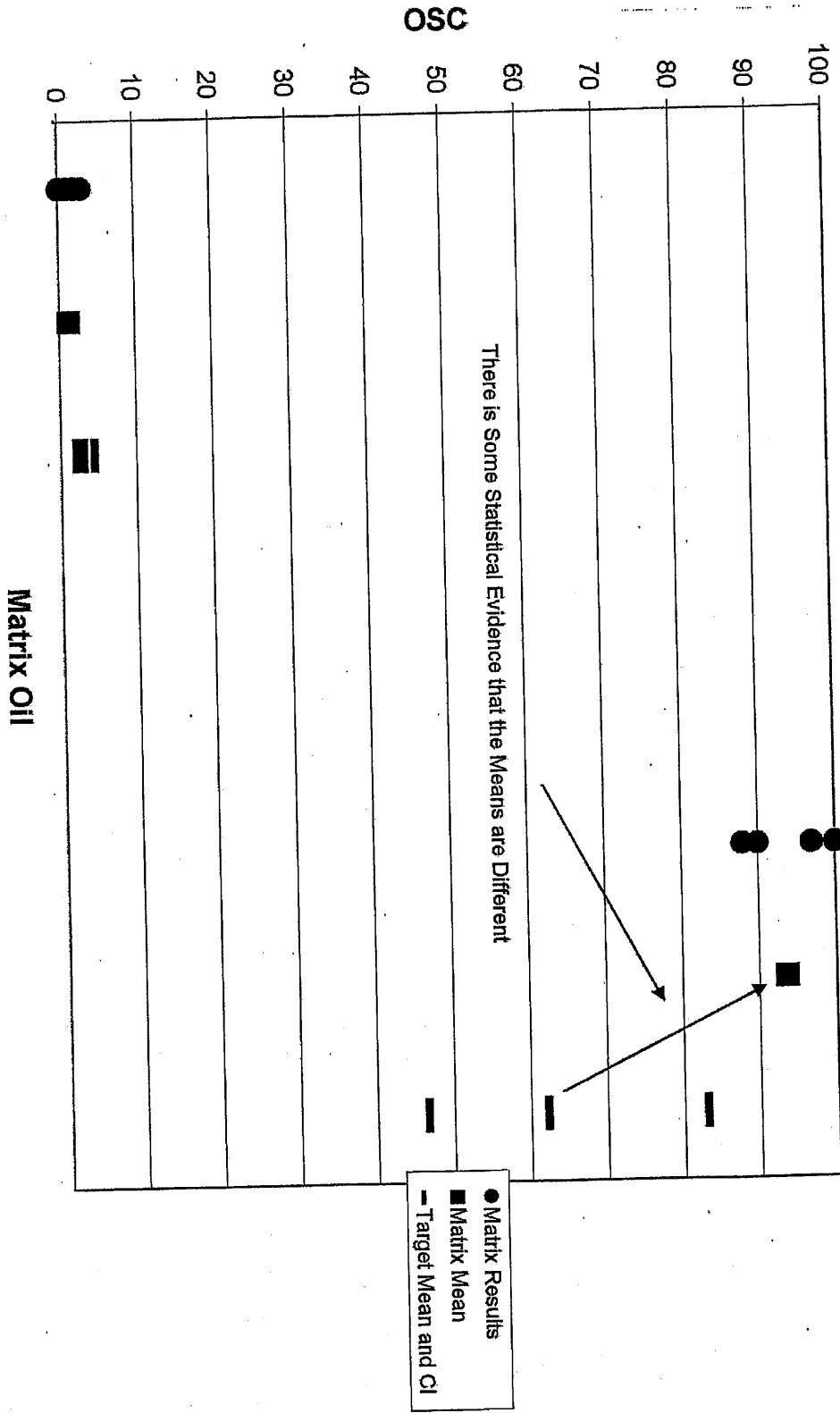
VG Prove-Out Matrix for Average Engine Varnish



VG Prove-Out Matrix for Piston Skirt Varnish



VG Prove-Out Matrix for Oil Screen Clogging





# Matrix Data

Test	Date Completed	Oil Code	Bore Size	AES merits	RCS merits	AEV merits	PSV merits	OSC % Area
Laboratory SwRI	12/06/02	1006	0.500MM	7.53	9.14	9.17	8.28	1
PerkinElmer SwRI	12/12/02	1006	0.500MM	8.77	9.16	9.16	8.48	3
SwRI	02/01/03	1006	0.125MM	9.08	9.58	9.33	8.79	0
PerkinElmer	02/02/03	1006	0.125MM	8.69	9.38	9.30	8.54	2
Lubrizon	02/08/03	925-3	0.125MM	5.42	6.61	8.16	7.15	97
Ethyl	02/16/03	925-3	0.125MM	6.75	8.36	8.70	7.36	100
Lubrizon	02/27/03	925-3	0.500MM	6.06	7.12	8.52	7.56	88
Ethyl		925-3	0.500MM	7.48	8.41	8.51	6.56	90



## Next Steps

- Run the Mirror Image of the Matrix (8 Runs) to Establish the Proper Targets

OR

- Use the Current LTMS Targets Until we have 10 Tests Each on Oils 925-3 and 1006
- In Either Case, Labs May Continue with Old Hardware Until They Run Out. Candidates Must be Run the Same as References.

**Sequence VG Prove-out Matrix Test Program  
MY 2000 4.6L V8 Ford Romeo Production Engine  
Romeo Block/AER Heads w/ Bearing Inserts**

Test Laboratory	Oil Code	Bore Size	Average Fuel Dilution Wt. %
PerkinElmer	1006	0.125MM	8.29
Ashland	1006	0.125MM	8.72
SwRI	1006	0.125MM	10.82
SwRI	1006	0.500MM	9.48
PerkinElmer	1006	0.500MM	9.53
Lubrizol	925-3	0.125MM	10.18
Ethyl	925-3	0.125MM	10.50
Ethyl	925-3	0.500MM	11.77
Lubrizol	925-3	0.500MM	12.32

# ATTACHMENT 5A

**Sequence VG Prove-out Matrix Test Program  
MY 2000 4.6L V8 Ford Romeo Production Engine  
Romeo Block/AER Heads w/ Bearing Inserts**

	Test Lab	Bore Size	AES merits	RCS merits	AEV merits	PSV merits	OSC % Area	OSC Transformed
<b>1006</b>								
Test 1	Lab A	0.500MM	7.53	9.14	9.17	8.28	1	0.693
Test 2	Lab G	0.500MM	8.77	9.16	9.16	8.48	3	1.386
Test 3	Lab A	0.125MM	9.08	9.58	9.33	8.79	0	0.000
Test 4	Lab G	0.125MM	8.69	9.38	9.30	8.54	2	1.099
Test 5	Lab E	0.125MM	6.99	9.13	9.30	8.68	65	4.190
Target	Mean		8.430	9.350	9.270	8.490	2.991	1.384
	Std Dev		0.600	0.200	0.100	0.180		0.850
	Min		7.350	8.990	9.090	8.166	-0.136	-0.146
	Max		9.510	9.710	9.450	8.814	17.430	2.914
Calculated From Matrix Results	Mean		8.212	9.278	9.252	8.554	3.365	1.474
	Std Dev		0.902	0.198	0.080	0.195		1.605
<b>925-3</b>								
Test 1	Lab B	0.125MM	5.42	6.61	8.16	7.15	97	4.585
Test 2	Lab D	0.125MM	6.75	8.36	8.70	7.36	100	4.615
Test 3	Lab B	0.500MM	6.06	7.12	8.52	7.56	88	4.489
Test 4	Lab D	0.500MM	7.16	8.08	8.51	6.72	90	4.511
Test 5	Lab E	0.500MM						
Target	Mean		6.230	7.380	8.570	7.400	62.244	4.147
	Std Dev		0.620	0.450	0.240	0.280		0.649
	Min		5.114	6.570	8.138	6.896	18.664	2.979
	Max		7.346	8.190	9.002	7.904	202.405	5.315
Calculated From Matrix Results	Mean		6.348	7.543	8.473	7.198	93.623	4.550
	Std Dev		0.767	0.818	0.226	0.360		0.060

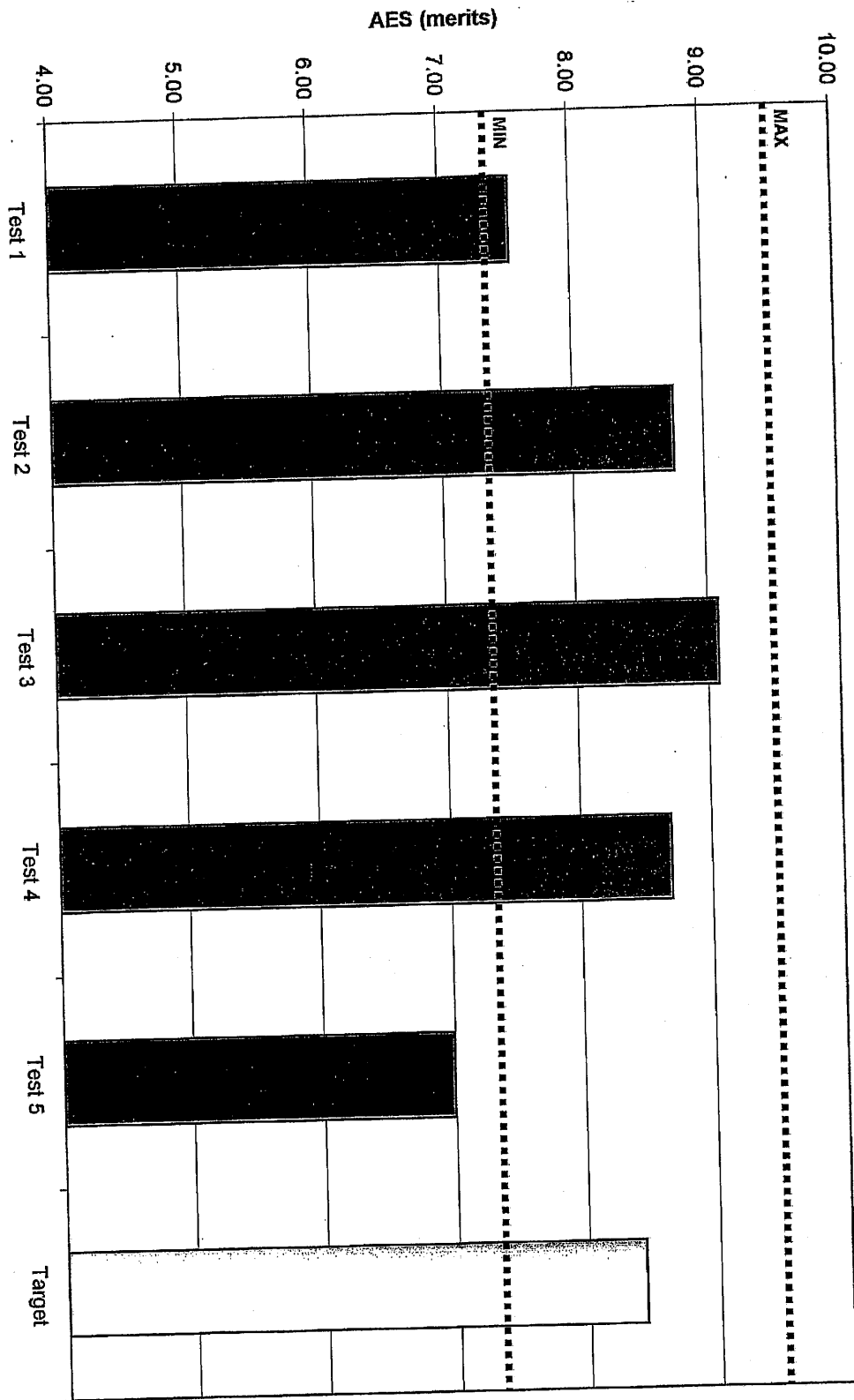
Transformed Result:  $OSC = \ln(\text{result} + 1)$

= Failing Result

**Comments:**

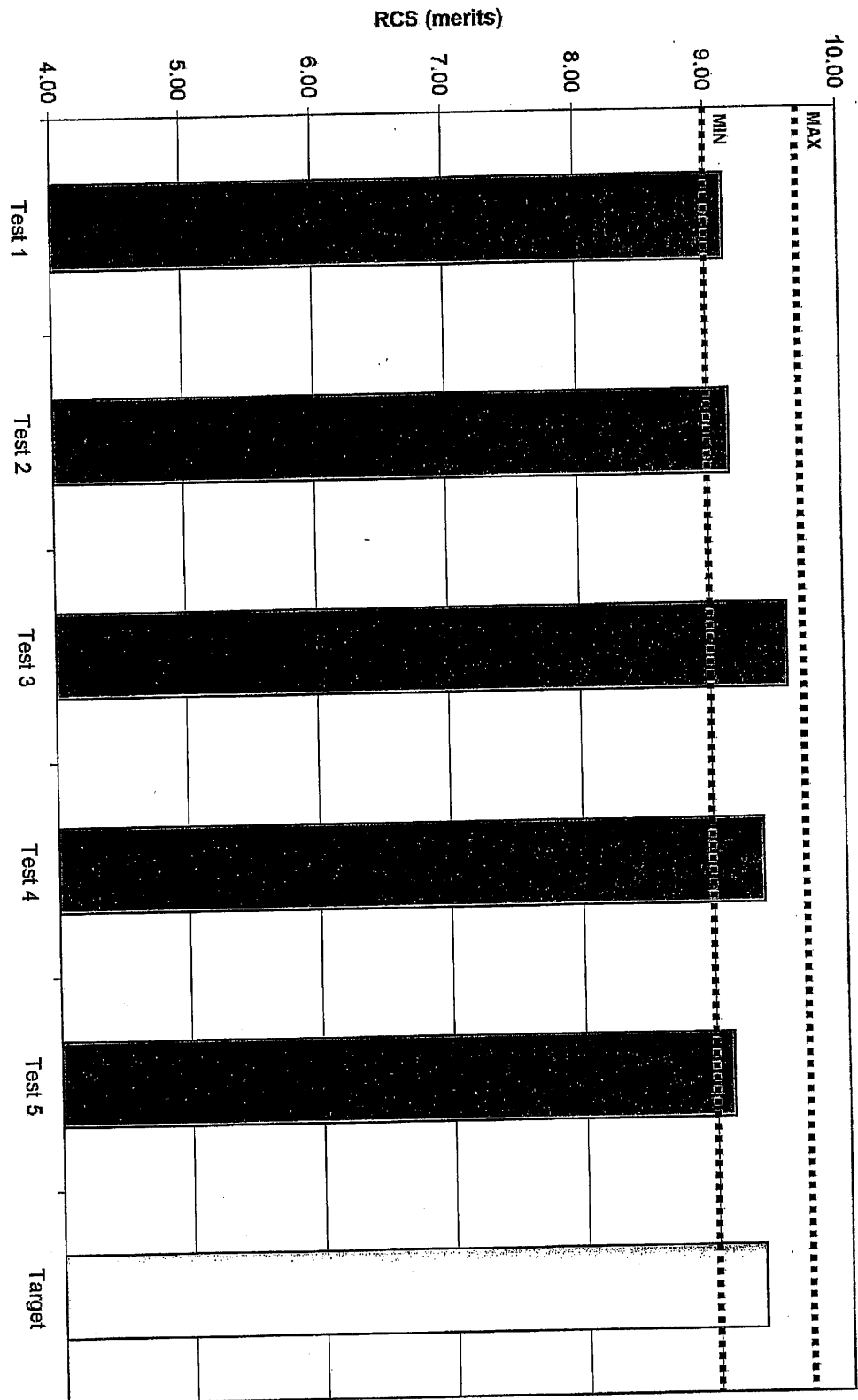
- Romeo XW7E engine block.
- AER F1 and F4 cylinder heads reconditioned with cam bearing inserts.
- OH Technologies polished camshafts.
- F1 intake manifold (standard VG intake manifold).
- EV-98 PCV valve (standard VG PCV valve).
- 216 hour total test length (standard VG test length).
- 3000 gram initial oil charge (standard VG initial oil charge).

Sequence VG Prove-out Matrix Test Program  
Reference Oil 1006: Average Engine Sludge

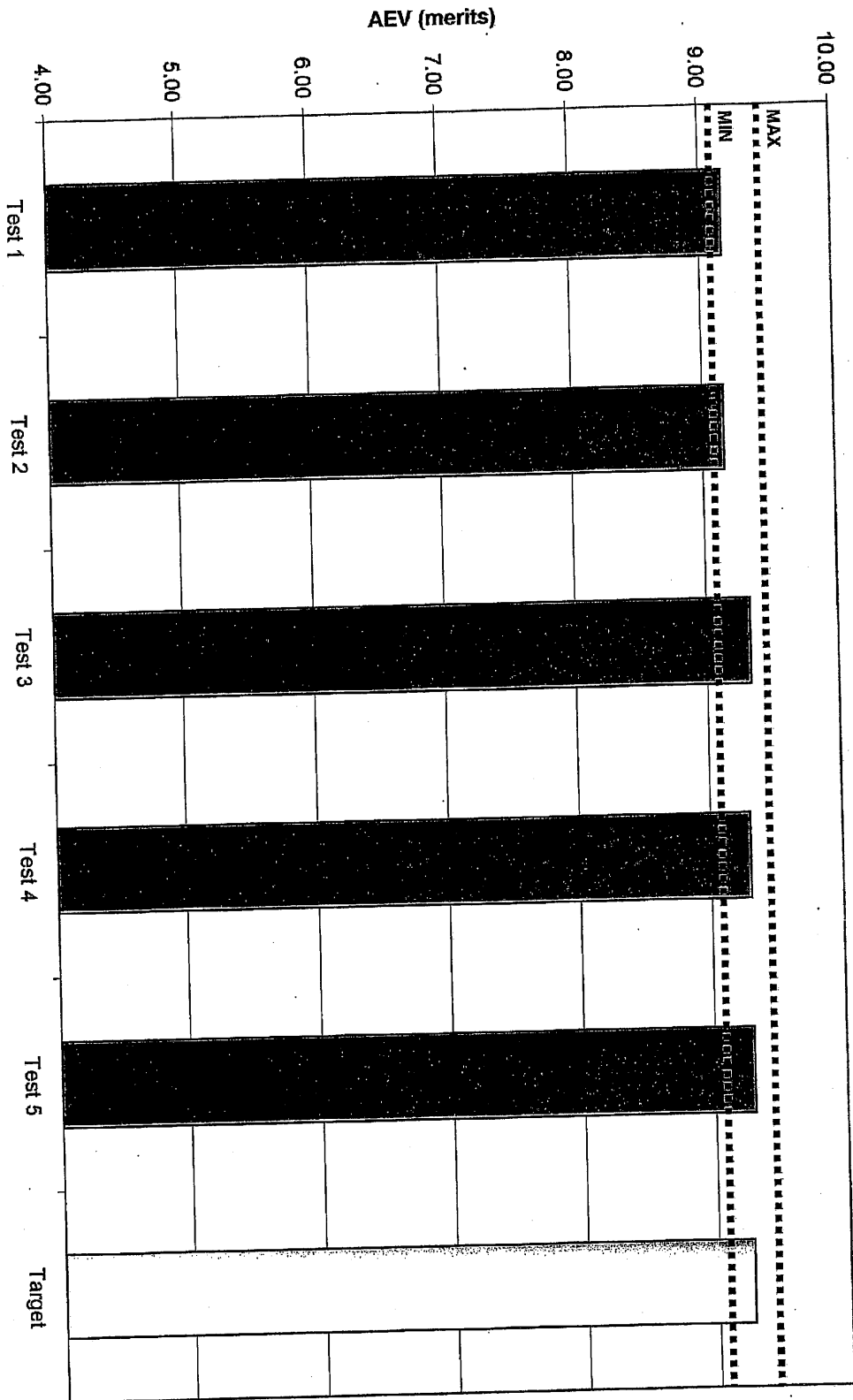


Sequence VG Prove-out Matrix Test Program

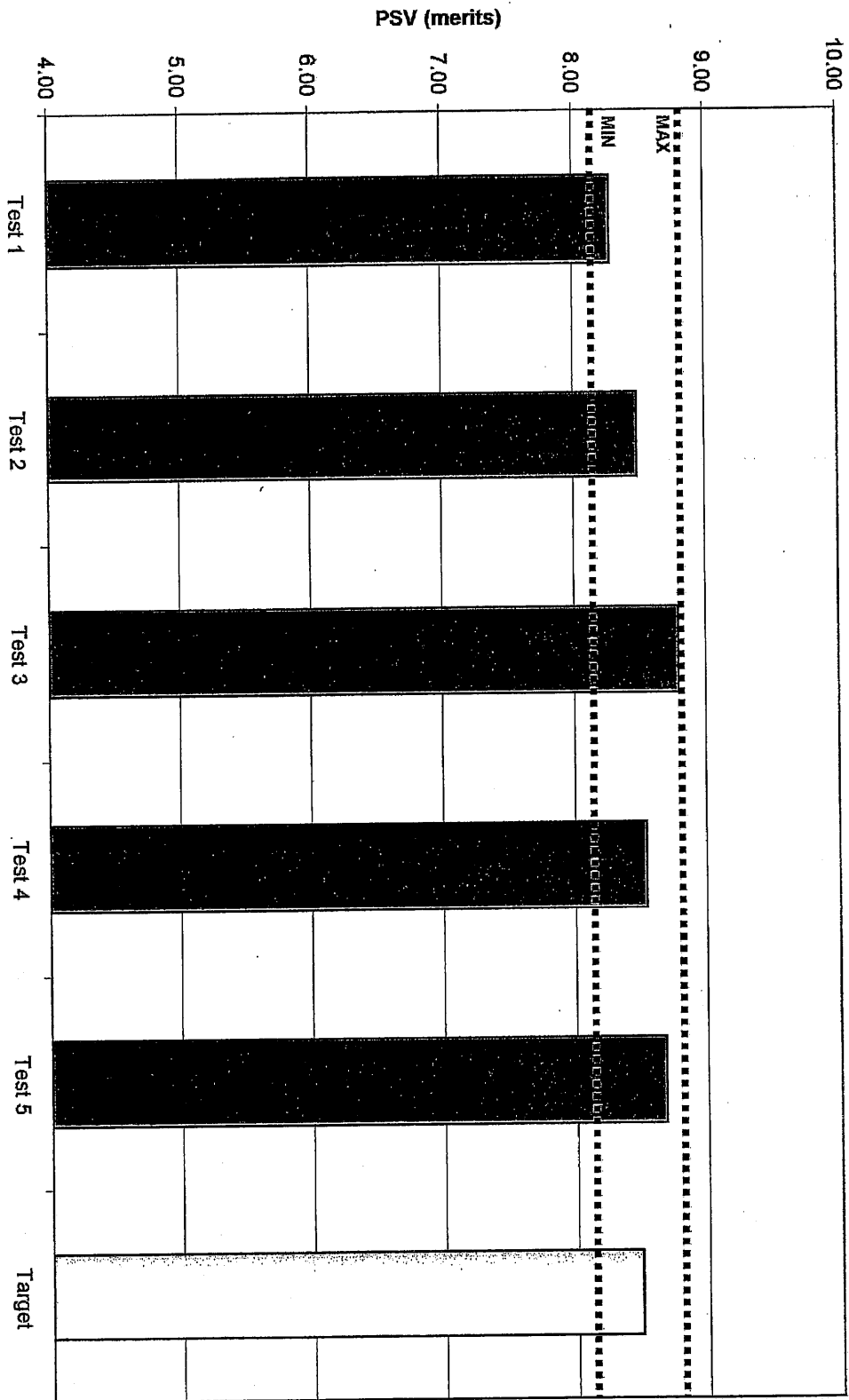
Reference Oil 1006: Rocker Cover Sludge



Sequence VG Prove-out Matrix Test Program  
Reference Oil 1006: Average Engine Varnish



Sequence VG Prove-out Matrix Test Program  
Reference Oil 1006: Piston Skirt Varnish

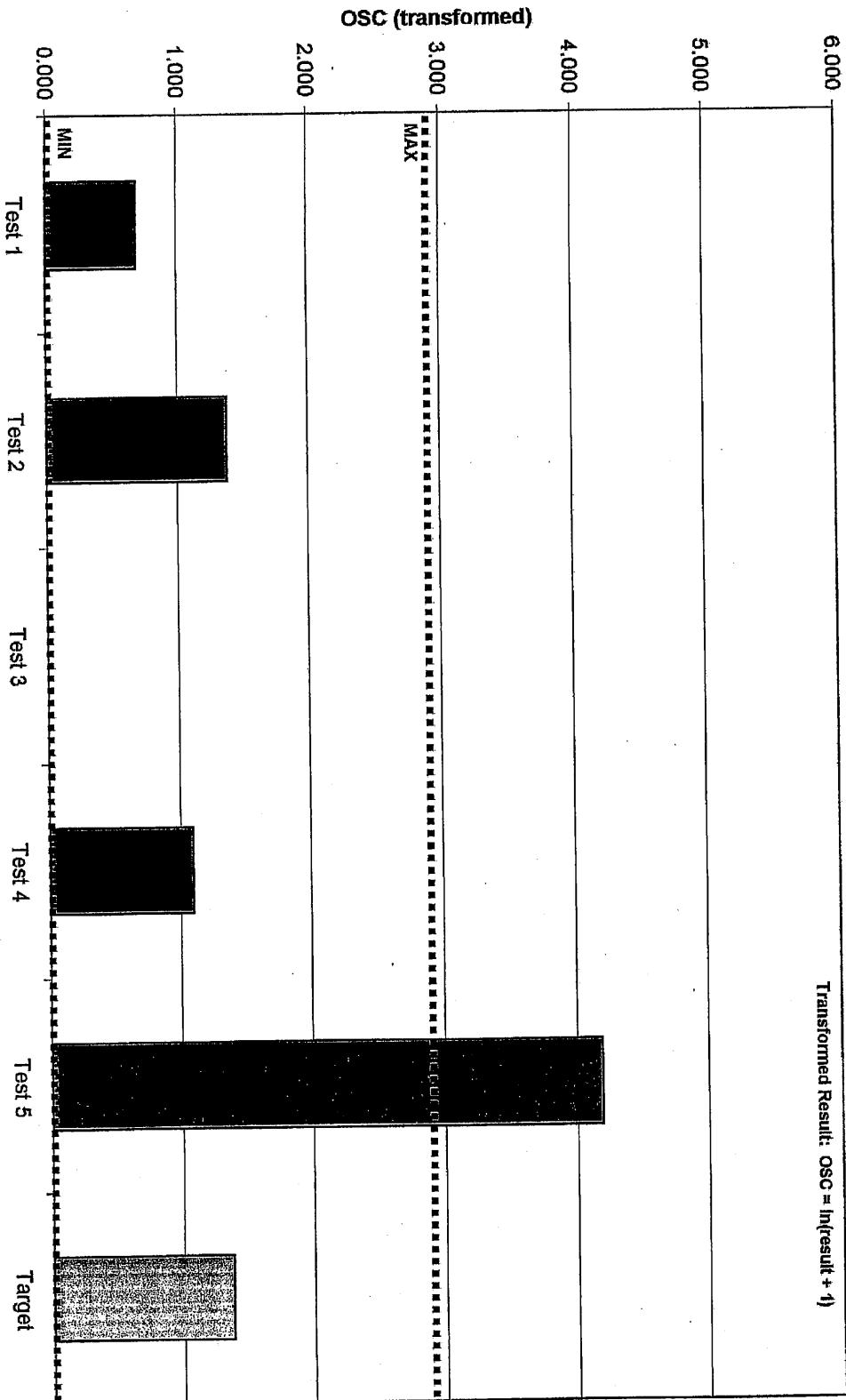




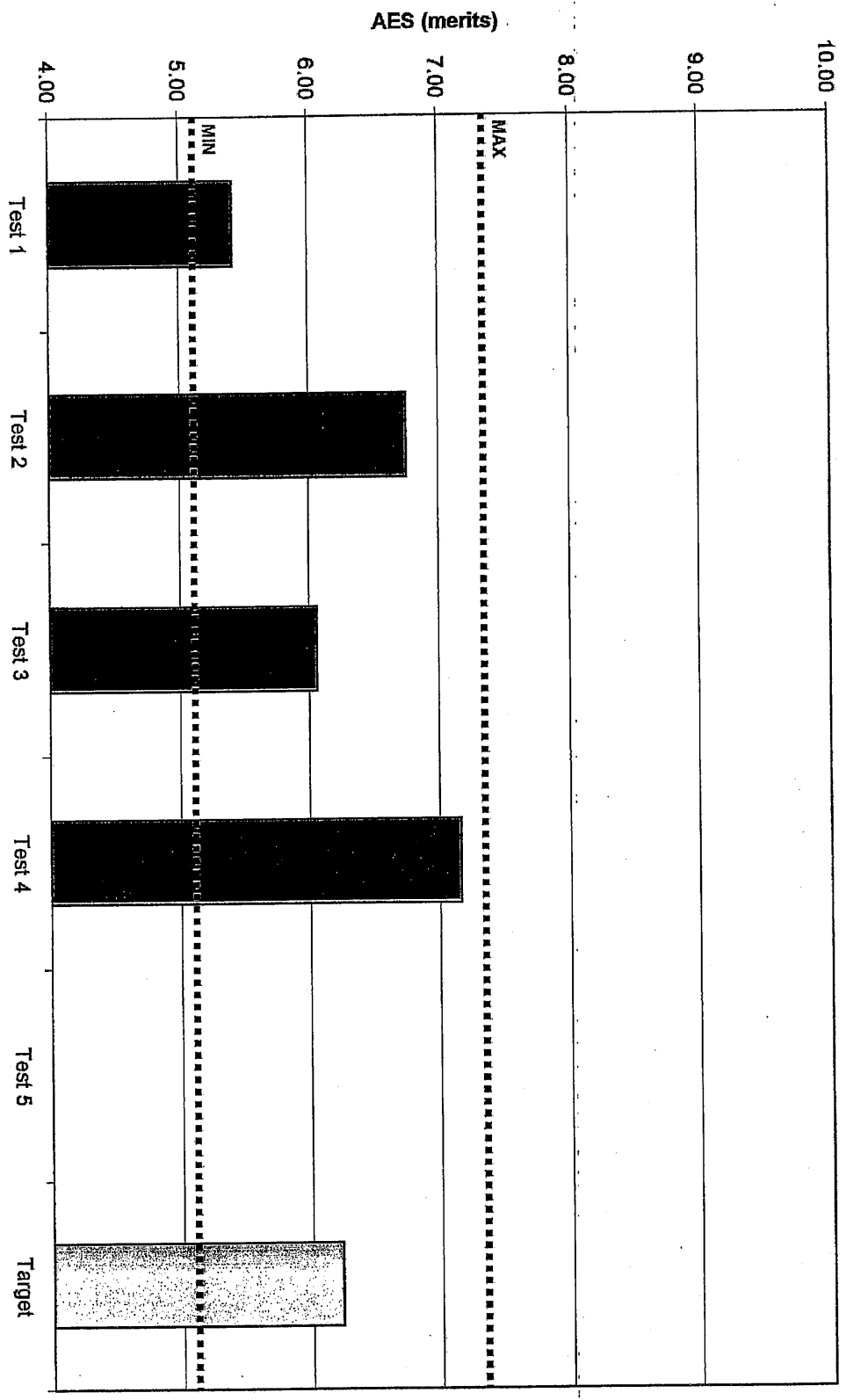
Sequence VG Prove-out Matrix Test Program

Reference Oil 1006: Oil Screen Clogging

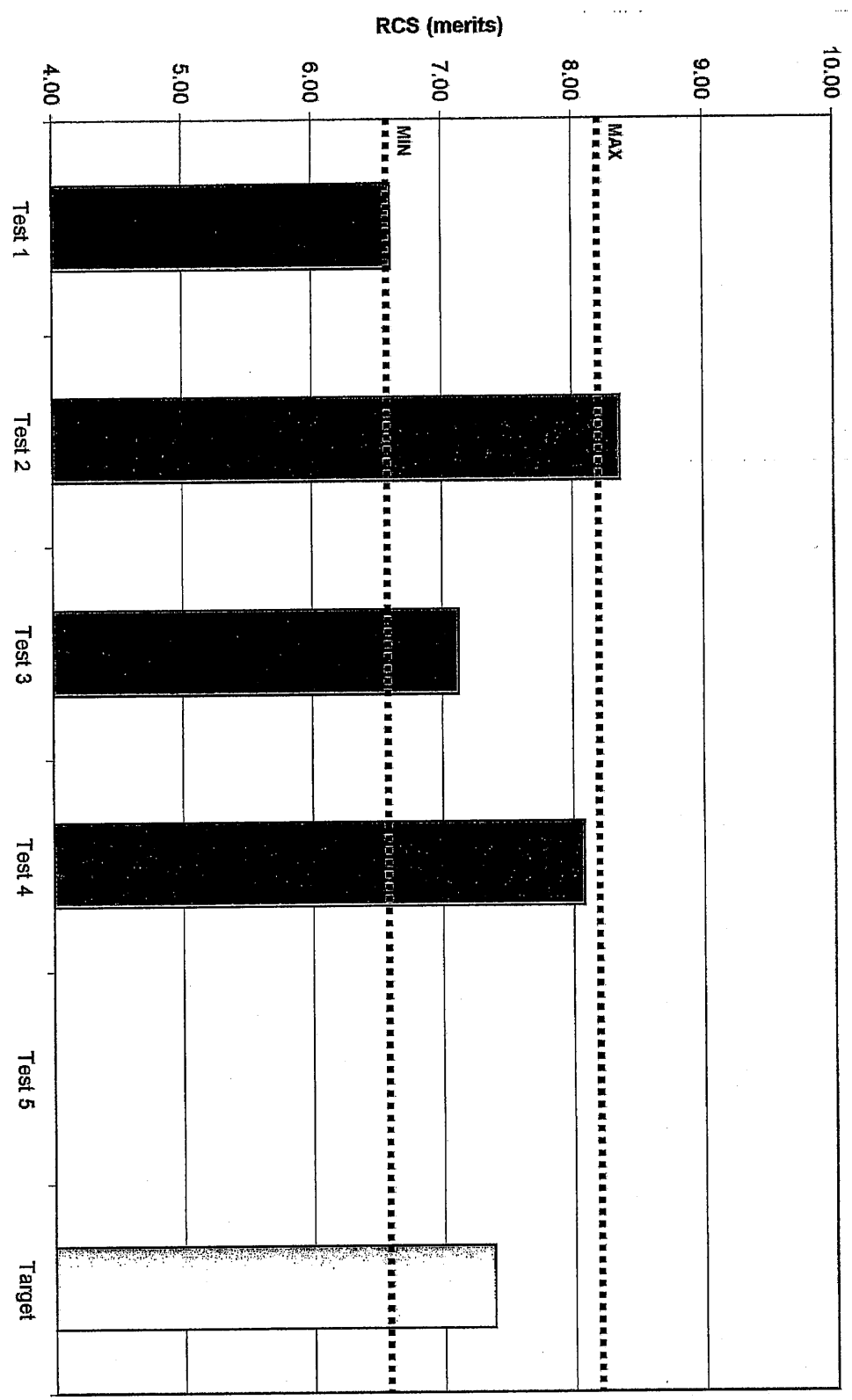
Transformed Result:  $OSC = \ln(\text{result} + 1)$



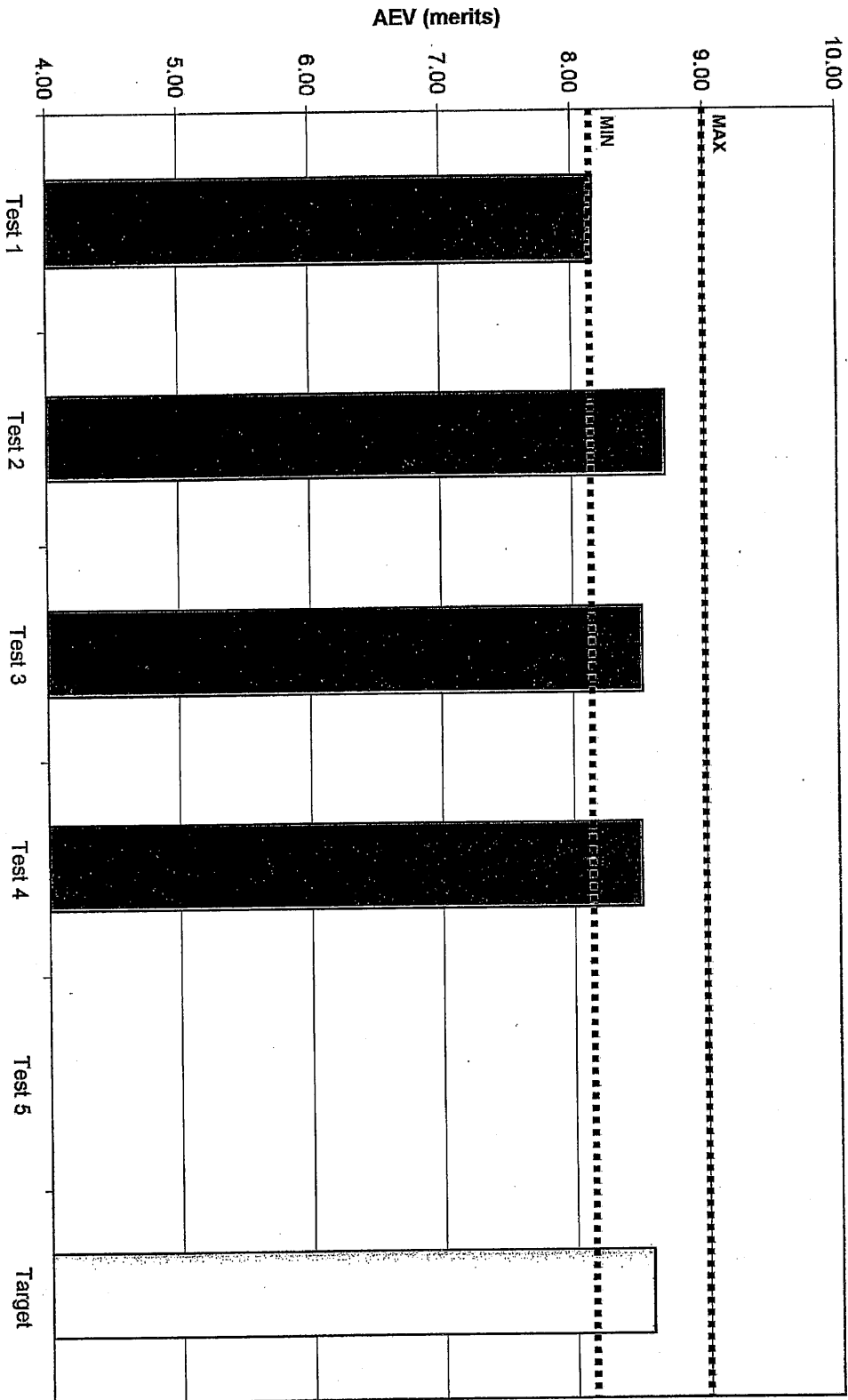
Sequence VG Prove-out Matrix Test Program  
Reference Oil 925-3: Average Engine Sludge



Sequence VG Prove-out Matrix Test Program  
Reference Oil 925-3: Rocker Cover Sludge

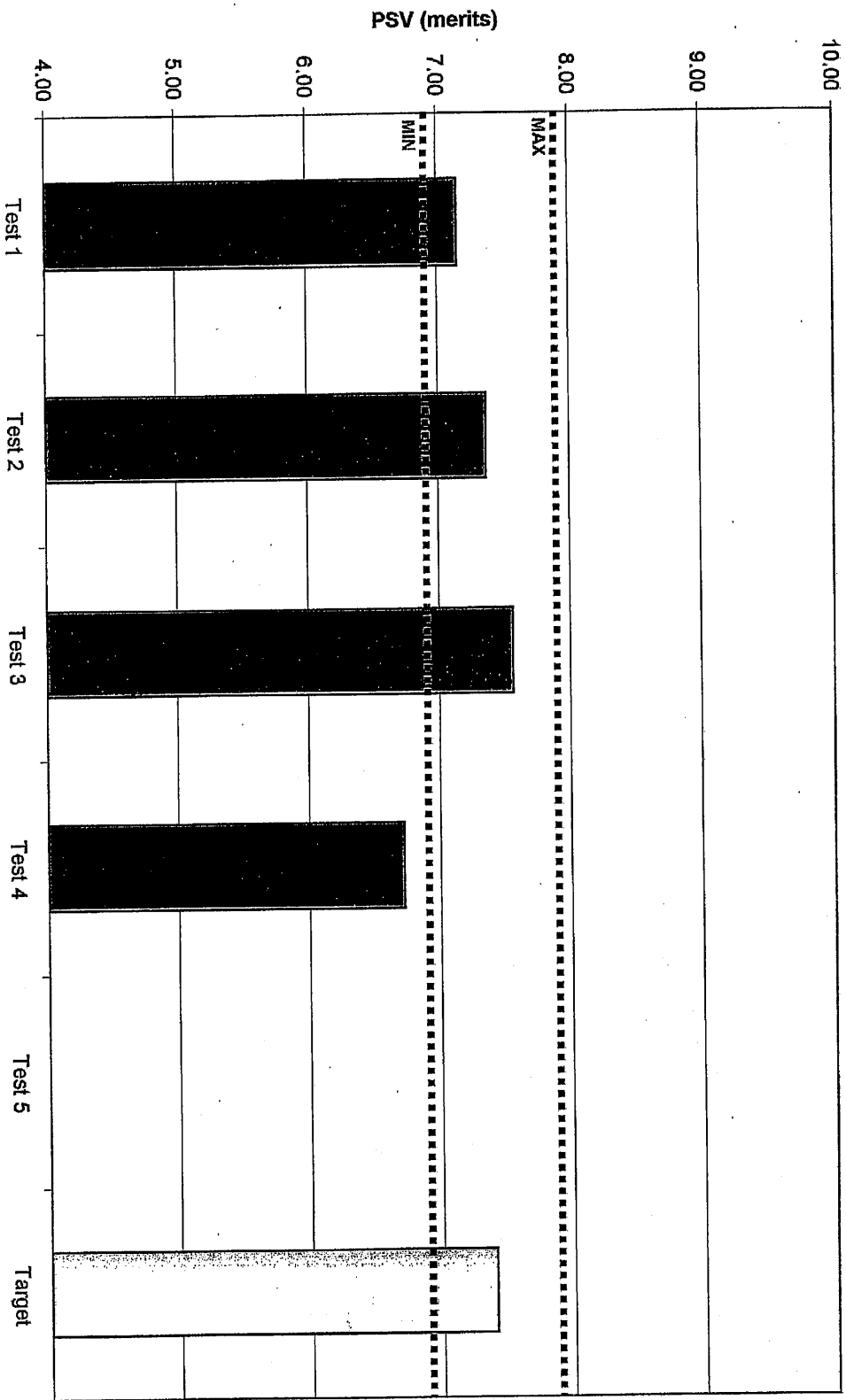


Sequence VG Prove-out Matrix Test Program  
Reference Oil 925-3: Average Engine Varnish



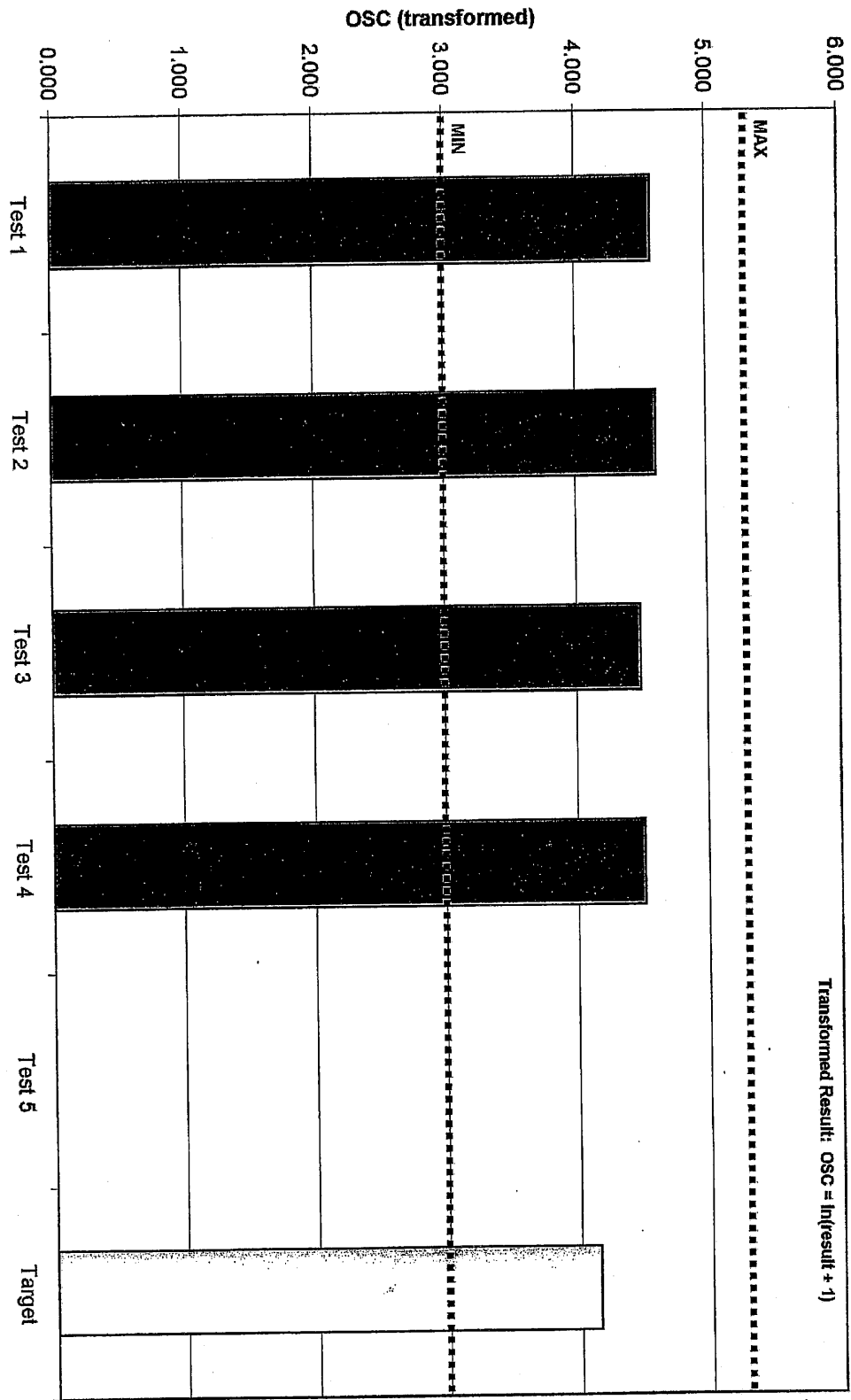
Sequence VG Prove-out Matrix Test Program

Reference Oil 925-3: Piston Skirt Varnish



Sequence VG Prove-out Matrix Test Program

Reference Oil 925-3: Oil Screen Clogging



## Sequence VG Romeo XW7E Engine Block Preparation @ Southwest Research Institute

### PRE-HONING

- New Block:** Inspect block, including all oil galleys, for debris and rust. Remove any debris or rust that is found, but perform no additional cleaning steps.
- EOT Block:** Solvent wash and manual clean block using brushes, including all oil galleys. Air dry block. Do not soak the block in solvent or pressure wash the block.

### HONING

Install the block in the honing machine with the right cylinder bank on the outside and the front of the block to the right.hone the right cylinder bank in the following order; cylinder # 3, cylinder # 1, cylinder # 4 and cylinder # 2. Then hone the left cylinder bank in the following order; cylinder # 7, cylinder # 5, cylinder # 8 and cylinder # 6. Follow this order to help insure a more uniform block temperature and to help eliminate the chance of over-heating one area of the block. The block does not need to be removed and reinstalled in the honing machine for the honing process. Just rotate the block and cradle to hone the different cylinder banks. The block will need to be removed, turned 180 degrees and reinstalled in the honing machine to perform the final surface finish measurements of the left cylinder bank. See the "Sequence VG 4.6L Cylinder Block Honing Procedure" for additional information on the honing process.

### POST-HONING

Remove stress plates from block. Loosen main caps, but keep main caps installed on block. Deburr top of cylinders. Clean block in jet washer for 30 minutes. Promptly remove block from jet washer, solvent wash and air dry. Spray block with 50/50 solution of EF-411 and Stoddard solvent to prevent rusting. Inspect block for debris and rust.

## SEQUENCE VG

## 4.6L CYLINDER BLOCK HONING PROCEDURE

- Hone block with CV616 honing machine.

**Settings:**

- Feed rate: 4
- Strokes per minute: 57
- Spindle speed: 170
- Stroke: 5.250 in.
- Overstroke: lower block 9 turns

**Stones:**

- Coarse: EHU512, hone @ 25-30 units of pressure
- Fine: JHU725, 5 strokes @ 20-25 units of pressure
- Plateau Hone Brush: 45 strokes @ 25-30 units of pressure

**Final Size:**

- Bore Gauge Set (for 0.25MM): 90.470 mm
- Bore Gauge Set (for 0.50MM): 90.700 mm
- Finish Target (Ra): 08 – 13  $\mu$ m
- Out-of-Round (Limit): 0.020 mm
- Taper (Limit): 0.006 mm
- Target a final size using piston size and ring land to bore clearance specification.
  - Clearance: 0.020 – 0.046 mm

**Post Honing Cleaning Procedure:**

- Remove stress plates from cylinder block, but keep main caps installed and loose.
- Wire brush cylinder block and thoroughly clean with Stoddard solvent.
- Clean cylinder block in Jet Washer for 30 minutes.
- Spray cylinder block with 50/50 solution of EF-411 and Stoddard solvent to prevent rusting.



ATTACHMENT 7



AER Manufacturing  
1605 Surveyor Blvd.  
P.O. Box 979  
Carrollton, TX 75011-0979  
Phone (972) 418-6499  
Fax (972) 417-3150

March 17, 2003

To Whom it May Concern:

Based on arrangements with Ford Motor Company, AER is not currently able to offer engine code OG-804-AA to be used for the VG testing purposes. We apologize for any inconveniences we have caused in offering and then resending our offer of these engines earlier.

Sincerely,

A handwritten signature in black ink, appearing to read 'Mark Spaulding', with a large, stylized flourish at the end.

Mark Spaulding  
Vice President of Operations

# VG Engine Hardware

- AER does not plan to supply engines for VG test purposes (Reference: Letter from M. Spaulding, AER VP of Operations dated March 17, 2003)
- Ford Power Products plans to sell 355 engines remaining. The cost is \$5,237 per engine at this time.
- All kits for 136 engines purchased are expected to be delivered by March 31, 2003.
- Elimination of 2 cylinder heads from the engine kit reduced the cost \$1,125 to a total of \$1425.

M. Riley  
*Ford Motor Company*  
Fuels and Lubricants Eng