March 14, 2002

Reply to: Fred Gerhart
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UNCONFIRMED MINUTES from the SEQUENCE VIB SURVEILLANCE PANEL

Held in Dearborn, MI
February 12th, 2002

Secretary Note: I was unable to attend this meeting. These minutes have been prepared using notes provided by Guy Stubbs of SwRI. The purpose of this meeting was to discuss VIC test development.

Welcome

Chairman Charlie Leverett called the meeting to order. The agenda was accepted and is included as Attachment 1.

Secretary Items

- Meeting minutes from the November 2001 were not available at the time of this meeting. They have since been posted to the TMC website.
- The attendance list was distributed and is included as Attachment 2.

Membership Changes or Additions

None noted.

VIC Discussion -

a.) Outline the rationale for developing a Sequence VI-C with respect to extended test time and increased limits for fuel economy increase

Barry Jecewski gave a presentation on the rationale for VIC development (see attachment No. 3).

b.) Outline the protocol and objectives of the test plan developed –
Patrick Lai and Milt Johnson gave a presentation on the initial design of experiment of the Ford test plan (see attachment No. 4).

Milt said that Oil RO182 was a GF-4 prototype, low phosphorus. 5W-20 oil. He also said that the reason for going from 4000 – 6000 mi. to 6000 – 8000 mi. is to make the oil more robust, to make it match customer expectations (customers don't always follow the 3000 mi. oil change recommendation). They do not expect the EPA to change the certification requirements from the current 4000 –6000 mi., but they can not speak for the EPA.

Patrick said the time prorated (TPR) percentage used were 85/15, 66/34, 6/94 for the 16-hour, 96-hour and 136-hour FEI calculations weighting of BCB/BCA. **NOTE: The FEI results on Slide #6, of attachment No. 4, are not severity adjusted.**

Gordon Farnsworth asked if we have seen anything, in the data so far, to say we need a VIC test? Does it do anything that the VIB does not do?

Charlie Leverette asked how the VIC development would be funded? He said if we can't answer that question, we are wasting our time.

Milt Johnson gave a presentation on the oil analysis (see attachment No. 5).

c.) Present and discuss any additional developmental Sequence VI-C tests that have been run by various labs.
Guy Stubbs presented data on SwRI's 1008 VIC shakedown (see attachment No. 6). Chemical analysis and TPR data by stage, given orally at the meeting, were added to this presentation.

d.) Discussion of next steps
Patrick gave a presentation on how the time pro-rating was developed (see attachment No. 7). Consensus of the group was to use the TPR % that Patrick presented. Rich Grundza will use these percentages in the VIC data dictionary, which should be available on the TMC website within a few weeks. *Action Item - Charlie to send out early copies of Patrick's and Milt's presentations to the group.*

Milt Johnson presented plot of RSI data on "Oil Consumption/Viscosity Grade/Engine Hrs" for the VIB test (see attachment No. 8).

Gordon Farnsworth made the comment that we need data to support adding 40-hours to the VIB test, because the data so far does not support it. An oil is needed that shows separation between the VIB and VIC test. The alternative is to use the VIB with different targets.

Consensus of the group was to run any future VIC development tests the way that Patrick ran them (i.e., FEI at 16, 96 and 136 hours).

Charlie summarized that first, Ford needs to come up with an oil that demonstrates the need for the additional 40-hours. Charlie (as S.P. chair) and Gordon (as Reference oil subpanel chair) volunteered to work with Barry and oil suppliers.

Charlie, Patrick and Guy (if management approves) volunteered one test on this “new oil.”

The GF-4 timeline was discussed. Consensus was that the first step is to find the “new oil”.

NEW BUSINESS

a.) Discussion on VIB & C reference oils situation

Rich gave a presentation on reference oils. BC-5 is being blended. 1008 is in short supply. He suggested changing usage: 10% - 1008, 45% - 1006, 45% - 538. Accepted by consensus.

Adjourn

Next scheduled meeting is the May Surveillance Panel tentatively scheduled for Pittsburgh PA.

Sequence VIB/C Surveillance Panel

Sequence VIC Test Development Task Force (TDTF)

February 12, 2002 Ford S.R. Laboratory

Detroit/Dearborn MI

Agenda

1.) Welcome

2.) Attendance Sign-in sheet (Guy Stubbs will handle sign-in and minutes for this meeting)

3.) Membership changes and/or additions.

4.) Minutes Approval from November 01, meeting (Fred told me that they should be available soon)

5.) VIC Discussion:

a.) Outline the rationale for developing a Sequence VI-C to replace the Sequence VI-B with respect to extended test time and increased limits for fuel economy increase. (Barry Jecewski)

b.) Outline the protocol and objectives of the test plan developed by Ford and Imperial Oil. Presentation of data from tests completed at Imperial Oil. (Patrick Lai, Milt Johnson)

c.) Present and discuss any additional developmental Sequence VI-C tests that have been run by the various labs. Note, if a particular lab(s) can not attend the development team meeting on Feb.12 they could send the data presentation to the Chairperson (Charlie Leverett).

d.) Discussion of next steps.

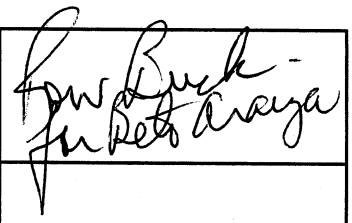
6.) Old Business

7.) New Business:

a.) Discussion on VIB & C Reference Oils situation

8.) Adjournment

ATTENDANCE ASTM SEQUENCE VIA/VIB SURVEILLANCE PANEL MEMBERSHIP

ARIAZO, BETO	Test Engineering, Inc, 12718 Cimarron Path San Antonio, TX 78249	(210)690-1958 (210)690-1959 bariazo@testeng.com	
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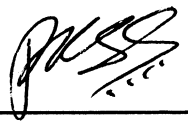
LAI, PATRICK Member	Esso Canada, Imperial Oil Ltd P.O. Box 3022 Sarnia, ONT N7T8C8 CANADA	(519)339-5611 (519)339-5866 patrick.k.lai@esso.com	
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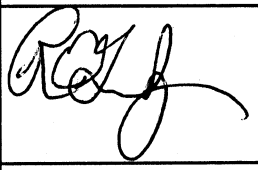
GRUNDZA, RICH Member	ASTM TMC 6555 Penn Avenue Pittsburgh, PA 15206-4489	(412)365-1031 (412)365-1047 reg@tmc.astm.cmri.cmu.edu	
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ATTENDANCE ASTM SEQUENCE VIA/VIB SURVEILLANCE PANEL MAILING LIST

NAME	ADDRESS	PHONE / FAX / E-MAIL	ATTENDANCE

Sequence VI-C Development Team Meeting

Scientific Research Laboratory

Dearborn, Michigan

February 12, 2002

Milton Johnson, Ford Motor Co.

Patrick Lai, Imperial Oil

Barry Jecewski Ford Motor Co.

Ford Motor Company

Why the change to Sequence VI-C?

Ford Motor Company is responding to both customer demand for increased fuel economy and performance . Ford will meet these challenges while maintaining sensitivity to environmental issues.

- Current sequence VIB aging of 80 hours in the second aging stage corresponds to 4,000-6,000 miles of aging in vehicles.

- increasing aging time in the second stage from 80 to 120 hours will ensure retention of fuel efficiency benefits for longer times in customer service (6,000-8,000 miles)

How can this be facilitated?

Among other items the proposed ILSAC GF-4 minimum performance standard establishes the goals for FEI(s) and additional oil aging (performance). Working as a team with oil companies and additive suppliers Ford Motor Co. will set the standard for both fuel economy increase of oil and oil performance.

- Ford is confident that these goals can be attained through engine oil formulation technology.

Ford Motor Company

The ILSAC GF-4 proposal is in part an increase in fuel economy and oil aging

SAE 0W-20 & 5W-20 vis grades:

2.4% FEI min after 16 hrs aging

2.1% FEI2 min after an additional 120 hrs aging

SAE 0W-30 & 5W-30 vis grades:

2.0% FEI min after 16 hrs aging

1.7% FEI2 min after an additional 120 hrs aging

SAE 10W-30 all other vis grades:

1.3% FEI min after 16 hrs aging

1.0% FEI2 min after an additional 120 hrs aging

Ford Motor Company

Initial Test Plan to Validate the Sequence VI-C

The following are inputs into the test matrix that was performed at Imperial Oil :

Test oil(s) 1008, 538, and RO182

Additional 40 hours of oil aging which equates to a goal of 6000-8000 miles .

Additional 360mls of oil to the 6000mls oil fill charge to address the oil consumption issue that manifested itself with the additional oil aging .

Repeatability issue (stand to stand).

Ford Motor Company

Initial Test Design Verification

Patrick Lai (Imperial Oil) will discuss the initial testing objective(s) and how they were addressed. Followed by oil test results.

Milton Johnson (Ford Motor Co.) will review the oil analysis done at the Scientific Research Lab on Seq.VIC oil samples.

Ford Motor Company

SEQUENCE VIC DEVELOPMENT
INITIAL DESIGN OF EXPERIMENT

DEARBORN, MI

FEBRUARY 12, 2002

Barry Jecewski, Ford Motor Company

Milton Johnson, Ford Motor Company

Patrick Lai, Imperial Oil

DESIGN OBJECTIVES

- TO EXAMINE OR DEMONSTRATE THE FOLLOWING
  - A WIDE RANGE OF FORMULATION CHEMISTRY
  - PERFORMANCE DEGRADATION AFTER 40 HOURS OF ADDITIONAL AGING
  - EFFECT OF 360 mL ADDITIONAL OIL CHARGE
  - ENGINE PERFORMANCE AND OIL ANALYSIS COMPARISON
    - VISCOMETRICS
    - OXIDATION / NITRATION
    - COEFFICENT OF FRICTION
    - DEPLETION OF P-O-C ABSORBANCE
  - REPEATIBILITY

DESIGN PROTOCOL

- 3 OILS UTILIZED, 2 WITH ESTABLISHED PERFORMANCE LEVELS
  - TMC 1008 (SAE 5W30)
  - TMC 538 (SAE 5W20)
  - RO 182 (SAE 5W20)
- 2 TEST STANDS, PREVIOUSLY VIB REFERENCED
- 5 TESTS
  - 4 AT 6.36L INITIAL OIL CHARGE
  - 1 AT 6.00L INITIAL OIL CHARGE

DESIGN MATRIX

	STAND E8	STAND W10
1	TMC 1008 (6.36L)	TMC 1008 (6.36L)
2	TMC 538 (6.36L)	RO 182 (6.36L)
3	TMC1008 (6.00L)	

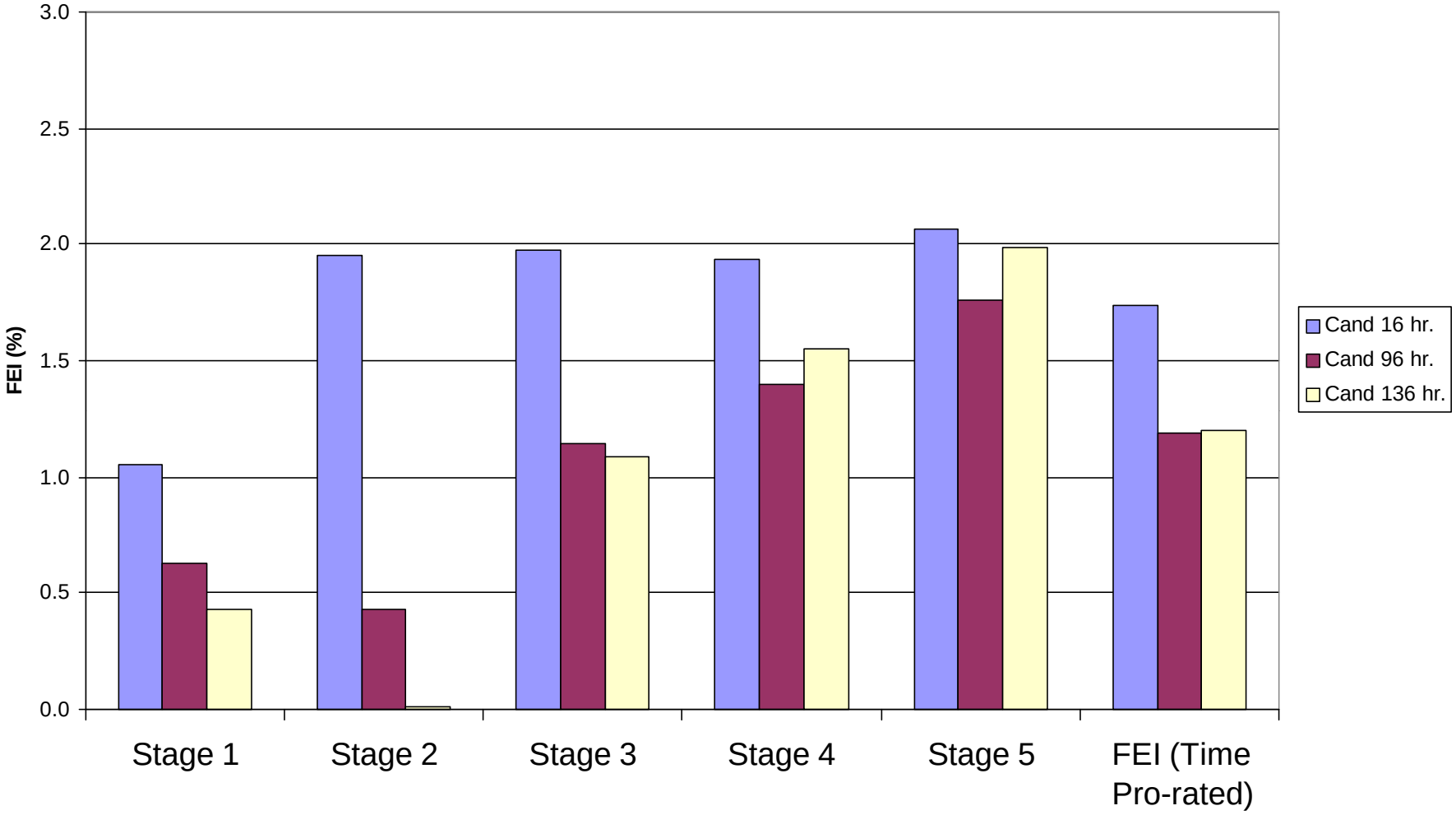
TEST PROTOCOL

- TESTS CONDUCTED AS PER VIB WITH FOLLOWING DIFFERENCES
  - INITIAL CANDIDATE OIL CHARGED WITH ADDITIONAL 0.36L (TOTAL 6.36L) FOR 4 OF 5 TESTS
  - ADDITIONAL 40 HOURS OF AGING AT VIB CONDITIONS TO A TOTAL OF 136 HOURS
  - 5-STAGE BSFC MEASUREMENTS AT 16, 96, AND 136 HOURS OF TOTAL AGING
  - SMALL (5 mL OR LESS) OIL SAMPLES TAKEN AT 12, 14, 16, 32, 48, 64, 80, 96, 104, 112, 120, 128, AND 136 HOURS OF AGING.
  - TIME PRO-RATED WEIGHTING** TO CALCULATE FEI AT 16, 96, AND 136 HR
- ** SEPARATE PRESENTATION ON TPR WEIGHTING

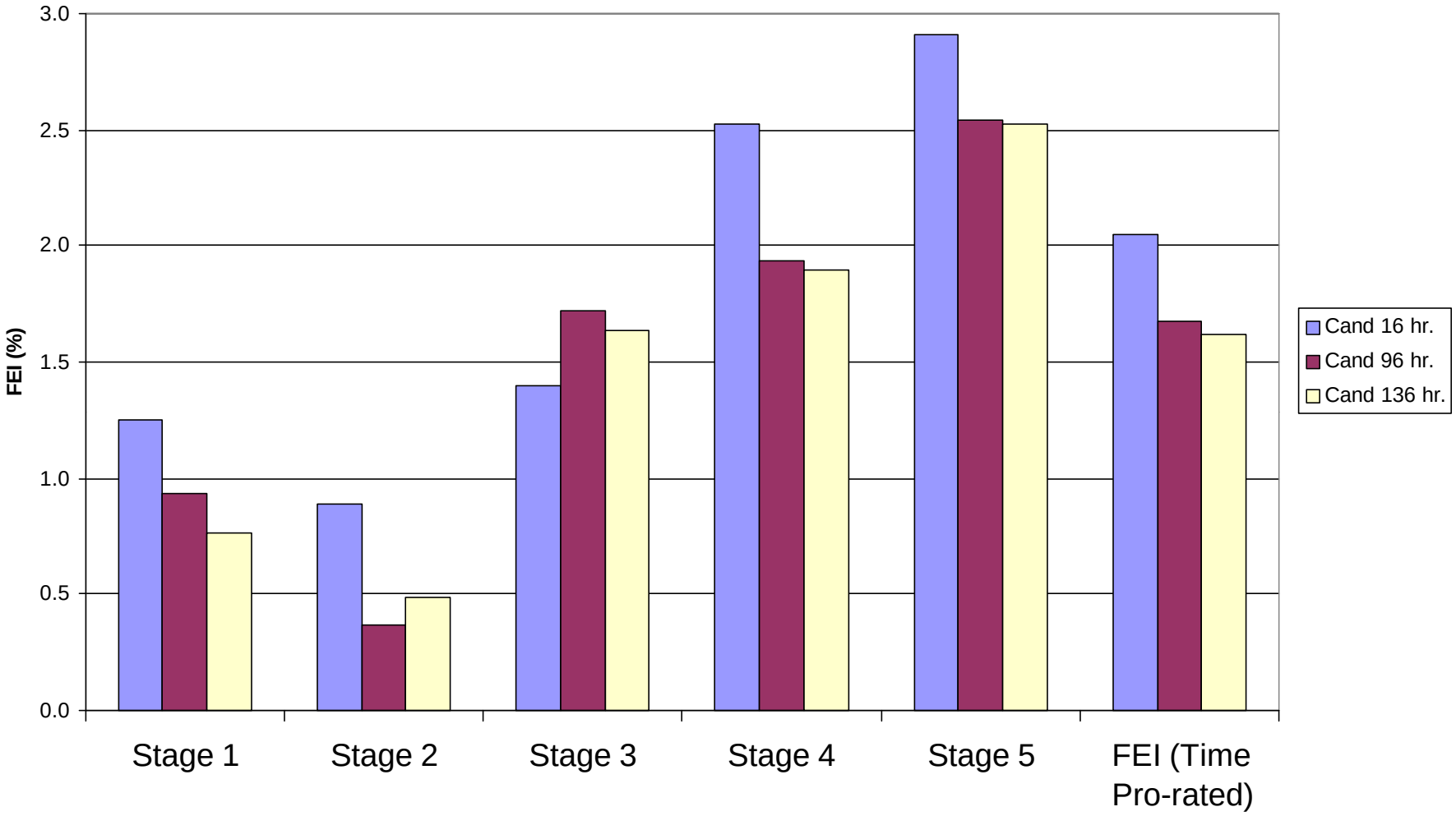
OVERALL RESULTS (FEI %)

TEST #	OIL	PHASE 16	PHASE 96	PHASE 136
E8 - 329	TMC 1008	1.74	1.19	1.20
E8 - 330	TMC 538	2.05	1.68	1.62
W10 - 134	TMC 1008	1.76	1.18	1.30
W10 - 135	RO182	1.91	1.86	1.74
E8 - 332	TMC 1008-6L	2.04	1.01	1.17

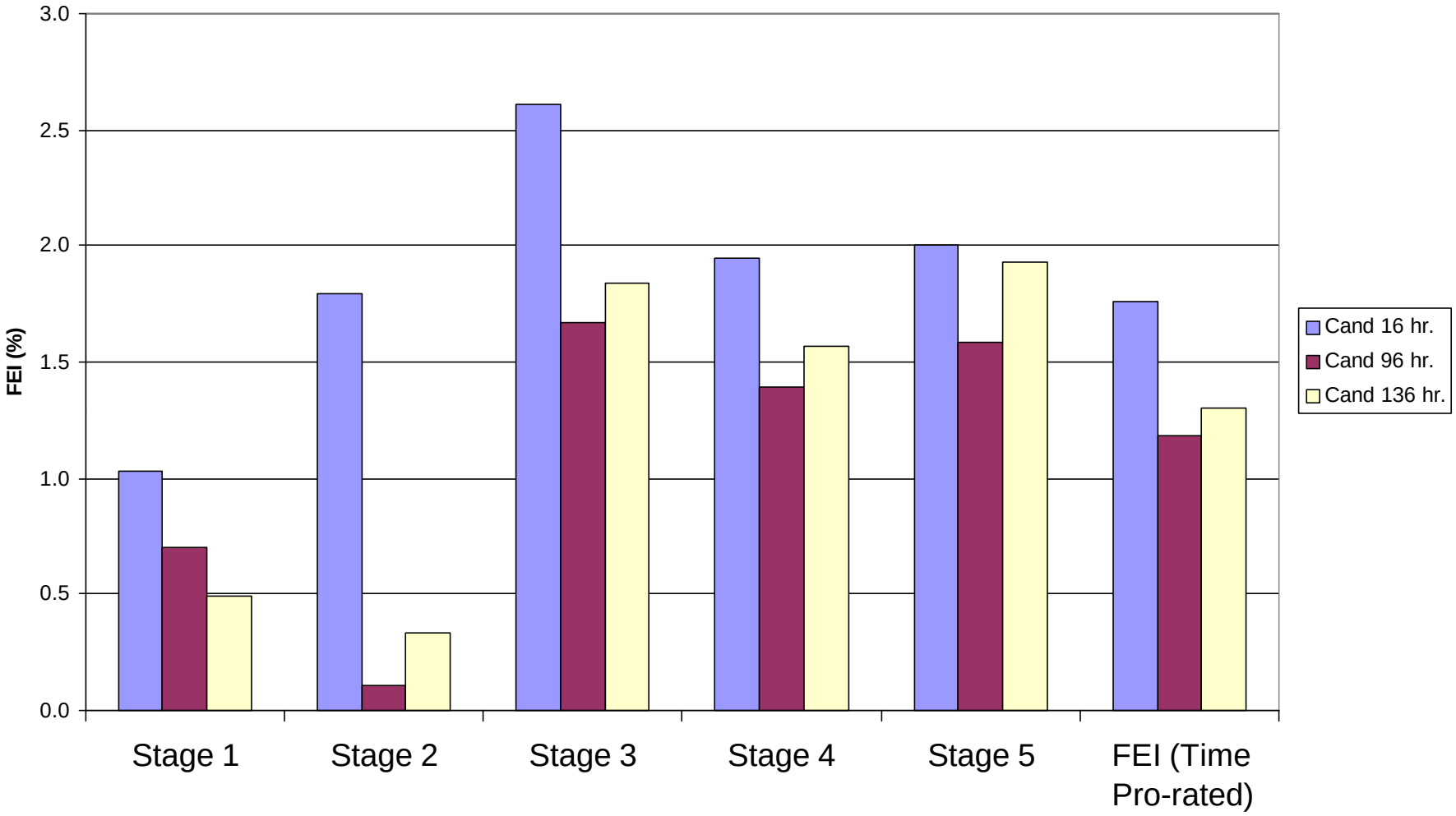
Time Prorated Fuel Economy
E8-329 TMC 1008



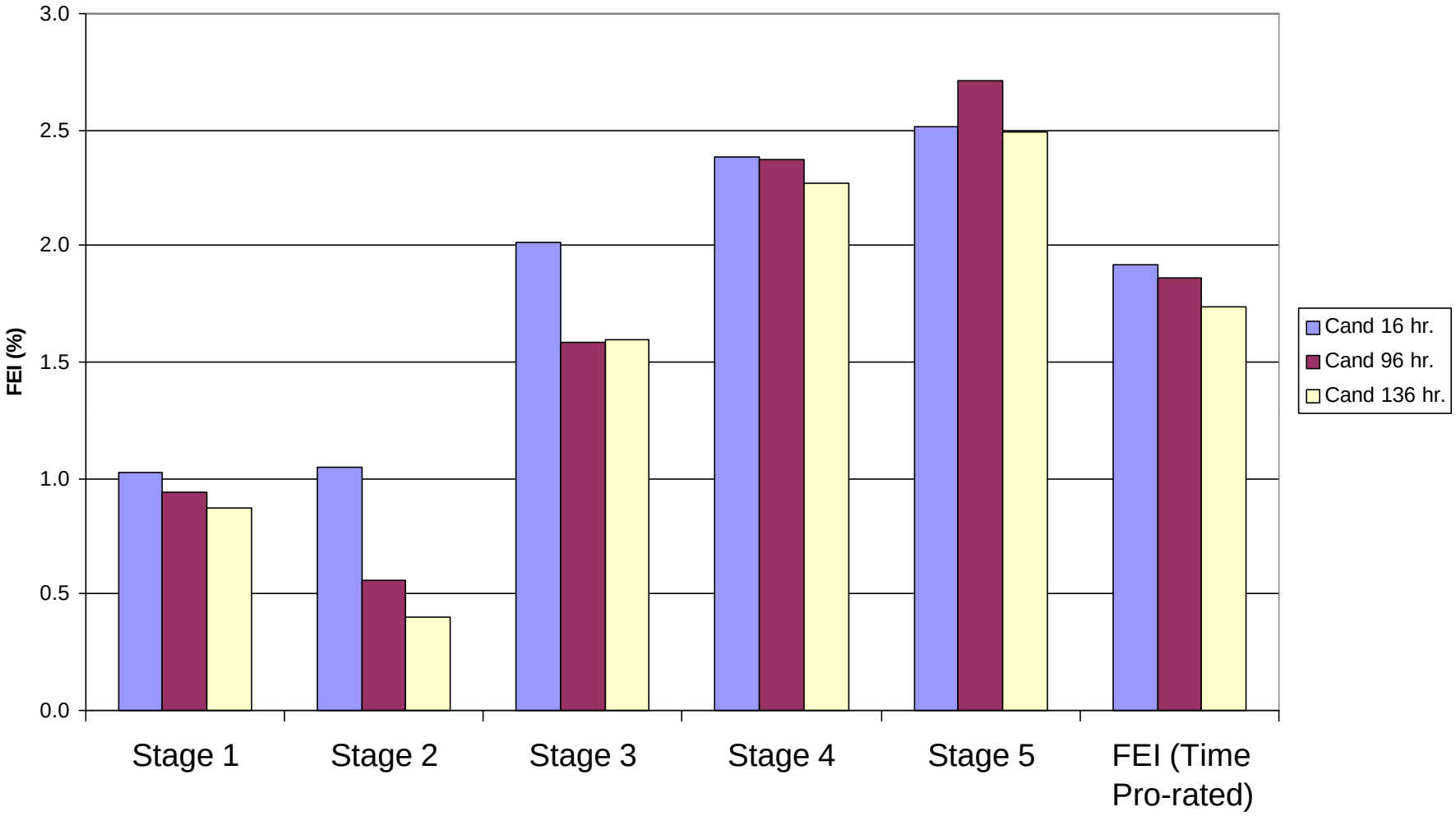
Time Prorated Fuel Economy
E8-330 TMC 538



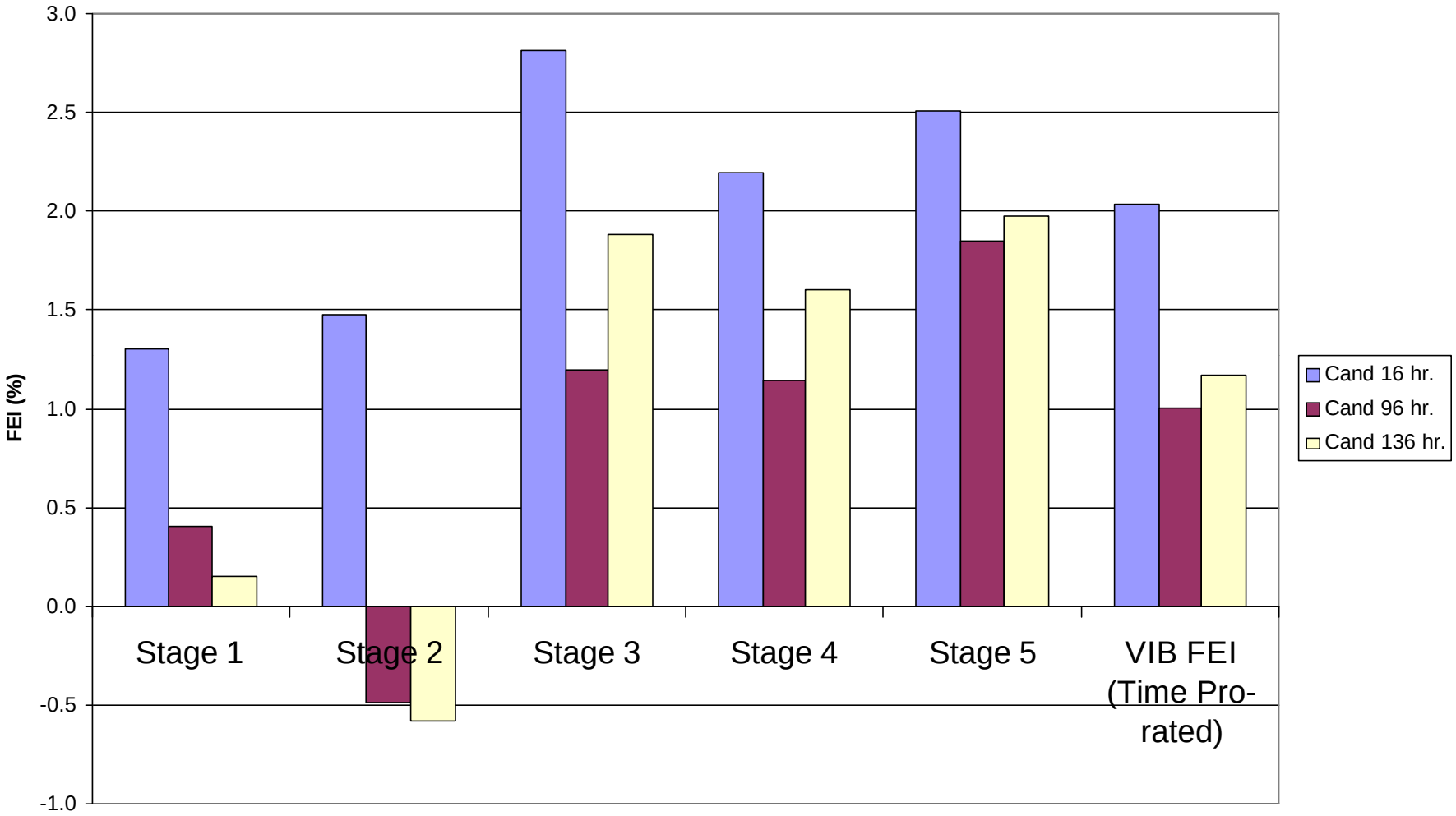
Time Prorated Fuel Economy
W10-134 TMC 1008



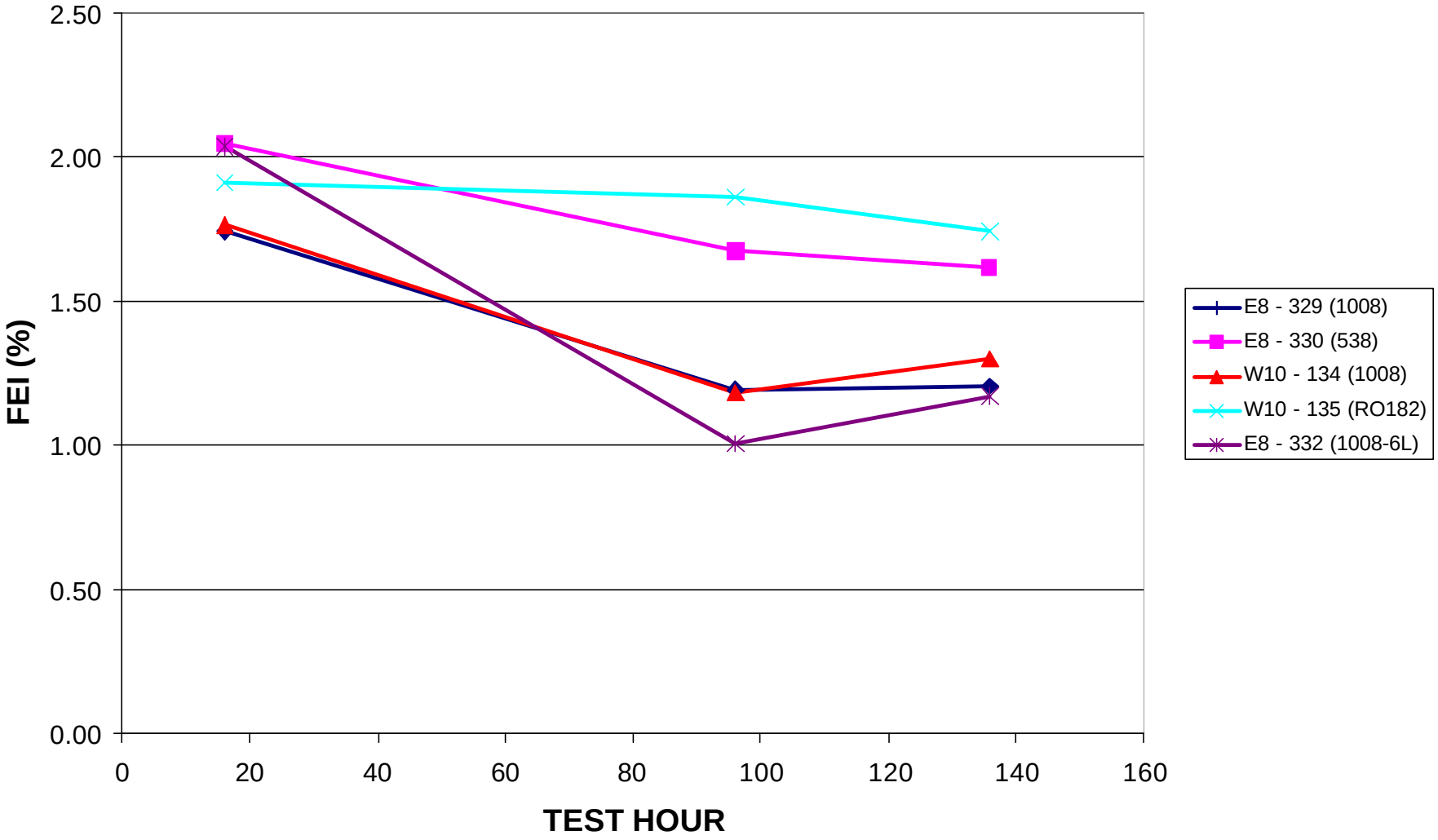
Time Prorated Fuel Economy
W10-135 RO 182



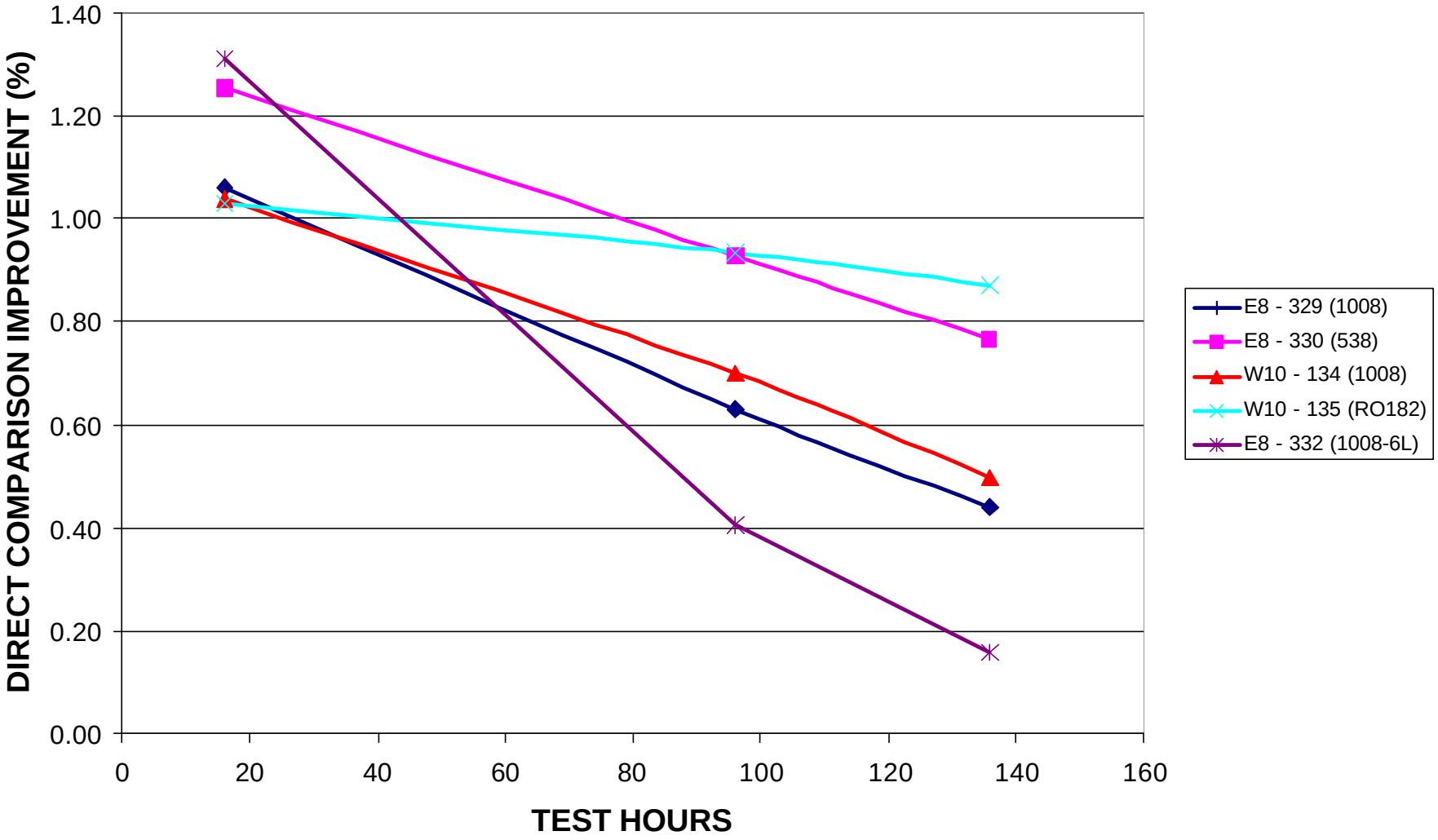
Time Prorated Fuel Economy
E8-332 TMC 1008 (6L)



FEI COMPARISON



STAGE IMPROVEMENT (STAGE 1)



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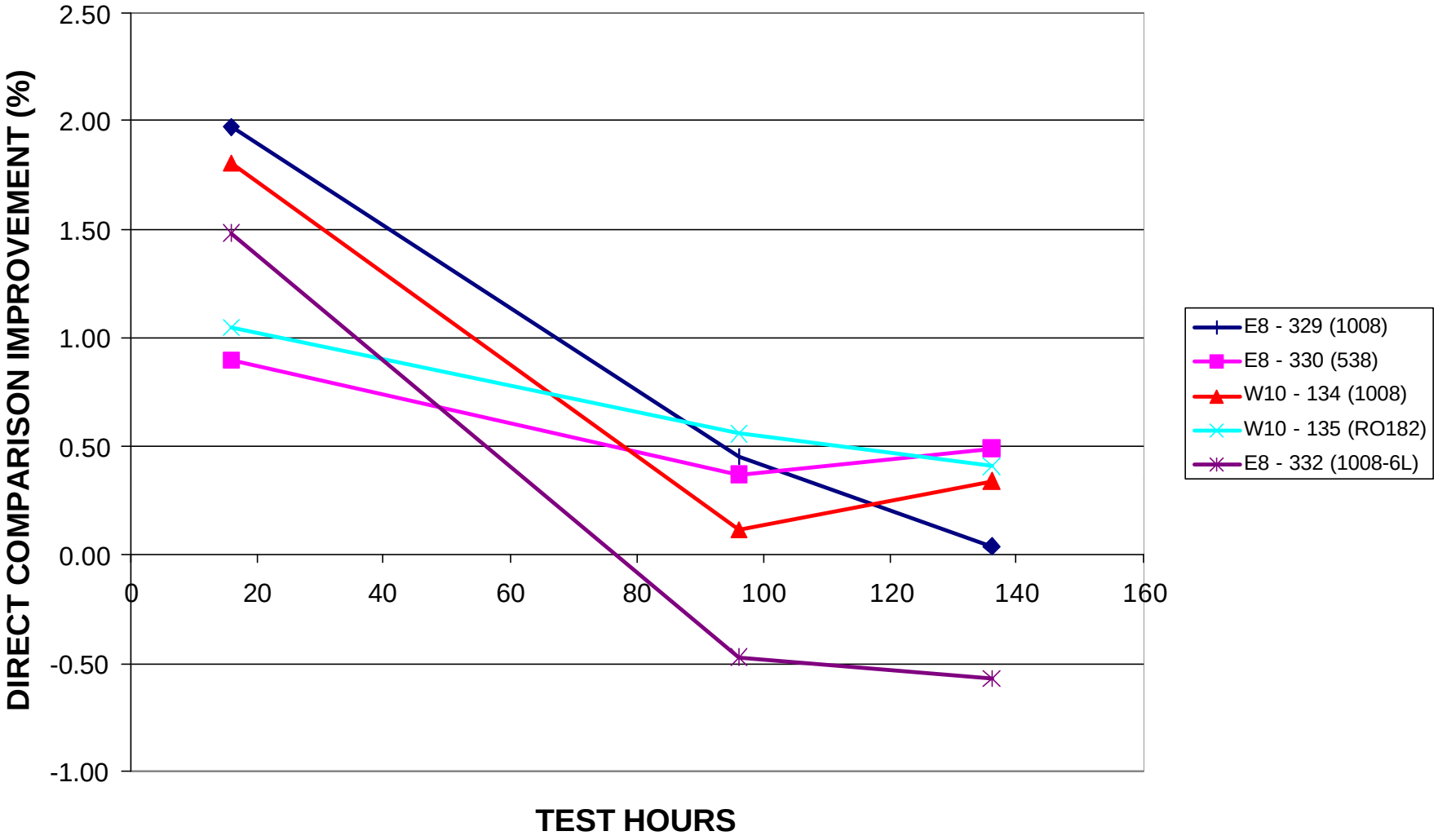

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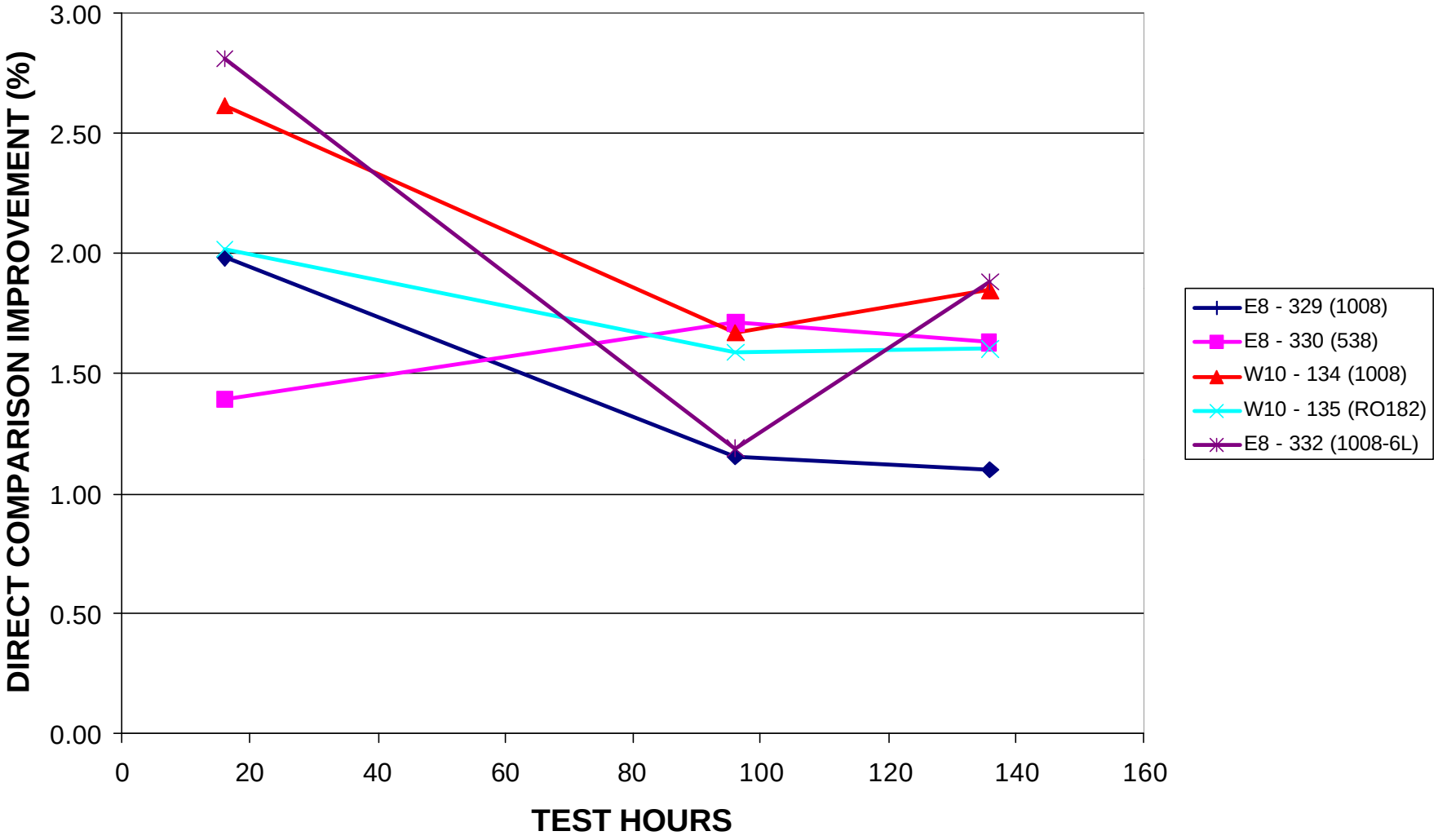

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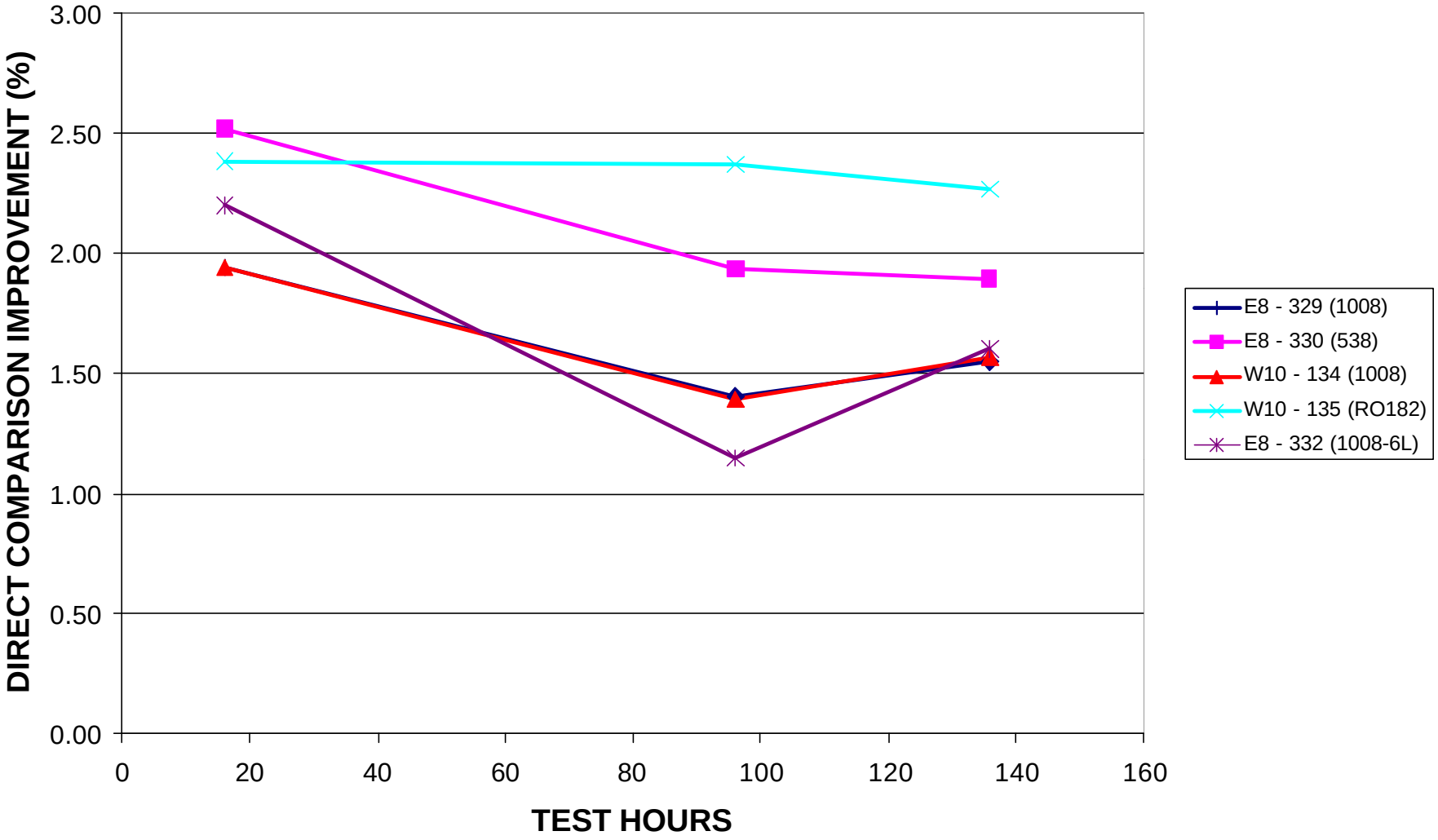

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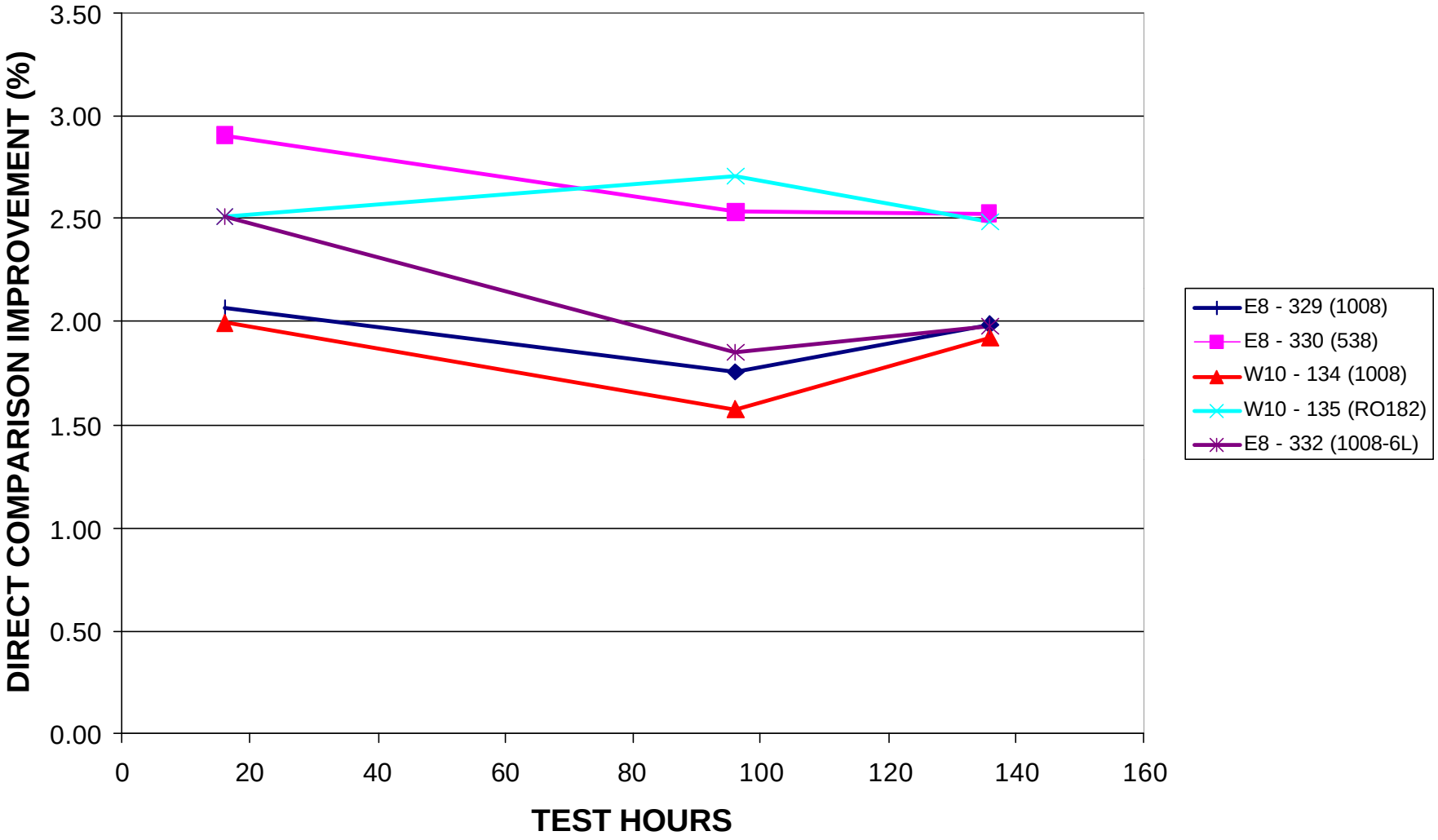
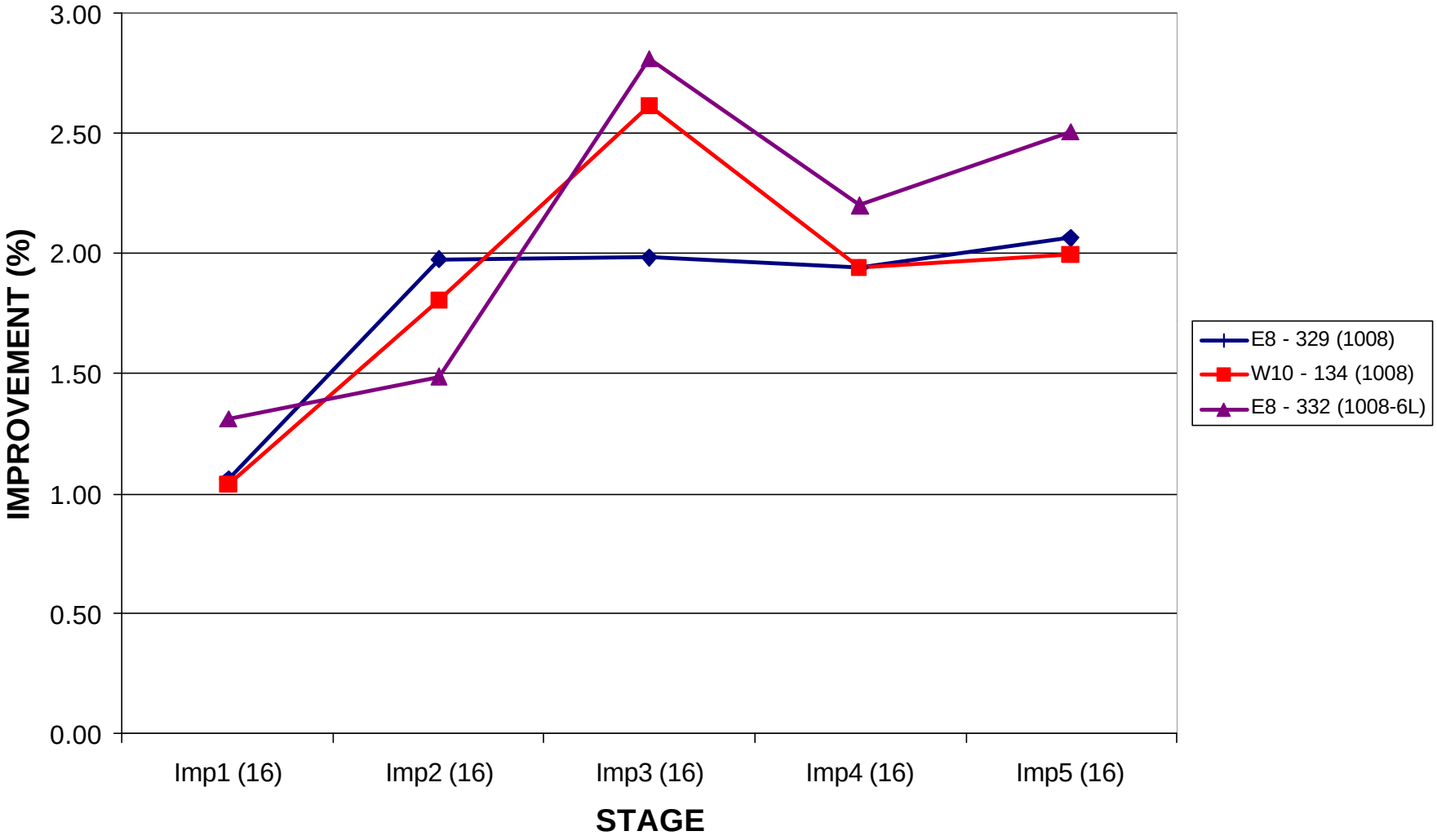
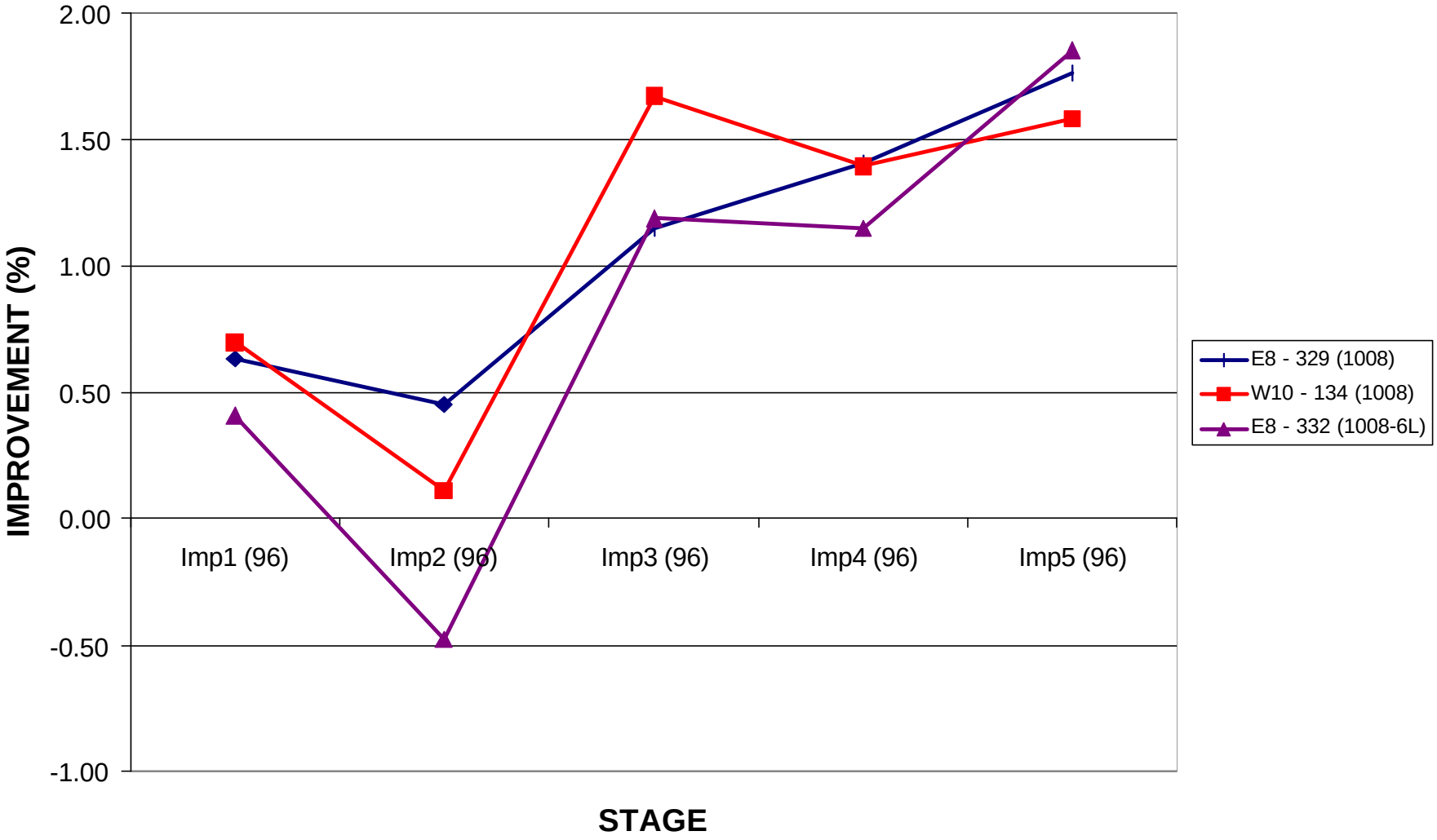


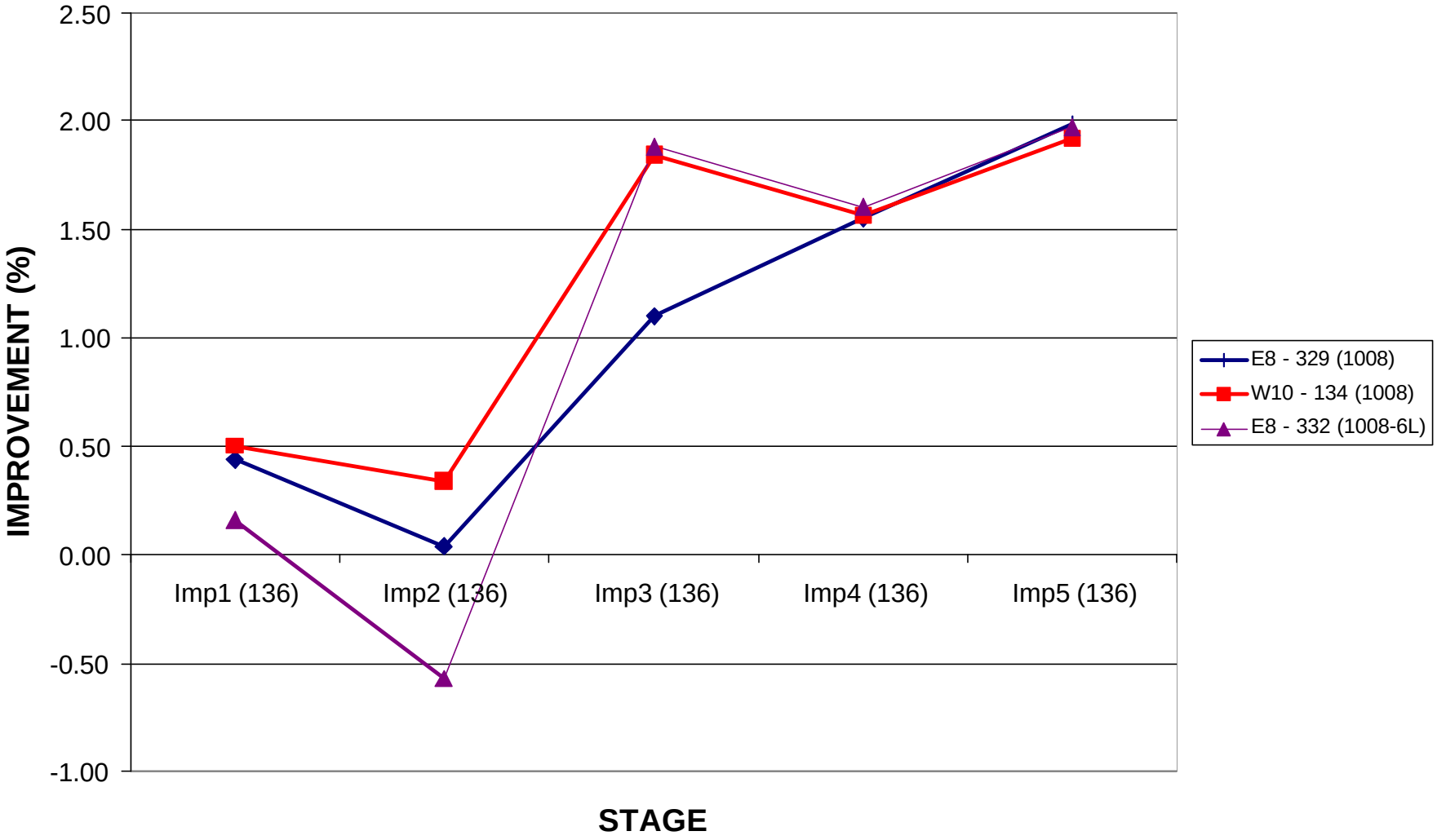
FEI @ 16 HOUR COMPARISON (1008)

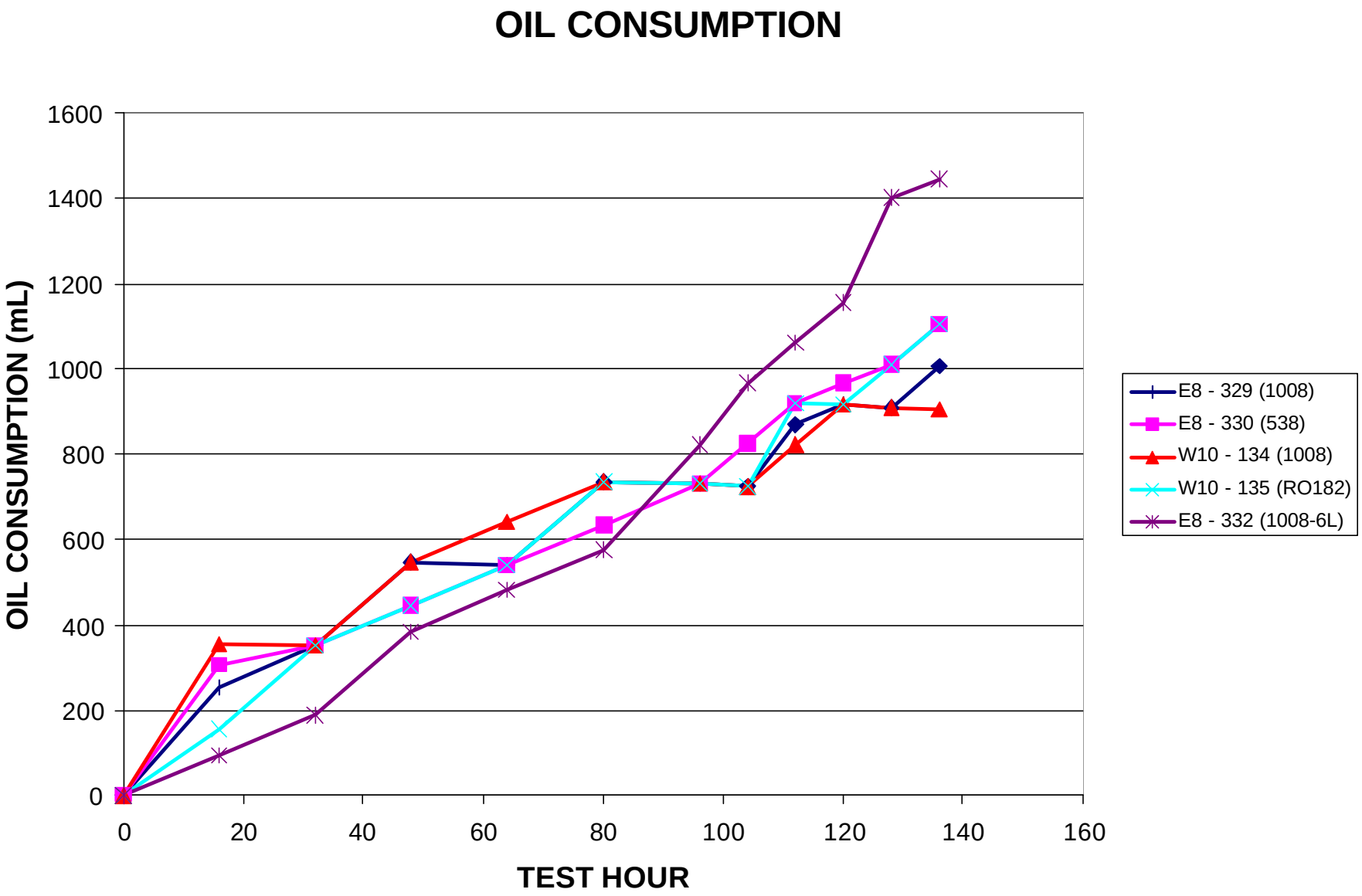


FEI @ 96 HOUR COMPARISON (1008)

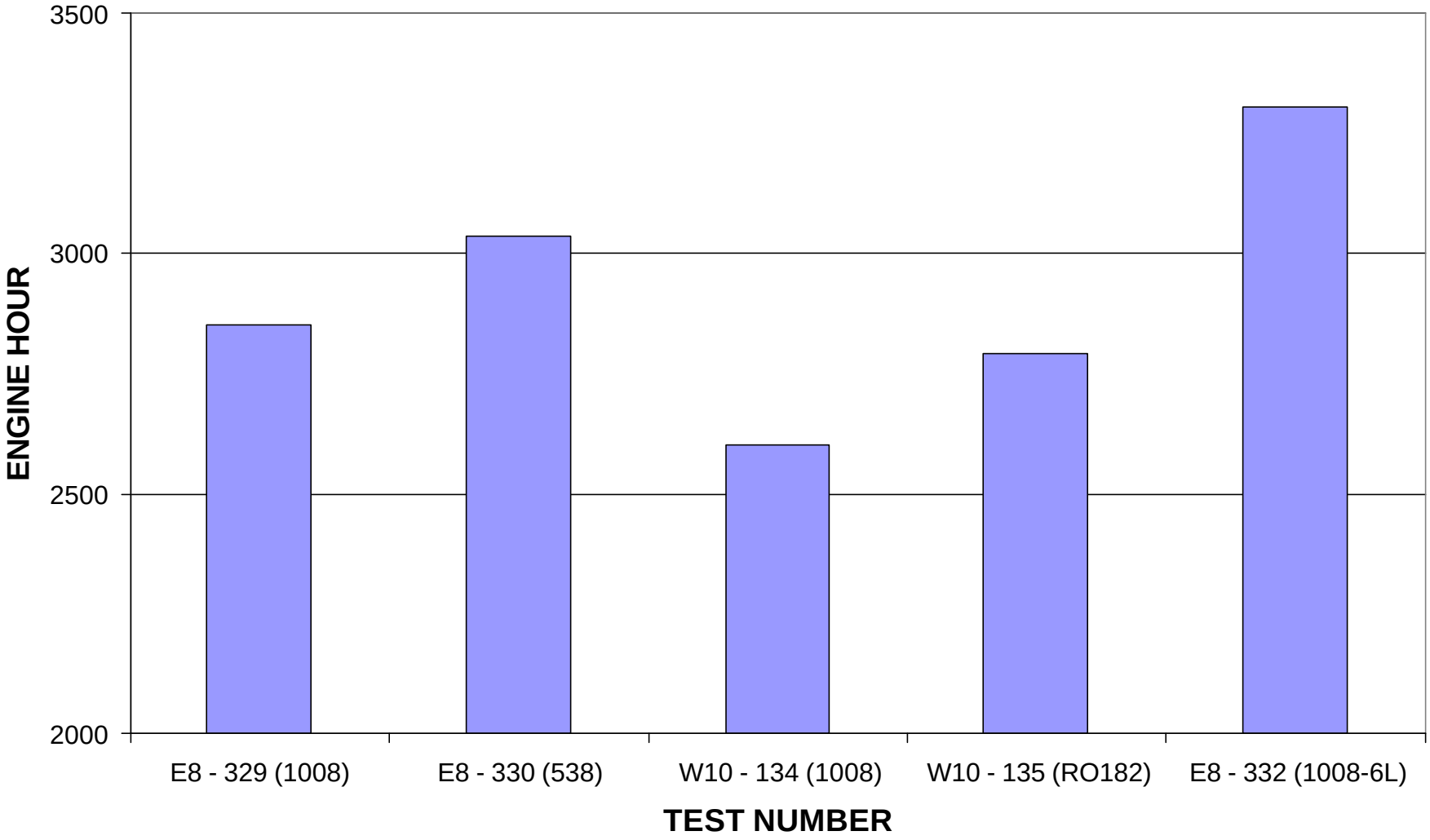


FEI @ 136 HOUR COMPARISON (1008)




OIL CONSUMPTION
OIL CONSUMPTION (mL)
1600
1400
1200
1000
800
600
400
200
0
0
20
40
60
80
100
120
140
160
TEST HOUR
E8 - 329 (1008)
E8 - 330 (538)
W10 - 134 (1008)
W10 - 135 (RO182)
E8 - 332 (1008-6L)

ENGINE HOUR AT START OF TEST



OBSERVATIONS – ENGINE DATA

- 3 DIFFERENT FAMILIES OF CHEMISTRY USED. NEED TO EXPAND TO MORE
- FOR THESE 3 OILS, LITTLE OR NO ADDITIONAL FEI DEGRADATION WITH EXTRA 40 HOURS OF AGING
- 360 mL OF EXTRA OIL CHARGE HAS NO SIGNIFICANT INFLUENCE ON FEI
- GOOD REPEATABILITY BETWEEN THE 2 STANDS USED DEMONSTRATED

Sequence VIC Development

Oil Analysis

Milton Johnson, Ford Motor Co.

Patrick Lai, Imperial Oil

Barry Jecewski, Ford Motor Co.

Presentation to Sequence VIC Development Team

February 12, 2002

Approach

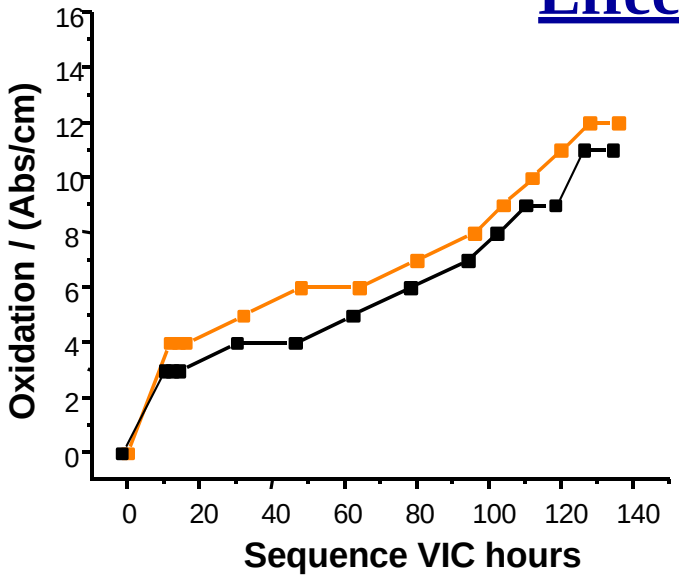
Determine effects of aging time on oil properties in extended length "Sequence VIC" testing.

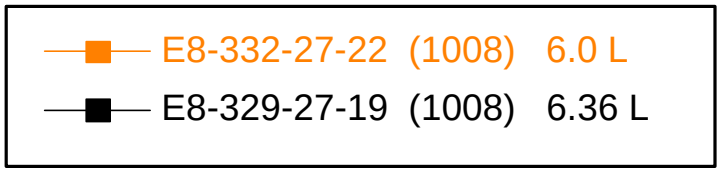
- Three oils
  - Reference oils 1008 and 538
  - GF-4 prototype – RO-182
- Two stands

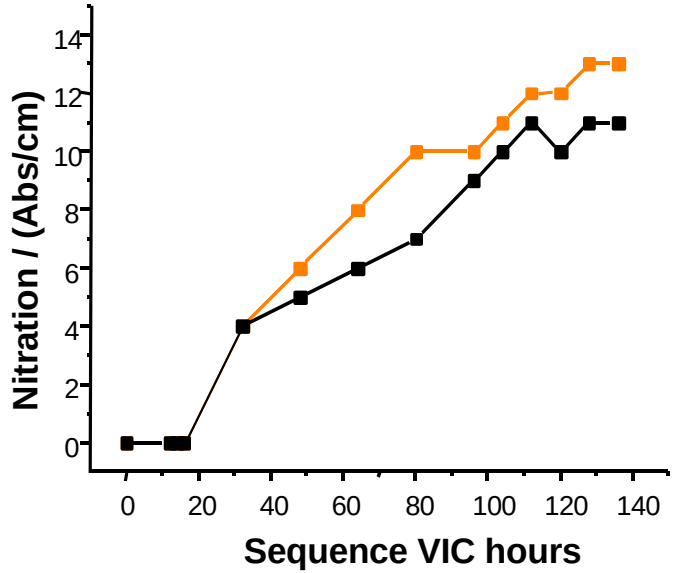
Monitor changes in oil as a function of aging time

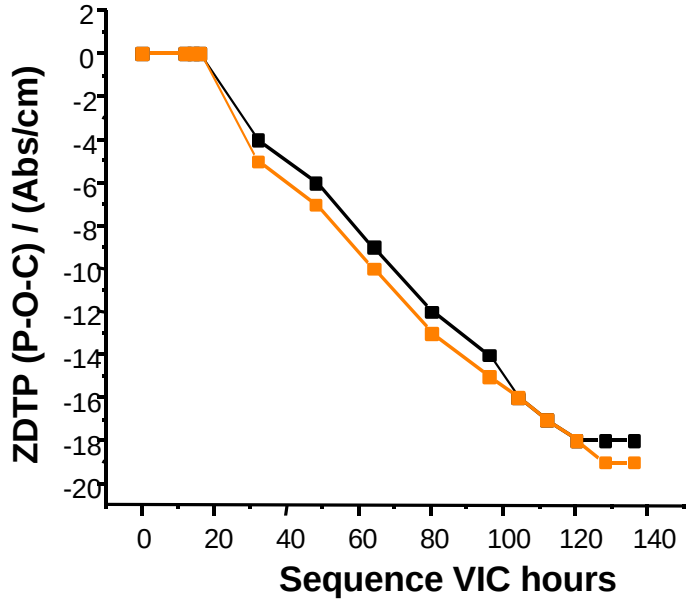
- Infrared spectroscopy
  - Oxidation
  - Nitration
  - P-O-C (ZDTP) depletion
- Friction coefficient – HFRR
  - 30 min @ 105 ºC, 1000 g load, 20 Hz, 1mm stroke
  - Report average value during last 10 minutes
- Viscosity – kinematic at 40 ºC

Effect of Oil Volume

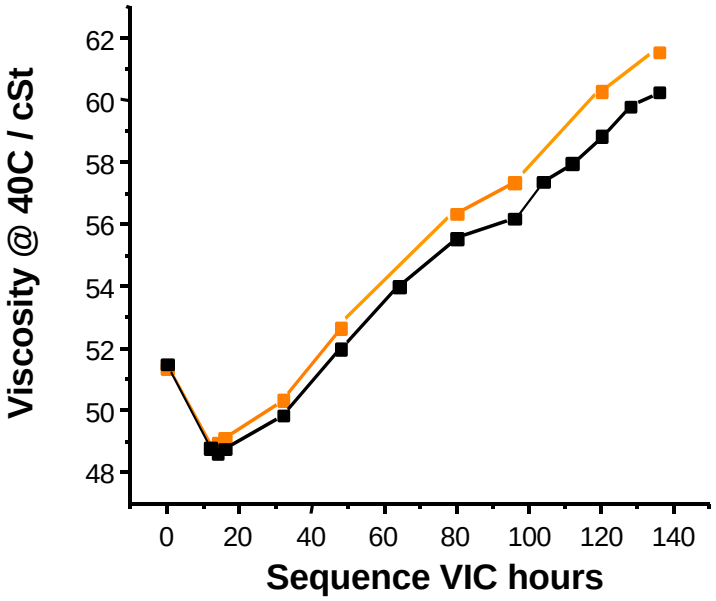


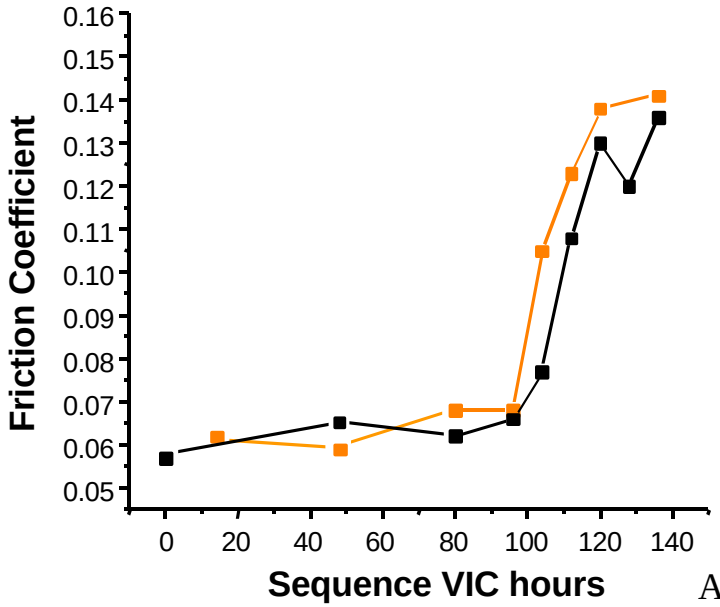






Effect of Oil Volume





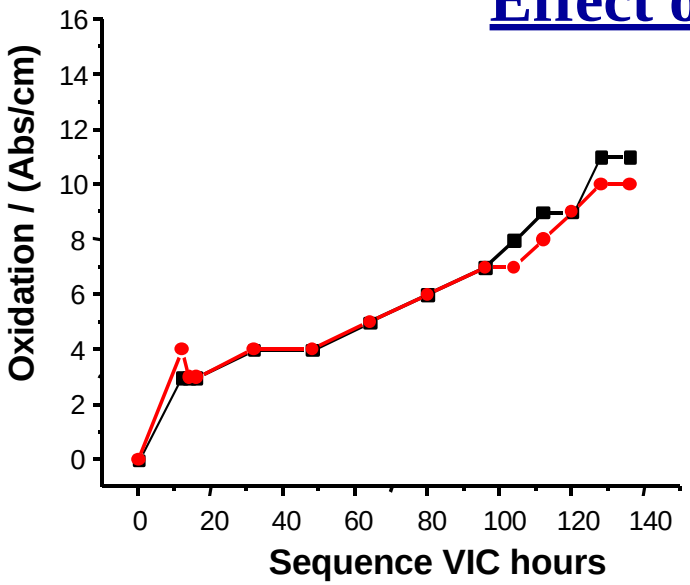
E8-332-27-22 (1008) 6.0 L

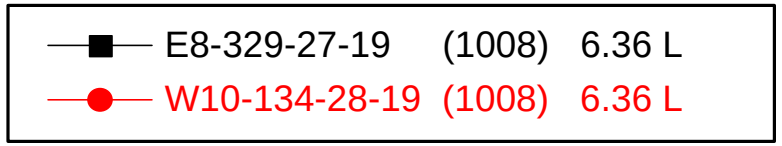
E8-329-27-19 (1008) 6.36 L

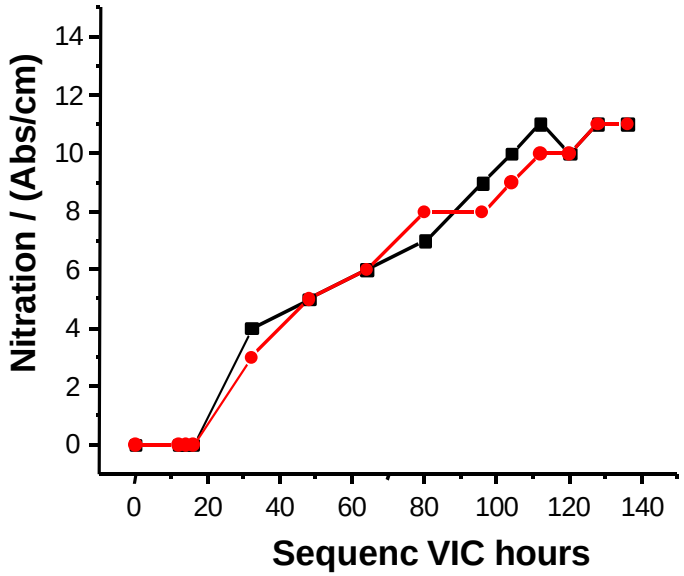
Increased oil volume reduced aging severity

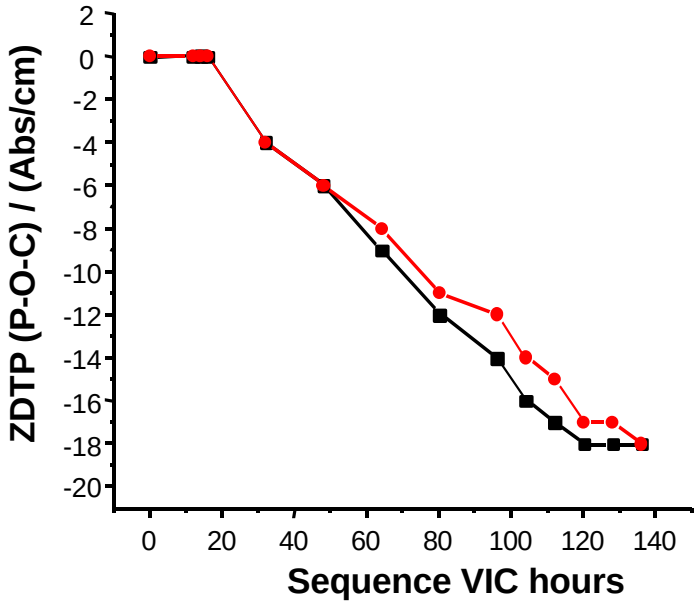
- Less oxidation and nitration
- Reduced additive depletion rate
- Less viscosity increase
- Longer time to loss of FM activity

Effect of Test Stand /Engine

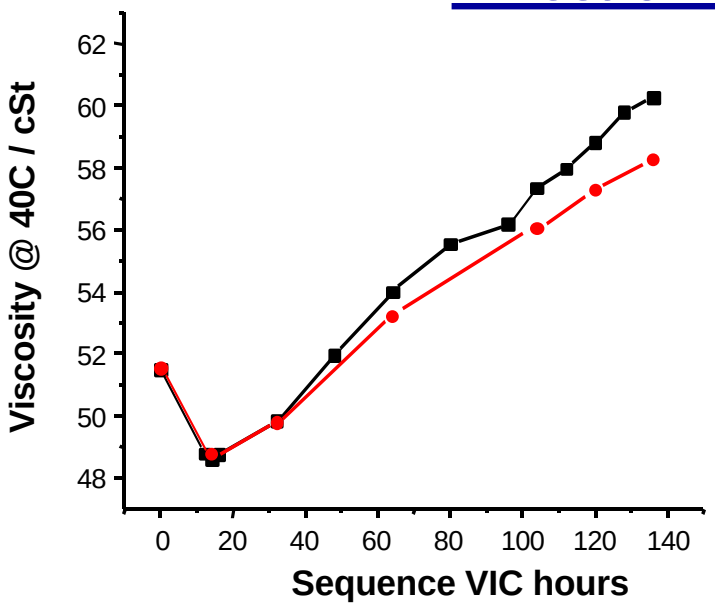


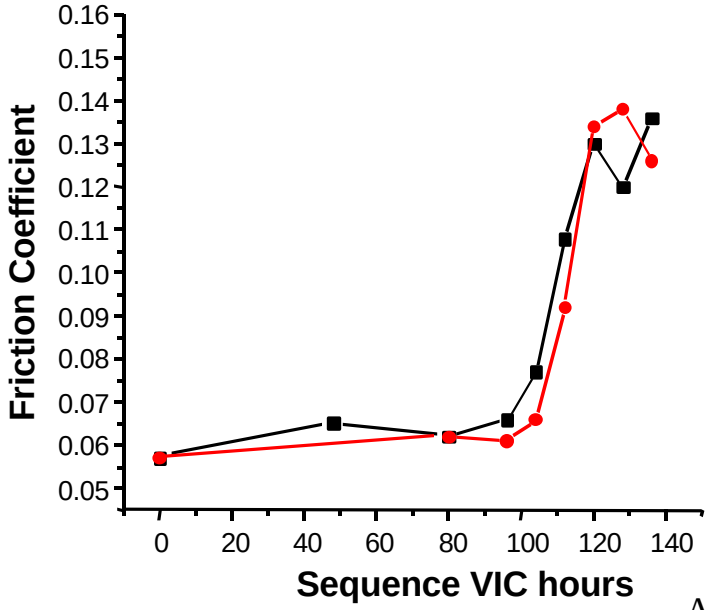






Effect of Test Stand /Engine





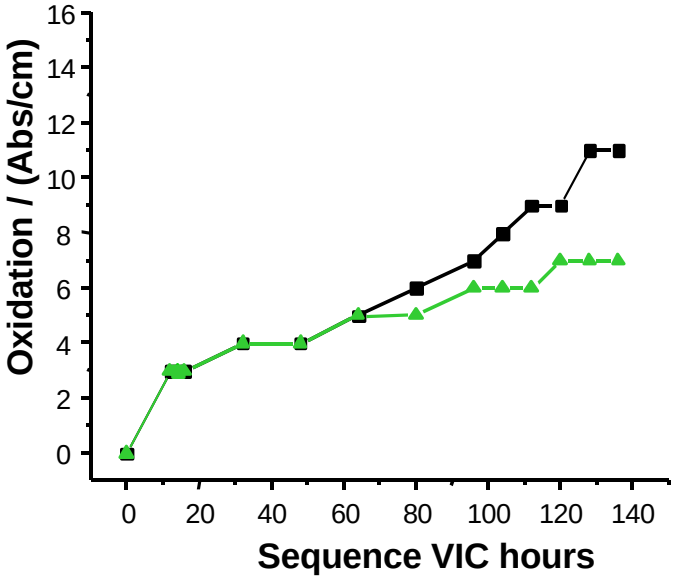
E8-329-27-19 (1008) 6.36 L

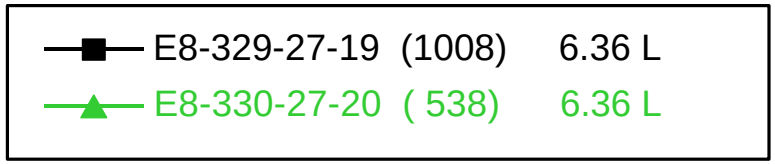
W10-134-28-19 (1008) 6.36 L

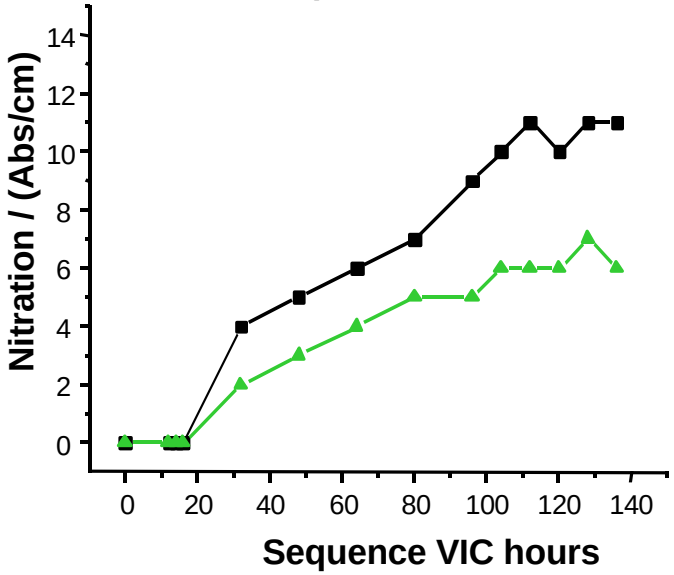
Some stand to stand differences noted.

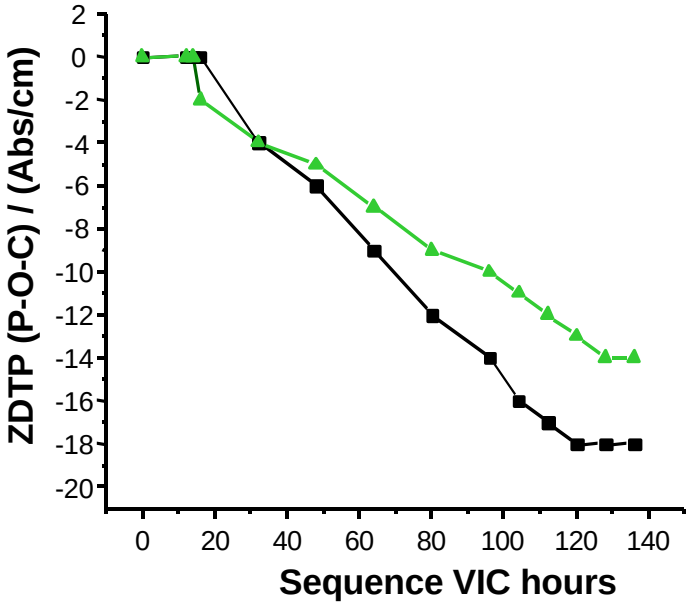
- Oxidation and additive depletion a little slower in W10
- Nitration similar
- Less viscosity increase in W10
- Time to loss of FM activity slightly longer in W10

Reference Oil Comparison

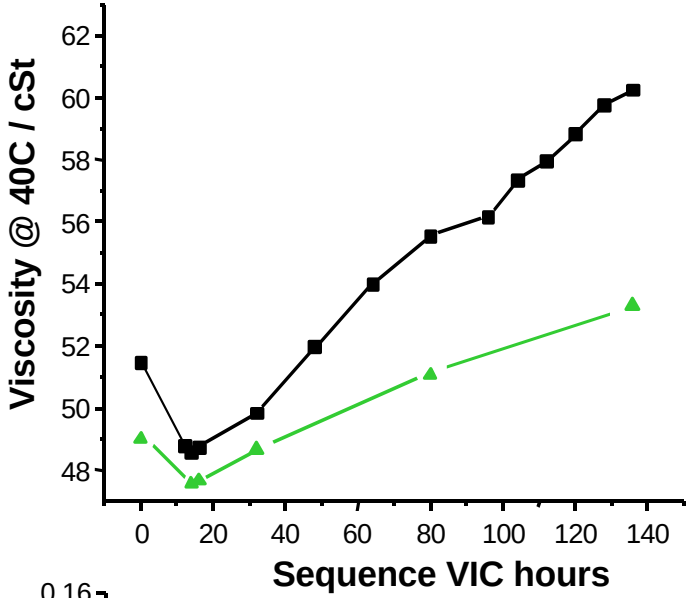


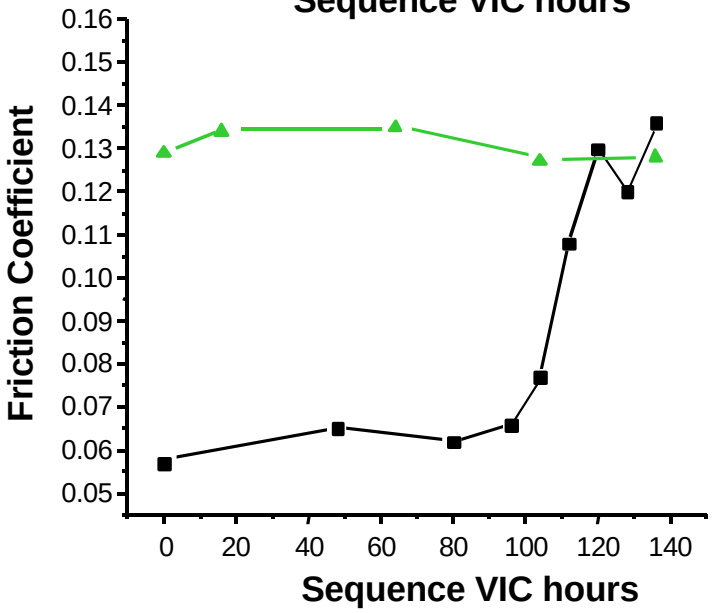


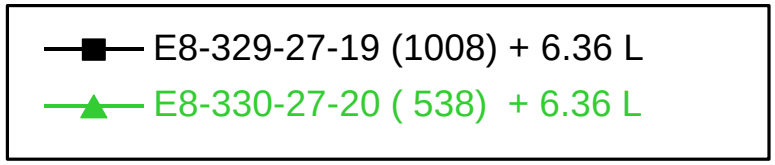




Reference Oil Comparison



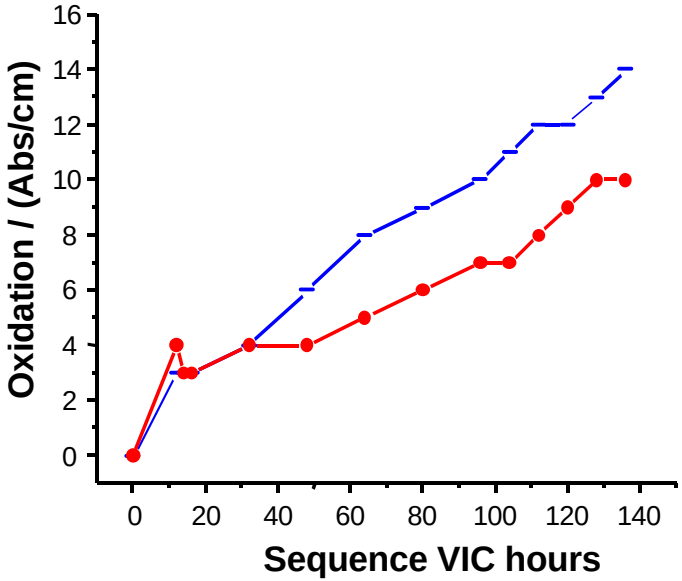


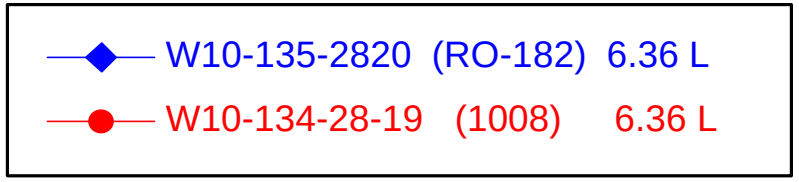


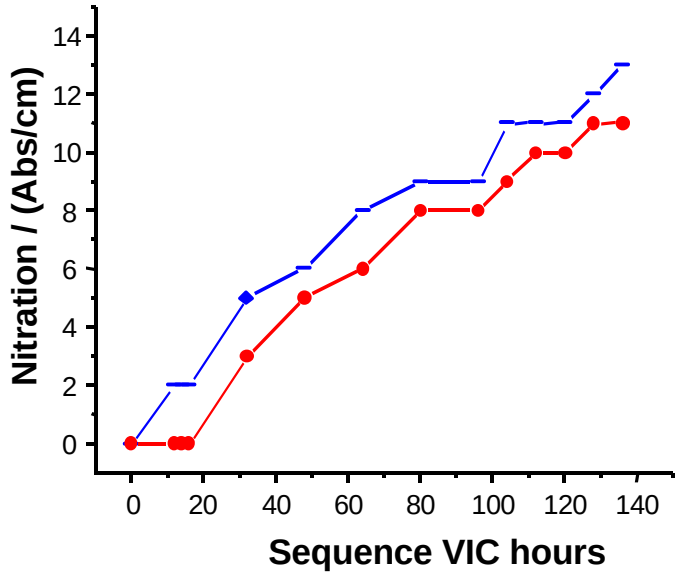
Reference oil 538 oxidizes less than 1008 and undergoes less viscosity change.

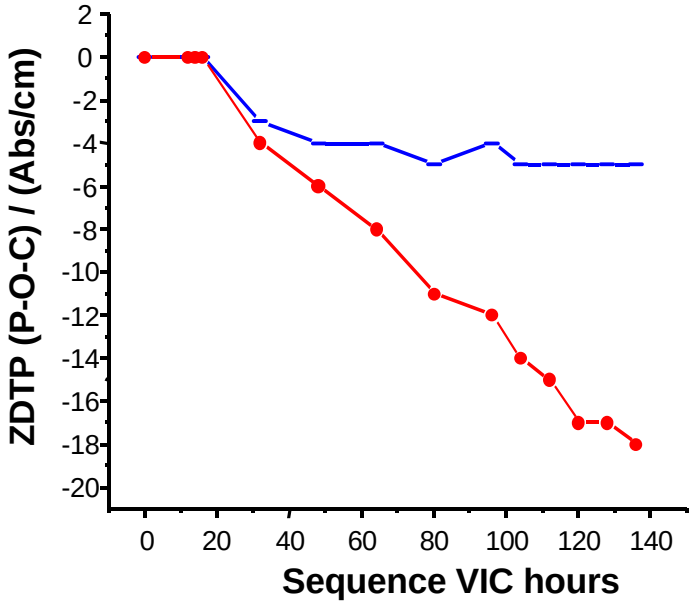
During the additional 40 hours of aging both oils continue to undergo oxidation and viscosity changes at the same rates as during the first 80 hours.

GF-4 Prototype - RO-182

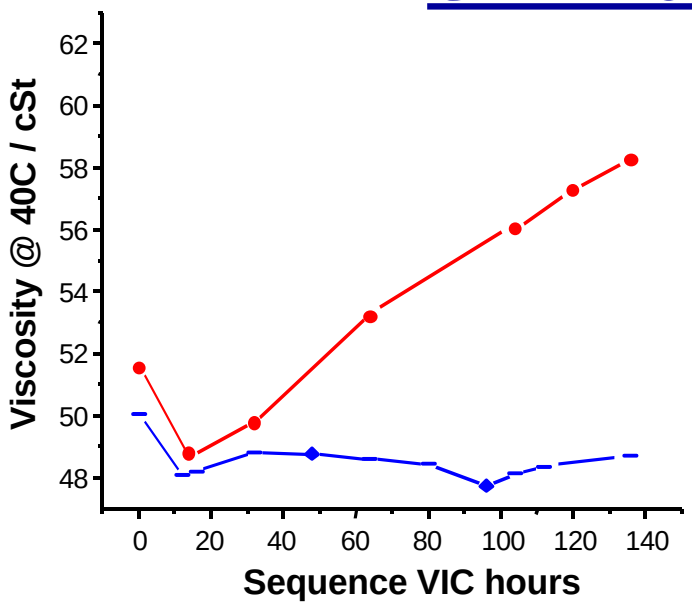


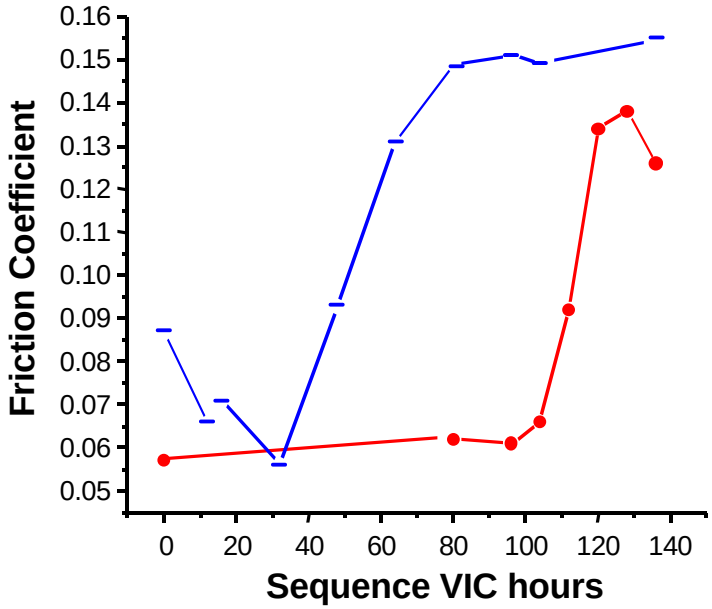






GF-4 Prototype - RO-182





W10-135-2820 (RO-182) 6.36 L

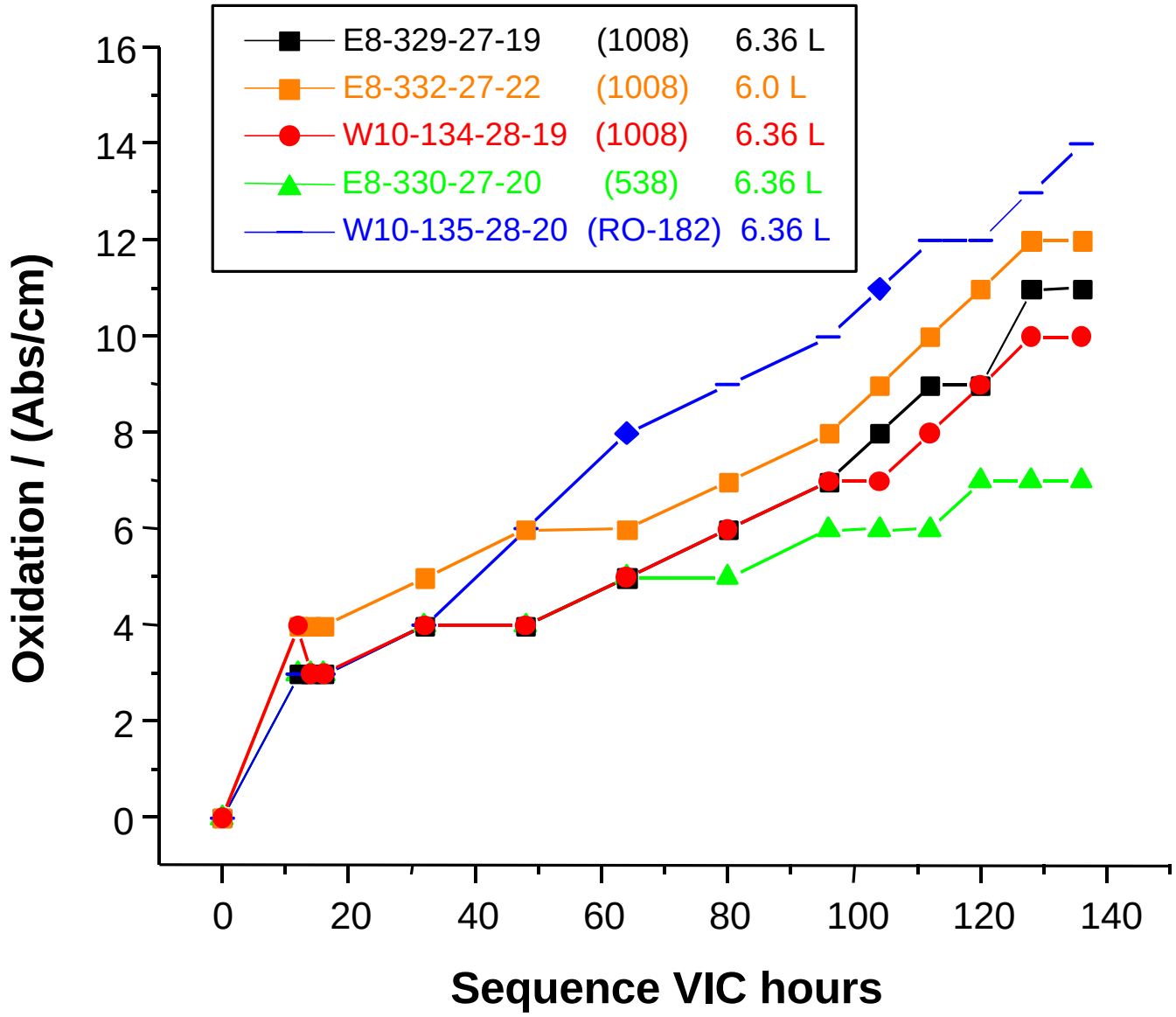
W10-134-28-19 (1008) 6.36 L

RO-182 provides very good viscosity control throughout the extended aging. Oxidation and nitration are higher than the reference oils but are still low.

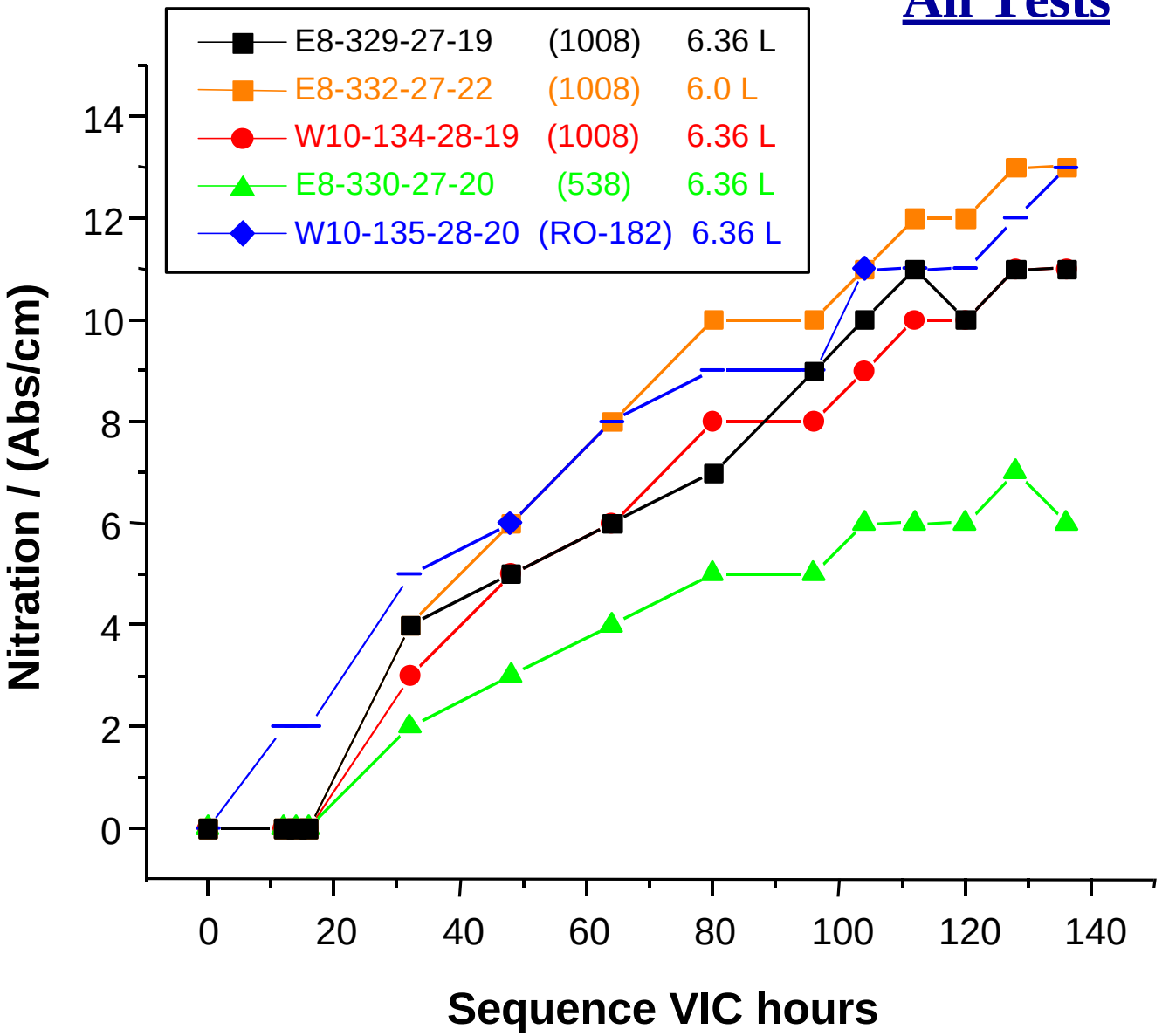
Conclusions

- Additional 360 mL oil reduces severity of aging.
- Extent of oxidation and nitration is low at 136 hours for all oils tested.
- Reference oils continue to age in uniform manner during additional 40 hr of aging.
- Some stand to stand variation noted
- Reference oil 538 oxidizes less and gives lower viscosity increase than 1008
- Prototype GF-4 oil (RO-182) controlled viscosity very well and gave low oxidation.

All Tests


E8-329-27-19 (1008) 6.36 L
E8-332-27-22 (1008) 6.0 L
W10-134-28-19 (1008) 6.36 L
E8-330-27-20 (538) 6.36 L
W10-135-28-20 (RO-182) 6.36 L
Oxidation / (Abs/cm)
0
2
4
6
8
10
12
14
16
0
20
40
60
80
100
120
140
Sequence VIC hours

All Tests


E8-329-27-19 (1008) 6.36 L
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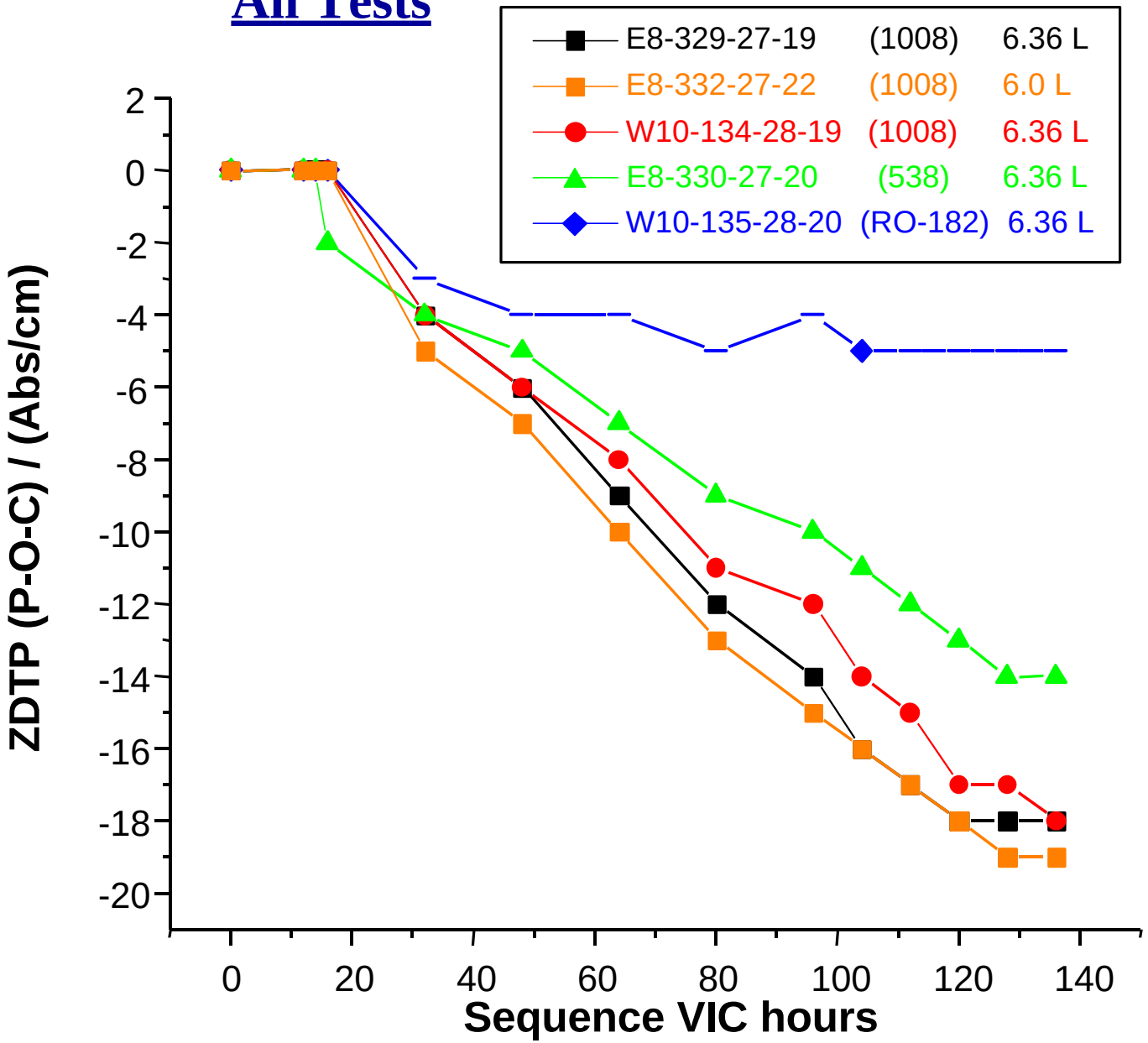
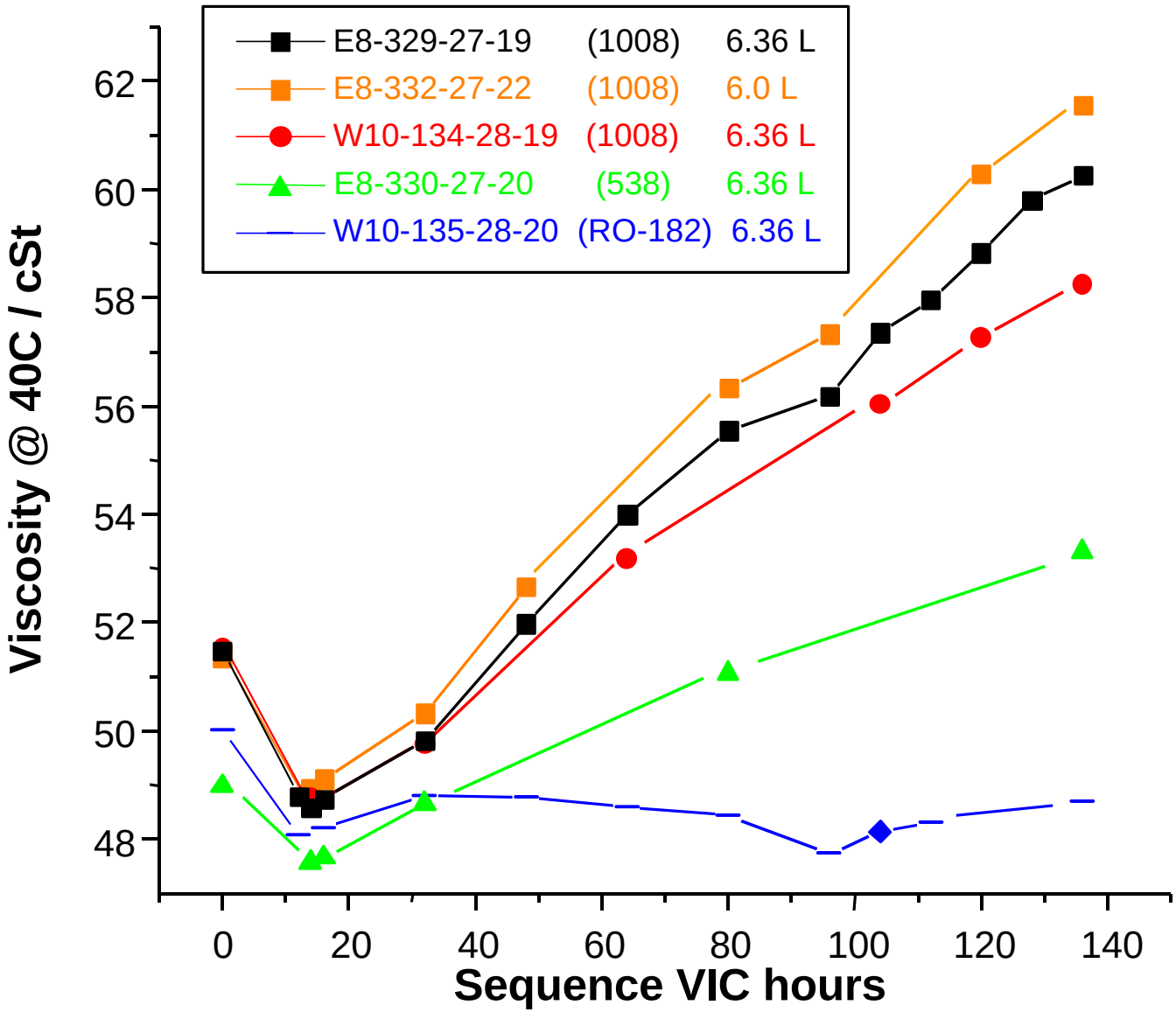
W10-134-28-19 (1008) 6.36 L
E8-330-27-20 (538) 6.36 L
W10-135-28-20 (RO-182) 6.36 L
Nitration / (Abs/cm)
0
2
4
6
8
10
12
14
0
20
40
60
80
100
120
140
Sequence VIC hours

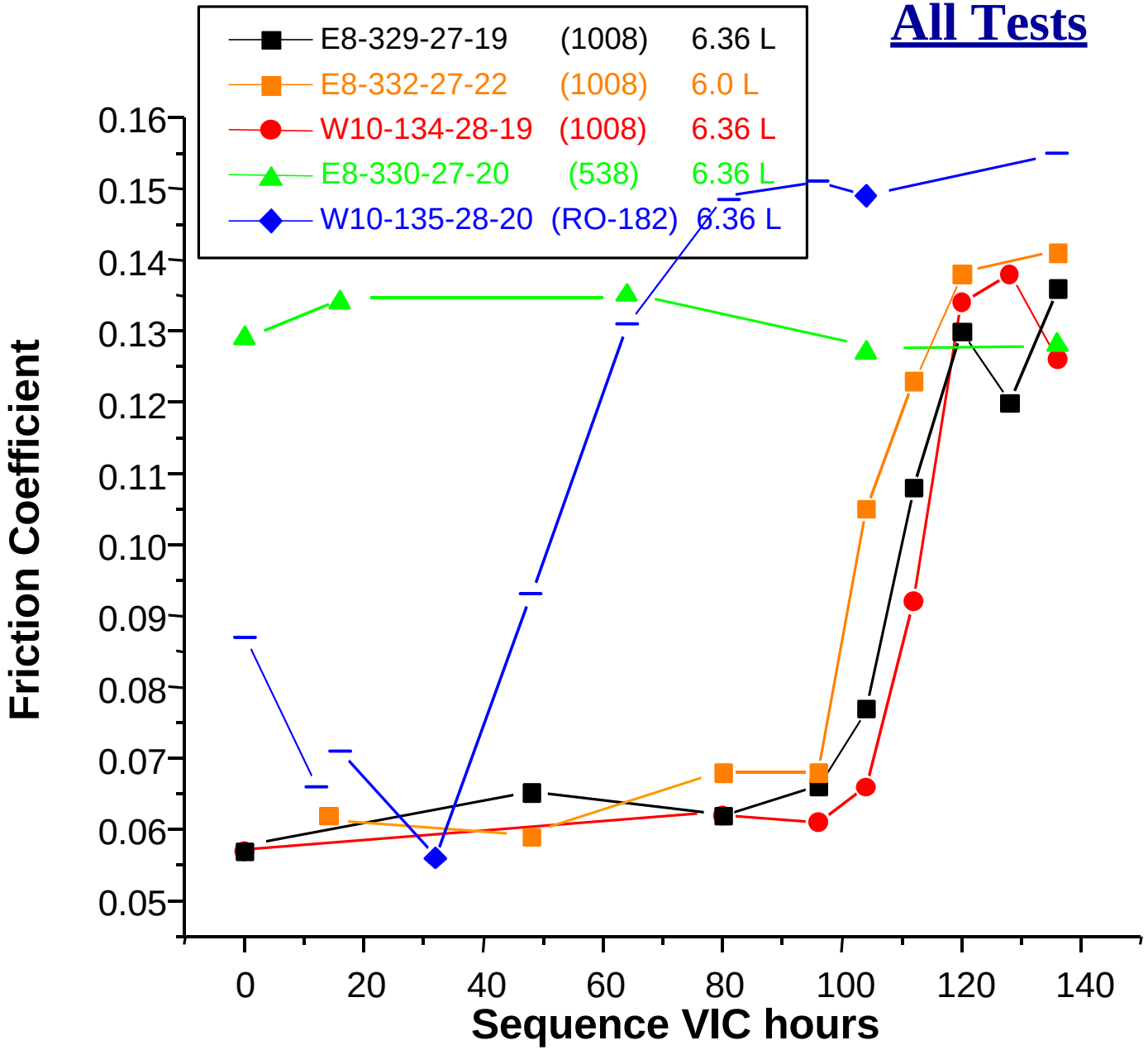
All Tests


E8-329-27-19 (1008) 6.36 L
E8-332-27-22 (1008) 6.0 L
W10-134-28-19 (1008) 6.36 L
E8-330-27-20 (538) 6.36 L
W10-135-28-20 (RO-182) 6.36 L
ZDTP (P-O-C) I (Abs/cm)
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
0
20
40
60
80
100
120
140
Sequence VIC hours

All Tests


E8-329-27-19 (1008) 6.36 L
E8-332-27-22 (1008) 6.0 L
W10-134-28-19 (1008) 6.36 L
E8-330-27-20 (538) 6.36 L
W10-135-28-20 (RO-182) 6.36 L
Viscosity @ 40C / cSt
62
60
58
56
54
52
50
48
0
20
40
60
80
100
120
140
Sequence VIC hours

All Tests


E8-329-27-19 (1008) 6.36 L
E8-332-27-22 (1008) 6.0 L
W10-134-28-19 (1008) 6.36 L
E8-330-27-20 (538) 6.36 L
W10-135-28-20 (RO-182) 6.36 L
Friction Coefficient
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0
20
40
60
80
100
120
140
Sequence VIC hours

VIC Shakedown on Oil 1008

FEI1	SA	Corrected FEI1	FEI2	SA	Corrected FEI2
1.74	0.03	1.77	1.53	0.10	1.63

Oil Consumption 1100 ml

FEI1 calculated using BCB only

FEI2 calculated using BCA only

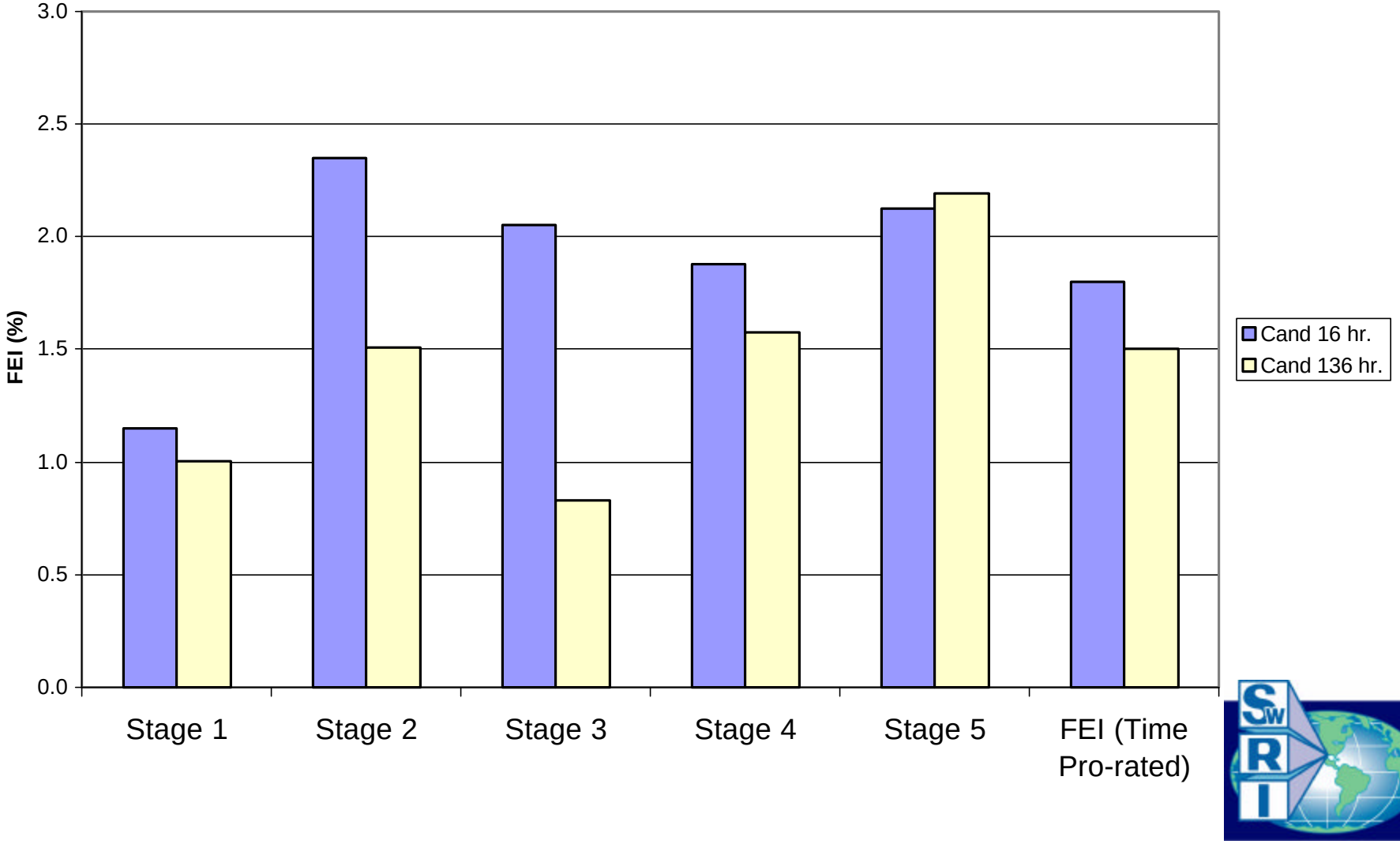
VIC Shakedown on Oil 1008

Chemical Analysis on sample at 143.5hrs

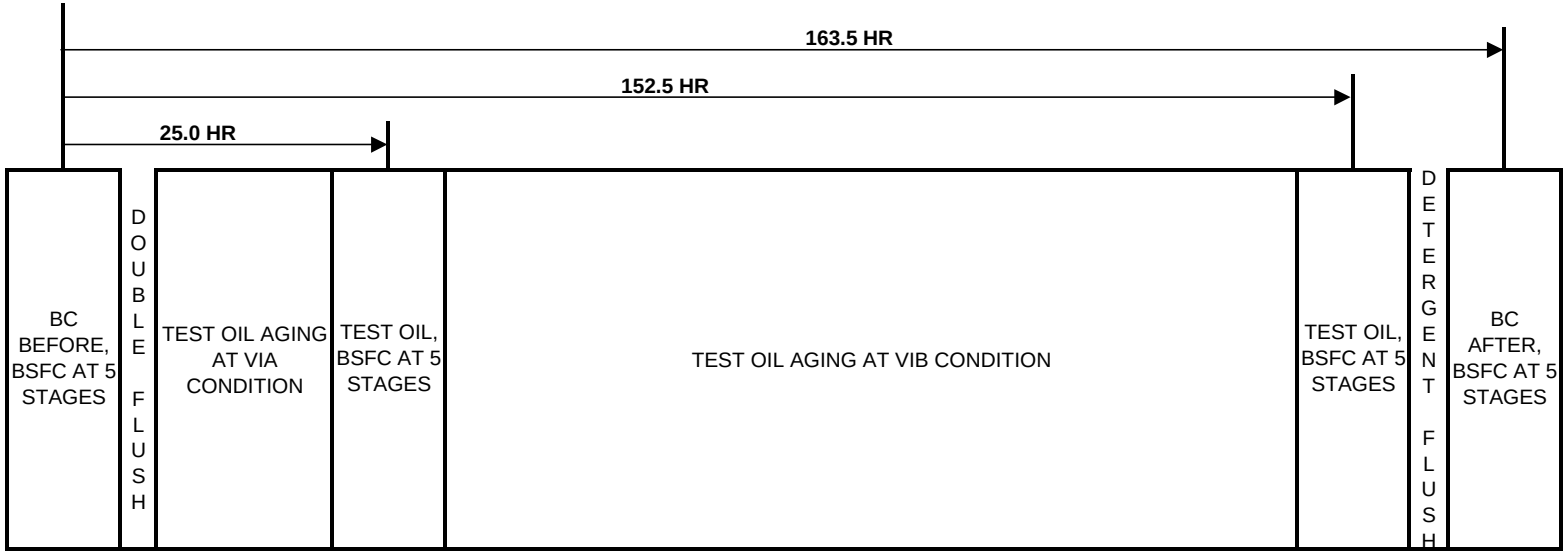
D4683 HTHS	D5293 CCS Visc	HFRR D6079 FricCoef	D3525M Fuel Dil	Oxidation E168 IR58	Nitration E168 IR61
10.93	4090	0.135	2.8	10.76	3.77

Viscosity @40°C - 59.3 on sample at 136hrs

Time Prorated Fuel Economy
VIC Shakedown on 1008, 72-48-49-5



ASTM SEQUENCE VIC TEST PROCEDURE TIME LINE FOR PRO-RATED CALCULATION



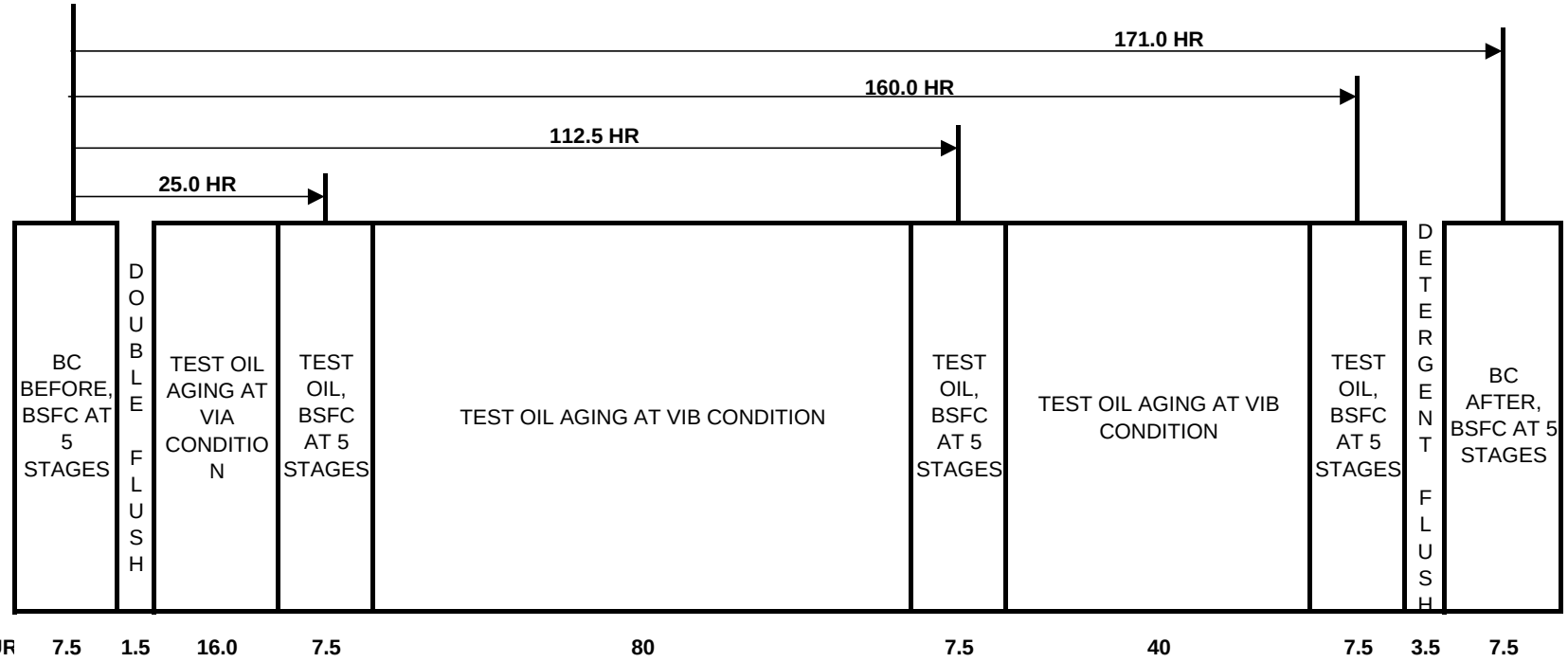
@ 16 hours

BCB 138.5 / 163.5 = 84.7%
BCA 25 / 163.5 = 15.3%

@ 96 hours

BCB 11 / 163.5 = 6.7%
BCA 152.5 / 163.5 = 93.3%

ASTM SEQUENCE VIC TEST PROCEDURE TIME LINE FOR PRO-RATED CALCULATION



	@ 16 hours	
BCB	146 / 171 =	85.4%
BCA	25 / 171 =	14.6%

	@ 96 hours	
BCB	58.5/ 171 =	34.2%
BCA	112.5 / 171 =	65.8%

	@ 136 hours	
BCB	11 / 171 =	6.4%
BCA	160 / 171 =	93.6%

SRC Sequence VI-C Test Procedure

STEP	OIL	STEP DESCRIPTION	Time (hour)	Run Total	SPEED rpm	LOAD Nm	POWER kW	OIL T C	COOL T C	COMMENTS	Timing Mark	TPR %
1		Double flush to BC	1.5	1.5	1500	98	15.39	125	105			
2	BC	Stage 1 stabilize and bsfc	1.5	3.0	1500	98	15.39	125	105		3.0	
3	BC	Stage 2 stabilize and bsfc	1.5	4.5	800	26	2.18	105	95			
4	BC	Stage 3 stabilize and bsfc	1.5	6.0	800	26	2.18	70	60			
5	BC	Stage 4 stabilize and bsfc	1.5	7.5	1500	98	15.39	70	60			
6	BC	Stage 5 stabilize and bsfc	1.5	9.0	1500	98	15.39	45	45			
7		Double flush to CAND	1.5	10.5	1500	98	15.39	125	105			
8	CAND	VIA aging	16.0	26.5	1500	98	15.39	125	105	Add 360mL of fresh oil from full mark		
9	CAND	Stage 1 stabilize and bsfc	1.5	28.0	1500	98	15.39	125	105		25.0	**15%**
10	CAND	Stage 2 stabilize and bsfc	1.5	29.5	800	26	2.18	105	95			**85%**
11	CAND	Stage 3 stabilize and bsfc	1.5	31.0	800	26	2.18	70	60			
12	CAND	Stage 4 stabilize and bsfc	1.5	32.5	1500	98	15.39	70	60			
13	CAND	Stage 5 stabilize and bsfc	1.5	34.0	1500	98	15.39	45	45			
14	CAND	VIB aging	120.0	154.0	2250	98	23.09	135	105			
15	CAND	Stage 1 stabilize and bsfc	1.5	155.5	1500	98	15.39	125	105	Sample 100mL at end of 136 hr aging	152.5	**93%**
16	CAND	Stage 2 stabilize and bsfc	1.5	157.0	800	26	2.18	105	95			**7%**
17	CAND	Stage 3 stabilize and bsfc	1.5	158.5	800	26	2.18	70	60			
18	CAND	Stage 4 stabilize and bsfc	1.5	160.0	1500	98	15.39	70	60			
19	CAND	Stage 5 stabilize and bsfc	1.5	161.5	1500	98	15.39	45	45	Sample 300mL to 500mL at end of stg 5		
20		High detergent flush to BC	3.5	165.0	1500	98	15.39	125	105			
21	BC	Stage 1 stabilize and bsfc	1.5	166.5	1500	98	15.39	125	105		166.5	
22	BC	Stage 2 stabilize and bsfc	1.5	168.0	800	26	2.18	105	95			
23	BC	Stage 3 stabilize and bsfc	1.5	169.5	800	26	2.18	70	60			
24	BC	Stage 4 stabilize and bsfc	1.5	171.0	1500	98	15.39	70	60			
25	BC	Stage 5 stabilize and bsfc	1.5	172.5	1500	98	15.39	45	45			
		Total	172.5									

SRC Sequence VI-C Test Procedure

STEP	OIL	STEP DESCRIPTION	Time (hour)	Run Total	SPEED rpm	LOAD Nm	POWER kW	OIL T C	COOL T C	COMMENTS	Timing Mark	TPR %
1		Double flush to BC	1.5	1.5	1500	98	15.39	125	105			
2	BC	Stage 1 stabilize and bsfc	1.5	3.0	1500	98	15.39	125	105		3.0	
3	BC	Stage 2 stabilize and bsfc	1.5	4.5	800	26	2.18	105	95			
4	BC	Stage 3 stabilize and bsfc	1.5	6.0	800	26	2.18	70	60			
5	BC	Stage 4 stabilize and bsfc	1.5	7.5	1500	98	15.39	70	60			
6	BC	Stage 5 stabilize and bsfc	1.5	9.0	1500	98	15.39	45	45			
7		Double flush to CAND	1.5	10.5	1500	98	15.39	125	105	Add 360mL of fresh oil from full mark at end of flush		
8	CAND	VIA aging	16.0	26.5	1500	98	15.39	125	105	Samples: 2mL @ 12; 2 mL @ 14; 5 mL @ 16 hr		
9	CAND	Stage 1 stabilize and bsfc	1.5	28.0	1500	98	15.39	125	105		25.0	**15%**
10	CAND	Stage 2 stabilize and bsfc	1.5	29.5	800	26	2.18	105	95			**85%**
11	CAND	Stage 3 stabilize and bsfc	1.5	31.0	800	26	2.18	70	60			
12	CAND	Stage 4 stabilize and bsfc	1.5	32.5	1500	98	15.39	70	60			
13	CAND	Stage 5 stabilize and bsfc	1.5	34.0	1500	98	15.39	45	45			
14	CAND	VIB aging	80.0	114.0	2250	98	23.09	135	105	Sample 5mL every 16 hours until 96 hr		
15	CAND	Stage 1 stabilize and bsfc	1.5	115.5	1500	98	15.39	125	105		112.5	**66%**
16	CAND	Stage 2 stabilize and bsfc	1.5	117.0	800	26	2.18	105	95			**34%**
17	CAND	Stage 3 stabilize and bsfc	1.5	118.5	800	26	2.18	70	60			
18	CAND	Stage 4 stabilize and bsfc	1.5	120.0	1500	98	15.39	70	60			
19	CAND	Stage 5 stabilize and bsfc	1.5	121.5	1500	98	15.39	45	45			
20	CAND	VIB aging	40.0	161.5	2250	98	23.09	135	105	Sample 5mL every 8 hours until 136 hr		
21	CAND	Stage 1 stabilize and bsfc	1.5	163.0	1500	98	15.39	125	105		160.0	**94%**
22	CAND	Stage 2 stabilize and bsfc	1.5	164.5	800	26	2.18	105	95			**6%**
23	CAND	Stage 3 stabilize and bsfc	1.5	166.0	800	26	2.18	70	60			
24	CAND	Stage 4 stabilize and bsfc	1.5	167.5	1500	98	15.39	70	60			
25	CAND	Stage 5 stabilize and bsfc	1.5	169.0	1500	98	15.39	45	45	Sample 300mL to 500mL at end of stg 5		
26		High detergent flush to BC	3.5	172.5	1500	98	15.39	125	105			
27	BC	Stage 1 stabilize and bsfc	1.5	174.0	1500	98	15.39	125	105		174.0	
28	BC	Stage 2 stabilize and bsfc	1.5	175.5	800	26	2.18	105	95			
29	BC	Stage 3 stabilize and bsfc	1.5	177.0	800	26	2.18	70	60			
30	BC	Stage 4 stabilize and bsfc	1.5	178.5	1500	98	15.39	70	60			
31	BC	Stage 5 stabilize and bsfc	1.5	180.0	1500	98	15.39	45	45			
		Total	180.0									

February 5, 2002

RSI Analysis of VIB Test

Requested Analysis

In a letter dated December 11, 2001, the Chairman and Test Sponsor for the Seq. VIB Surveillance Panel made the following request:

"I am forwarding a request from the ASTM Sequence VIB Surveillance Panel to have RSI supply the following data. In the development of the Sequence VIC test oil consumption has become an issue. Currently we have Seq. VIB Reference Oil Data but believe non-reference oil data would give us a better understanding of relative oil consumption. We would like to request RSI supply the following information from their VIB database:

Oil Consumption/Viscosity Grade/ Engine Hrs"

Analyses Conducted in Responses to Request

The requested analyses are reported in Figures 1 through 3, attached. Figures 1 through 3 are plots of Oil Consumption versus Engine Hours for SAE 5W-20, 5W-30 and 10W-30 candidate oils, respectively. These plots were generated from a total of 685 operationally valid tests on the three viscosity grades. A linear regression line with 95 percent confidence limits is shown on each plot.

For the reported data, the mean oil consumption for SAE 5W-30 candidate oils was significantly lower than for SAE 5W-20 or SAE 10W-30 candidate oils; but there was no significant difference in the mean oil consumption between SAE 10W-30 and 5W-20 candidate oils.

Additional Consideration

In Figures 1 through 3, the oil consumption data for each test were plotted as though the data consisted of 685 independent results. In Figure 4, attached, the linear regression line for Oil Consumption versus Engine Hours is shown separately for each of the 34 test engines in the database that had run at least 10 candidate tests. The slopes for these individual regression lines vary from 0.632 to a negative 0.159.

The heavy, dashed line in Figure 4 is the <u>average slope</u> of the individual Oil Consumption versus Test Hours regression lines for all 34 test-engines; this <u>average slope</u> is 0.246. This <u>average slope</u> is not a regression line for all of the data and should not be confused with the regression lines for all the data shown in Figures 1 through 3.

With 34 engines and three viscosity grades, there were not enough data to establish a model that incorporated both engine and oil viscosity influence. However, the effect of the test engine on the slope of the Oil Consumption versus Engine Hours regression lines appears to be much greater than the effect of test oil viscosity.

We recognize that there are alternative methods to analyze "Oil Consumption/Viscosity Grade/ Engine Hrs" as requested, but we feel the Average Slope Line in Figure 4 is probably the best tool to illustrate the typical change in oil consumption of Seq. VB test engines with engine hours.

Attachment

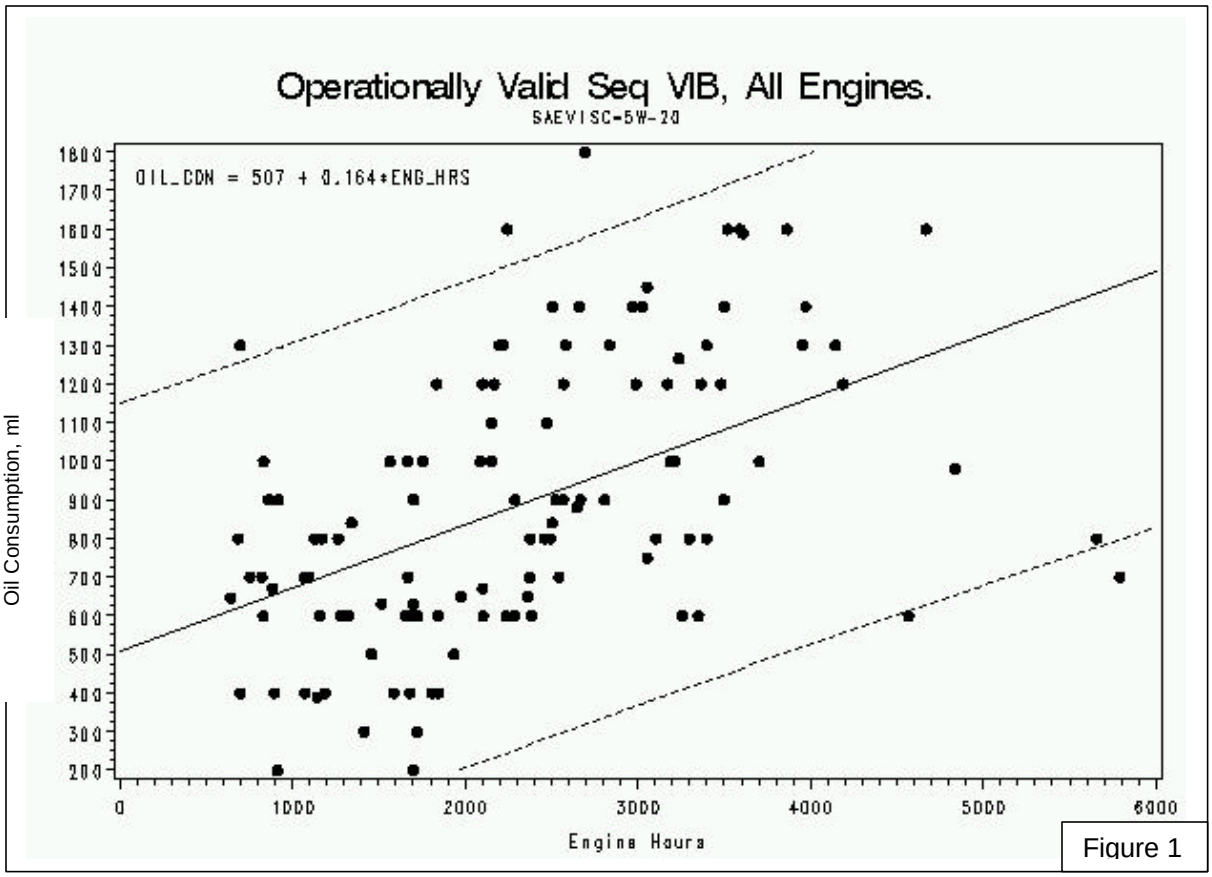


Figure 1

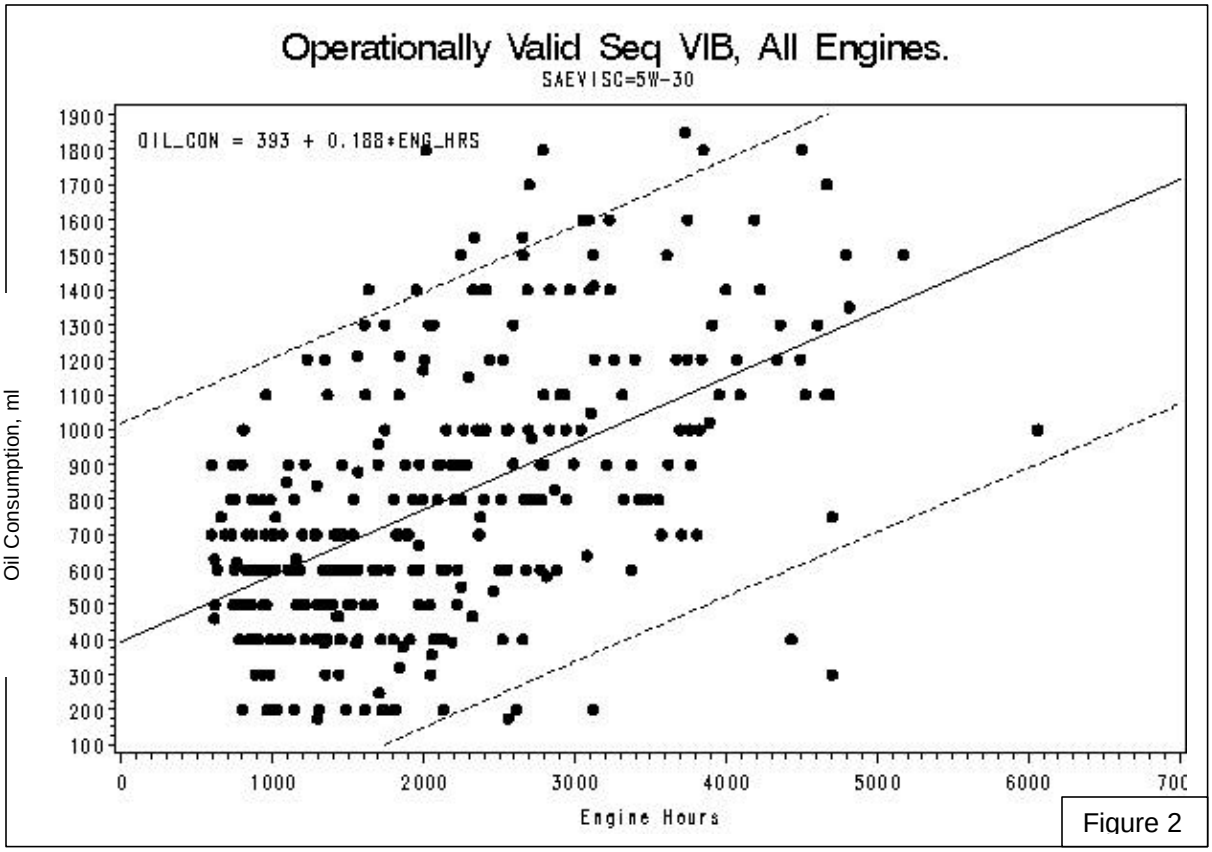


Figure 2

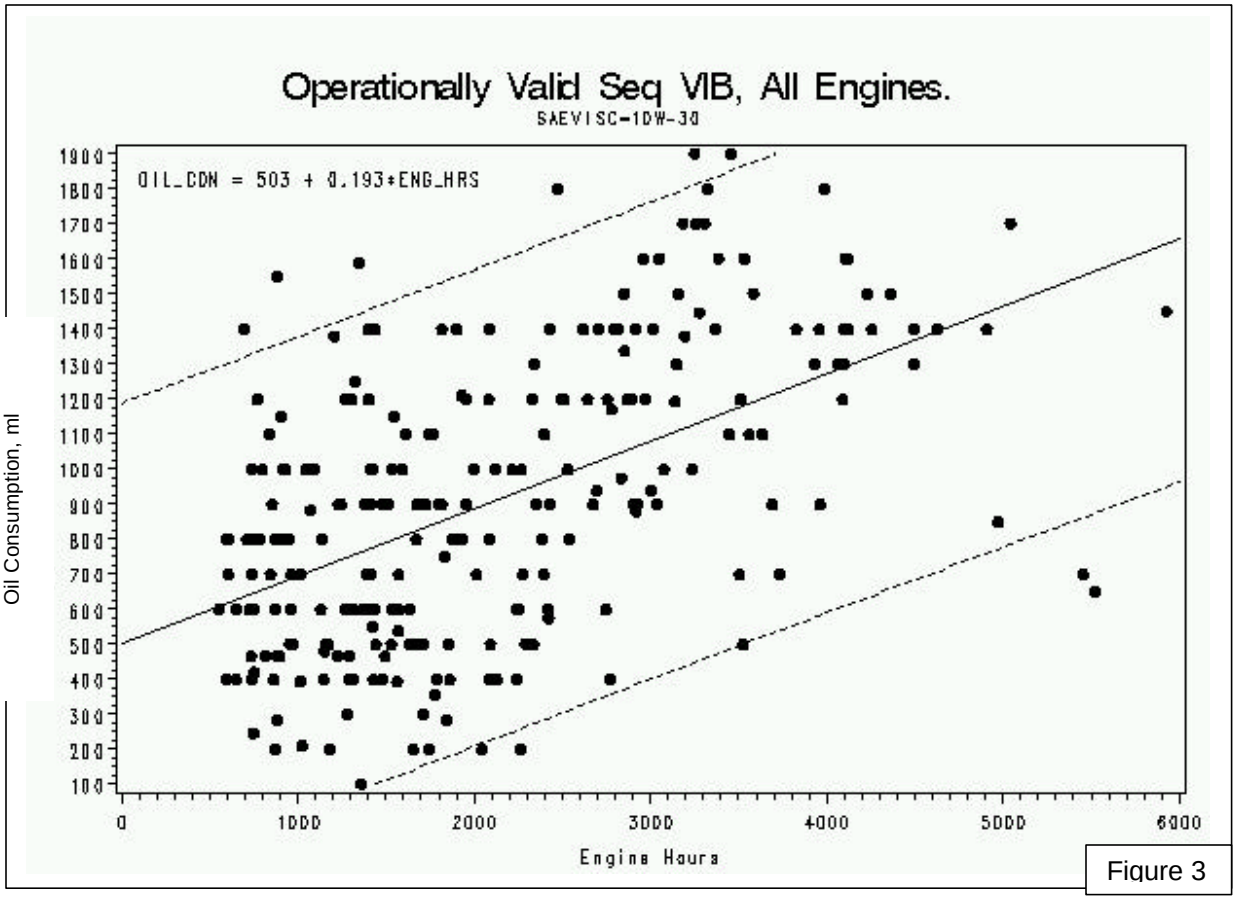


Figure 3

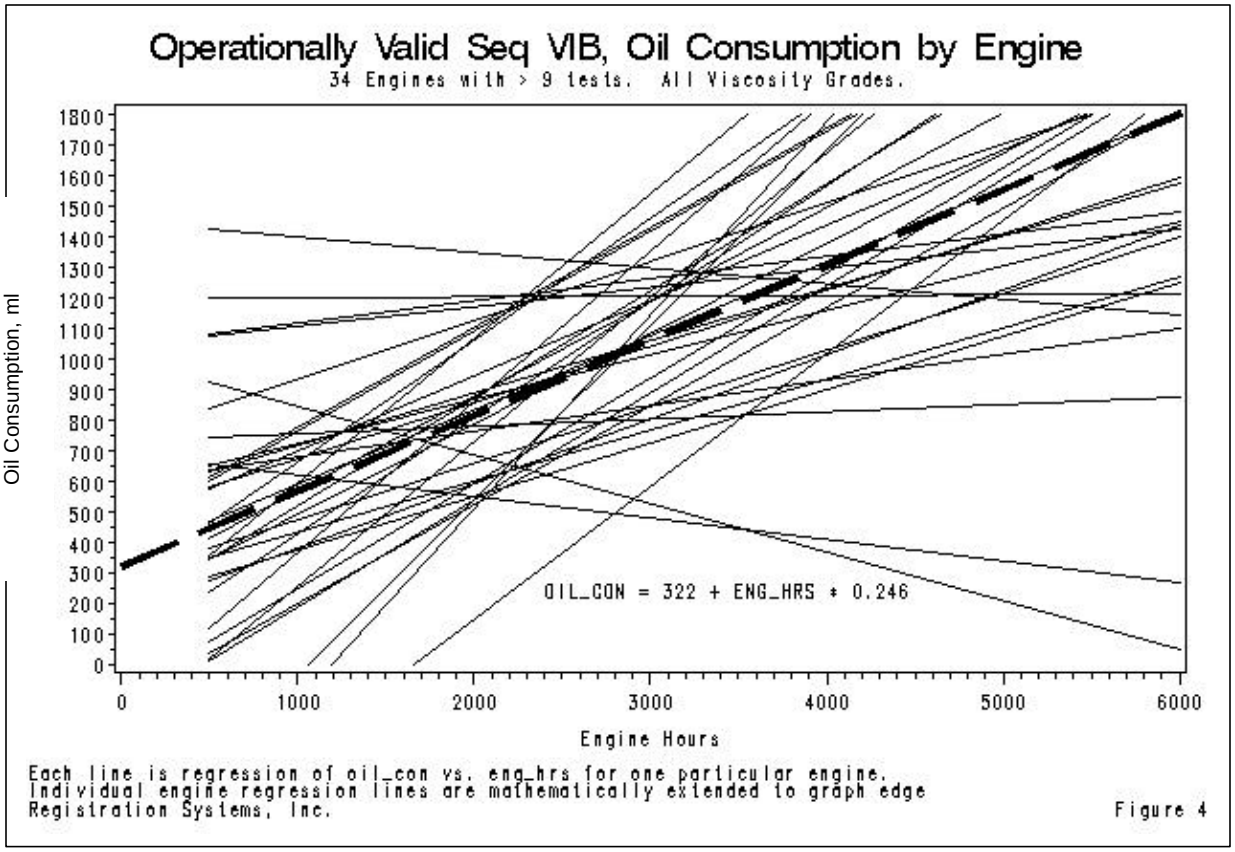


Figure 4

Reference Oils

- Additives for BC5 being blended this week
- Blend is scheduled to be completed this month
- Need to ship BC2 or 4 to labs for back to back comparisons
- Only 84 gallons of 1008 at TMC
- New blend is being procured, but it is

Reference oils (con't)

- Taking longer than expected
- Propose saving 1008 in lab inventories for VIC development, concentrate VIB reference tests on 538 and 1006.
- Does panel wish to pursue introduction of 1006-2? Usefulness for future tests?

VIB Procedural Item

- 13.2.10 reads “Make the viscosity measurement on non-reference oils only according to Test Method D445.” According to procedure, this is not to be done to reference tests, though most labs, if not all are reporting this data. What was the intent? Is procedure revision warranted?