



Committee D-2 ON PETROLEUM PRODUCTS AND LUBRICANTS

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Reply to: Michael S. Griggs
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Wickliffe, OH 44092-2298

October 23, 2000

To: Members of the Single Cylinder Oil Test Engine (SCOTE) Surveillance
Panel and guest attending the September 19, 2000 meeting.

Enclosed are the minutes of the SCOTE Surveillance panel meeting held in
Chicago, Illinois. Please forward any corrections or additions to my attention.

Michael S. Griggs
Secretary, SCOTE Surveillance Panel

MEETING MINUTES

SINGLE CYLINDER DIESEL SURVEILLANCE PANEL

HELD SEPTEMBER 19, 2000
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ACTION ITEMS

- Set up a SCOTE Surveillance Panel conference call regarding rater's workshop attendance.- Scott Parke
2. The CO₂% measurement procedures are changed such that checking of the exhaust CO₂% is suggested rather than mandatory.- Ben Weber (procedure rewrite)
 3. Clean the 1Q EGR heat exchanger with compressed air before each test start.- 1Q labs
 4. Cleaning of the 1Q EGR heat exchanger with compressed air may be done within the 305-307 kPa exhaust back pressure range, but must be cleaned if back pressure exceeds 307 kPa.- 1Q labs
 5. The use of high temperature silicone and lab preferred gaskets for sealing of exhaust flanges was agreed upon. Mike Zaiontz will send an e-mail listing the silicone sealer part numbers.
 6. Mike Zaiontz will coordinate with Jim McCord on Mack T-10 liner wear step

- 7 Issue TMC Information Letter stating that 1P/1Q thermocouples are to be installed midstream. Typical insertion depths to be provided for reference information only.- Scott Parke
8. Ensure that the HDEOCP is aware of the panel's need to have a 1Q lab volunteer to run an E-4 oil run.- Stacy Bond
9. Contact Stacy Bond if interested in assuming the SCOTE panel chairmanship-SCOTE Surveillance panel members
10. Set up a SCOTE panel teleconference following completion of the second E-4 oil run.- Stacy Bond, Scott Parke

1.0 CALL TO ORDER AND MEMBERSHIP CHANGES

Chairman Stacy Bond opened the meeting at 9:00 am. The agenda is attachment 1.

2.0 MEETING MINUTES

- 2.1 The meeting minutes for the July 12, 2000 meeting was approved
- 2.2 The attendance list is attachment 2

3.0 RATER WORKSHOP ATTENDANCE

- 3.1 Scott Parke advised the panel that he had been getting inquiries from various raters asking for clarification of the workshop attendance requirements. He explained that with the Spring 2001 workshop eliminated, raters who attended the Spring 2000 workshop would still need to attend the Fall 2000 workshop to avoid a year and a half lapse between workshops. The panel agreed that without Spring workshops, raters would have to attend the Fall workshop to stay current.
- 3.2 There was quite a bit of discussion about the circumstances leading to the elimination of the Spring workshop. Scott Parke explained that CRC eliminated the Spring workshop as a way to address funding concerns of various labs. Several panel members expressed a concern that having only one rating workshop per year could make it much more difficult to keep raters current.
- 3.3 Scott Parke mentioned that CRC was looking towards ASTM to provide specific definition of workshop requirements. Al Hahn commented that this would require quite a bit of coordination between CRC and the Surveillance panel to address all procedural issues related to rating. The panel felt that there would be enough time by Spring 2001 to hold a

workshop as an ASTM function, if that was the direction the panel wanted to pursue.

- 3.4 Scott Parke agreed to coordinate a Surveillance panel teleconference to discuss specific rate workshop attendance requirements.

4.0 1Q TEMPLATE

- 4.1 Phil Scinto presented an update of the 1Q template (attachment 3) which was last updated in the Spring.

- 4.2 Specific comments of the page by page review are as follows:

Page K2- Six labs (Lubrizol, PerkinElmer, Ethyl, SwRI, Exxon/Mobil and ALI) have committed to the demonstration matrix. Delete third paragraph. Five labs are matrix ready.

Page K6- Parameter dependence will be looked at.

Page K8- Scott Parke noted that there is a process in place for introducing new oils (D.1.4).

Page K9- LSRD and Phillips PC-9 are the current fuels, but PC-9 will be used exclusively for the matrix and beyond. Stacy bond provided panel members with the PC-9 fuel spec sheet (attachment 4). Fuel approval such as in the Sequence V test is not required for SCOTE testing.

Page K10- Phil Scinto suggested removing paragraph D.4.4. from the template.

Page K11- (D.5.5) Rater workshops are planned only every 12 months. Change rating in paragraph D.6.3 from "C" to "A".

5.0 1Q LAB VISIT REVIEW

5. Mike Zaiontz presented attachment 5 which summarizes the status of the 1Q lab visitation. The panel noted that Exxon/Mobil and Lubrizol have run sufficient 1Q tests to demonstrate the capability to conduct operationally valid tests. ALI has completed a shakedown and has one test pending completion to meet the "demonstrated capability" requirement.
- 5.2 Mike Zaiontz commented that one issue revealed during the lab visits was lack of consistency in EGR TC and pressure transducer locations. TC and pressure transducer orientations must be as per paragraph 4.8 of the April 13, 2000 meeting minutes.

- 5.3 Mike Zaiontz presented attachment 6 to clarify specific details of the 1Q EGR and exhaust system. Most labs use a Barco venturi meter in the EGR coolant pump return line, however, other flow measurement devices such as turbine meters are approved. The panel agreed that the EGR heat exchanger must be cleaned with compressed air at each test start and acknowledged that subsequent cleaning may be necessary. Following some discussion on the undesirability of excessive shutdowns for heat exchanger cleaning, it was agreed that cleaning is allowed in the 305-307 kPa back pressure range and is mandatory above 307 kPa. Also, the EBP range was set at 300-307 kPa. Most labs have experienced exhaust leaks in the 1Q test. Mike Zaiontz commented that the high temperature Permatex silicone sealant works well. He agreed to provide labs with the sealer's part number. Jim McCord mentioned good success with a spiral type gasket.
- 5.4 Mike Zaiontz reviewed the requirements for the 1Q gas analyzer and span/zero gases (attachment 7). The requirement to take more frequent CO₂ % measurements at test startup (0-24 hours) was extended to include after each shutdown. Al Hahn was asked whether it was really necessary to continue taking exhaust stack CO₂% measurements along with intake air CO₂% measurements since the test is run to a specific inlet air CO₂%. The consensus was that the exhaust CO₂ % value was not needed to control EGR rate. Al Hahn commented that the procedure should state that it is suggested to check exhaust CO₂%.

6.0 UPDATE 1Q PROCEDURE

- 6.1 Mike Zaiontz presented attachment 8 which summarizes liner wear step expected wear, measurement accuracy and the T-10 liner wear step measurement method. Al Hahn commented that the panel needs to get up to speed on the Mack T-10 method. Mike Zaiontz agreed to work with Jim McCord on T-10 liner measurement observations. Phil Scinto asked Al Hahn if liner wear step was another potential parameter for the test. Al Hahn replied that it would have to be looked at closely to see if it turns out to be something significant before a decision could be made.
- 6.2 Scott Parke noted that 1P/1Q TC insertion depths vary widely and solicited feedback from the group. There was quite a bit of discussion on the exact definition of insertion depth and how labs would actually measure this. Stacy Bond ultimately offered the simple requirement of "install midstream". Scott Parke suggested that TC insertion depth dimensions could be added for reference only. Since there were no objections to those suggestions, Scott Parke volunteered to issue a TMC Information Letter stating typical insertion depths (information source-Exxon/Mobil) and the requirement to install TC's midstream.

- 6.3 Al Hahn asked about the status of SwRI running low on EBP. Mike Zaiantz and Jim McCord will continue to work together to resolve the disparity.

7.0 TEST DEVELOOPER'S REPORT ON 1Q

7. Al Hahn presented attachment 9 which describes current EGR hardware, operating conditions, and a proposed EGR cooler modification. He pointed out that the cooling jet bolt (1Y4010) had more of the shank relieved than in the 1P so more oil could be flowed.
- 7.2 Al Hahn commented that the proposed EGR cooler modification involved blocking off two of the four main EGR passages (exhaust barrel side) to increase gas velocities in an attempt to reduce carbon surface adhesion.
- 7.3 Bob Weissman presented operational data (attachment 10) on a 1Q test with a modified cooler. This data shows the results of blowing down the EGR cooler in place with compressed air. Ethyl cleaned the EGR cooler through the 3/8" pipe plug opening which was enlarged to 1/2". A wand was placed in the opening and sealed with a rubber stopper and then shop air was applied for 30 seconds. His data shows that both EBP and exhaust temperatures were restored to start of test conditions following the cleaning.
- 7.4 Tom Hitchner presented operational data on the modified coolers (attachment 11). He concluded that the modified EGR cooler is still subject to fouling and that he is not seeing the benefits of the modification (EBP and exhaust temperature continue to increase).

8.0 MATRIX DECISION CRITERIA

- 8.1 Stacy Bond requested that the panel address the six items in the matrix decision criteria list (attachment 1, paragraph III.e.). The panel was in unanimous agreement that items 2,3, 5 and 6 were satisfied.
- 8.2 Stacy Bond commented that for item #4, the panel still needed ALI's 1005 test results and that test results to date need to be reviewed to see if labs are in agreement. Scott Parke presented attachment 12 and Al Hahn presented attachment 13 (1Q data summaries).
- 8.3 Al Hahn pointed out that his summary included min/max and averages. He felt that the spread for weighted demerits looked good and that he was pleased with TL and TC spread. He noted that iron and chromium levels were high (reflective of EGR engines), lead levels were ok, and viscosity was up. The bore polish was not as significant as expected. Al Hahn was expecting more liner wear step but admitted that the panel needs a better handle on the measurement method. He expressed concerned with

intermediate ring LSC as a potential problem for the 1Q test. There was nothing out of the ordinary for ring gap increase.

There was some discussion on the spread of TLC. Stacy Bond suggested that differences in TLC could be attributed to rating. Bob Weissman supported Stacy's comment by offering referee rating results which showed TLC differences of 19.5 versus 8.75. Stacy Bond solicited feedback on each parameter (except 1st test listed in attachment 13 which did not use the ½" orifice and the test on oil E). The panel agreed, with minimal discussion, that WD, TGC, OC and ETOC were in reasonable agreement. There were some discussions that there were possibly two populations for TLC, however, it was ultimately concluded that TLC was in reasonable agreement. The panel did agree that UCWD was not in agreement.

- 8.5 Al Hahn presented attachment 13 to facilitate discussions which addressed item #1 of the decision criteria (test discrimination). He pointed out that on page 2 of the attachment, the CH-4 oil which had 1.3-1.4 % ash had higher upper piston deposits than the CF-4 oil which had 0.9 % ash. The E-4 oil (1.8 % ash) had high WD at 484. This oil showed discrimination from an overall deposits standpoint. Al Hahn briefly discussed page 3 of the attachment which compares non-EGR vs. EGR tests. He noted that deposits farther down on the piston were more significant with the EGR tests.
- 8.6 The remaining discussions regarding discrimination focused on oil E-4 which also showed high deposit values in other SCOTE tests. Phil Scinto emphasized that the need for an additional run on oil E-4. Stacy Bond added that the current data is insufficient to show discrimination. Several panel members expressed concern that there could be a significant delay in getting the additional run on oil E-4. Stacy Bond emphasized that the current constraints to the matrix are the need for an additional run on oil E-4 and 1 lab's run on 1005. Phil Scinto advised the panel that the HDEOCP should be made aware of the concern that no one is coming forward to volunteer to run oil E-4. Jim McCord expressed willingness to run oil E-4 and agreed to check with his lab to see if he could commit a test.

9.0 TIMELINE UPDATE

- 9.1 Stacy Bond presented the 1Q timeline (attachment 14) for updating. The timeline was extended about 5 weeks.

Scott Parke estimated that oils would be available in about 6 weeks.

MISCELLANAEOUS

- 10.1 At the end of the meeting, Mike Zaiantz provided a summary (attachment 15) of the current 1Q status for inclusion in the meeting minutes.
- 10.2 Stacy Bond informed the panel that due to a change in his responsibilities, he was soliciting a volunteer to replace him as SCOTE Surveillance Panel Chairman. He asked interested panel members to contact him.

NEXT MEETING

The next meeting will be at the call of the Chairman, however, it was agreed up hold a teleconference after the completion of the E-4 test.

FROM: Stacy Bond
Surveillance Panel Chairman

PLACE: Bedford Park Public Library
(Close to ALI)
7816 W 65th Place

DATE: September 19, 2000
TIME: 9:00 am to 5:00 pm

I. Approve minutes from July meeting

II. Membership Changes

III. 1Q DEVELOPMENT

- a. Review lab visit
- b. Phillips Fuel Implementation
- c. Demonstration Matrix and Oils
- d. Update 1Q Procedure
- e. Matrix Decision Criteria
 1. Test results demonstrate discrimination in the most current test procedure to the satisfaction of the Surveillance Panel. Each oil used to demonstrate discrimination should have a minimum of 2 valid results in the most current test procedure.
 2. The lab inspection team has made a visit to each Matrix lab and filed a report regarding the matrix lab's conformance to the specification that includes, at a minimum completed lab inspection checklists.
 3. Matrix lab readiness, as summarized by the lab inspection team reports, is deemed satisfactory by the Surveillance panel.
 4. Each Matrix lab has run at least 2 operationally valid tests (shakedown runs are eligible) using the test matrix procedure. The Surveillance panel will decide if these test results are satisfactory in terms of precision and relative agreement among labs.
 5. The current batch supply of critical test parts used in the matrix is sufficient to use in post matrix testing beyond one reference cycle.
 6. Labs in the Matrix: PerkinElmer, Southwest Research, AutoResearch Laboratories, Ethyl, Lubrizol, and ExxonMobil.
- f. Update timeline



V. SOLICIT RECAPACEMENT FOR CHAIRMAN

V. SET NEXT MEETING

Please forward any additional agenda items to me.




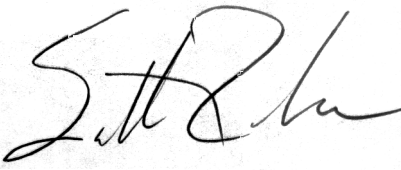
SCOTE SURVEILLANCE PANEL
Attendance Roster

*** Please indicate any corrections that should be made to members name, address, etc ***

Member	Status	Indicate Presence with Signature	Alternate
Name: Bond, Stacy Company: PerkinElmer Address: 5404 Bandera Road San Antonio, TX 78238 Phone: 210-523-4604 Fax: 210-523-4607	M		
Name: Carlson, Jon Company: Lubrizol Corporation Address: 4801 N.W. Loop 410, Ste. 430 San Antonio, TX 78229 Phone: 210-520-8013 Fax: 210-520-1983			
Name: Clark, Gil Company: Specified Fuels Consultancy Address: 117 E. Church St. Lake Orion, MI 48362 Phone: 248-693-6434 Fax: e-mail: sdclark63@juno.com			
Name: Cooper, Mark Company: Oronite Technology Group Address: Chevron Chemical Company 4502 Centerview Ste. 210 San Antonio, TX 78228 Phone: 210-731-5606 Fax: 210-731-5699			
Name: Fetterman, Pat Company: Infineum, USA L.P. Address: PO Box 735 Linden, NJ 07036 Phone: 908-474-3099 Fax: 908-474-3363			
Name: Foerster, Ed Company: EG&G Automotive Research Address: 5404 Bandera Road San Antonio, TX 78238 Phone: 210-523-4607 Fax: 210-694-0892			
Name: Griggs, Mike Company: The Lubrizol Corporation Address: 29400 Lakeland Blvd. Wickliffe, OH 44092 Phone: 440-943-1200 Ext. 2905 Fax: 440-943-9013			
Name: Gutzwiller, Jim Company: Infineum Address: 4335 Piedras Dr., W. Suite 101 San Antonio, TX 78228 Phone: 210-732-8123 ext. 13 Fax: 210-732-8480			

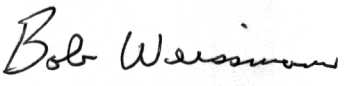
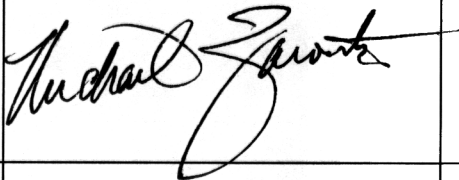
SCOTE SURVEILLANCE PANEL
Attendance Roster

*** Please indicate any corrections that should be made to members name, address, etc ***

Member	Status	Indicate Presence with Signature	Alternate
Name: Hahn, Al Company: Caterpillar, Inc./Tech Center Address: Bldg. L/P.O. 1875 Peoria, IL 61656-1875 Phone: 309-578-3617 Fax: 309-578-4232	M		
Name: Hillman, Gregory E. Company: AutoResearch Lab Inc. Address: 6735 S. Old Harlem Ave. Chicago, IL 60638 Phone: (708) 963-4262 Fax: (708) 563-0087	M		
Name: Hitchner, Tom Company: Exxon/Mobil R&E Address: 600 Billingsport Road Paulsboro, NJ 08066 Phone: 856-22-3012 Fax: 856-224-3628 e-mail: w_thomas_hitchner@email.mobil.com	M		
Name: Lewis, John Company: Shell Research Limited Address: P.O. Box 1 Poole Lane INCE (Nr. Chester) Chester CH1 3 SH United Kingdom Phone: Fax: 011-44-151-373-5888			
Name: Buck, Ron Company: Test Engineering, Inc. Address: 12718 Cimarron Path San Antonio, TX 78249-3417 Phone: 210-690-1958 Fax: 210-690-1959 e-mail: rbuck@testeng.com			
Name: Nycz, David S. Company: Caterpillar, Inc. Address: Box 610 Mossville, IL 61552-0610 Phone: 309-578-3003 Fax: 309-578-6457			
Name: Parke, Scott Company: ASTM/TMC Address: 6555 Penn Avenue Pittsburgh, PA 15206-4489 Phone: 412-365-1036 Fax: 412-365-1047	M		
Name: Rumford, Robert H. Company: Specified Fuels & Chemicals, LLC Address: 1201 South Sheldon Road Channelview, TX 77530-0429 Phone: 281-457-2768 Fax: 281-457-1469			

SCOTE SURVEILLANCE PANEL
Attendance Roster

*** Please indicate any corrections that should be made to members name, address, etc ***

Member	Status	Indicate Presence with Signature	Alternate
<p>Name: Schaus, Jerry Company: AutoResearch Laboratories, Inc. Address: 6735 S. Old Harlem Avenue Chicago, IL 60638 Phone: 708-563-4257 Fax: 708-563-0087</p>			
<p>Name: Stephen, Carl Company: Ashland, Inc. Address: 22nd Front Street Ashland, KY 41101 Phone: 606-329-5198 Fax: 606-329-3009</p>			
<p>Name: Sutherland, Mark Company: Ethyl Petroleum Additives, Inc. Address: 9901 IH 10 West Suite 800 San Antonio, TX 78230 Phone: 210-558-2818 Fax: 210-694-0892</p>			
<p>Name: Strigner, Paul Company: 31 Sequin Street Address: Ottawa, Ontario K1J6P2 CANADA Phone: Fax: MAIL</p>			
<p>Name: Weissman, Bob Company: Ethyl Petroleum Additives, Inc. Address: 500 Spring Street P.O. Box 2158 Richmond, VA 23219 Phone: 804-788-5340 5373 Fax: 804-788-6358</p>			
<p>Name: McCord, James Company: SWRI Address: 6220 Culebra Rd. San Antonio, TX 78228-0510 Phone: 804-788-5340 Fax:</p>			
<p>Name: Zaiontz, Mike Company: PerkinElmer Address: 5404 Bandera Road San Antonio, TX 78238 Phone: 210-647-9483 Fax:</p>			

SCOTE SURVEILLANCE PANEL
Attendance Roster

(Visitors Page)

Member	Status	Indicate Presence with Signature	Alternate
Name: Philip R. Scinto Company: Lubrizol Address: 29400 Lakeland Blvd. Drop # 152A Wickliffe OH 44092 Phone: 440-347-2161 Fax: PRS@LUBRIZOL.COM			
Name: Company: Address: Phone: Fax:			
Name: Company: Address: Phone: Fax:			
Name: Company: Address: Phone: Fax:			
Name: Company: Address: Phone: Fax:			
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Name: Company: Address: Phone: Fax:			

ATTACHMENT ONE**SPECIFICATION FOR PC-9 REFERENCE DIESEL TEST FUEL**

PROPERTY	ASTM METHOD	MIN	MAX
Sulfur, M%	D2622	0.04	0.05
Gravity, °API	D287 or D4052	34.5	36.5
Cetane Number	D613	42	46
Cetane Index	D4737 & D976		Report
Hydrocarbon Composition Aromatics, Vol %	D1319	28	33
Total Acid Number	D664		0.05
Strong Acid Number	D664		0
Copper Strip Corrosion	D130		1
Flash Point, °C	D93	54	
Pour Point, °C	D97		-18
Viscosity, cSt @ 40°C	D445	2.4	3
Carbon Residue, M%	D524 (10% Bottoms)		0.35
Water & Sediment, Vol %	D2709		0.05
Accelerated Stability, mg/100 ____	D2274		0.5
Distillation, °C			Report
1BP			Report
10%			Report
50%			Report
90%		282	338
EP			Report
No additives allowed			

Caterpillar 1Q Lab Visitation

Laboratory	Lab Visited by Inspection Team	* Lab Ready for Testing	**Demonstrated Capability to Conduct Operationally Valid Tests
AutoResearch Laboratories Incorporated	Yes	Yes	
Ethyl Corporation	Yes	Yes	Yes
ExxonMobil Corporation	Yes	Yes	
Lubrizol Corporation	Yes	Yes	
PerkinElmer Automotive Research	Yes	Yes	Yes
Southwest Research Institute	Yes	Yes	Yes

* The laboratory has testing capacity installed in compliance with specification.

** The laboraory has completed at least two (2) operationally valid tests. These tests can be comprised of any combination of shakedown, reference oil, or non-reference oil tests.

EGR/Exhaust System

EGR Coolant Pump

Flow Range Control 30 - 40 L/m
Barco meter in return line

EGR Heat Exchanger

Coolant In/Out
T/C Locations
Exhaust Sample Location] As per April '00 Minutes

Orifice Size 1/2"

Cleaning

Clean with compressed air prior to each test
Subsequent cleaning at discretion of lab

Exhaust Leaks

High temperature silicone (option)
Spiral gasket (option)

CO₂ ZERO/SPAN

CO₂ Meter

Indication Resolution 0.02% of full scale

Zero Gas Accuracy ± 2% (maximum)

Span Gas Accuracy ± 2% (maximum)

Procedure:

- 1) Zero and Span the CO₂ meter within 2 hours of intake air CO₂ measurement
- 2) Measure intake air CO₂ at test hour 1, once every 4 hours to test hour 24, then once every 8 hours till EOT.
- 3) Adjust EBP to achieve ~~1.50~~ ± 0.05% CO₂ in the intake air.

1.55

Cylinder Liner Wear Step

	inches	mm
Expected Wear	0.00020	0.005
Measurement Accuracy	0.00004	0.001

Mack T10 Liner Wear Step Method

- 1) Level cylinder liner by taking trace below the ring reversal area. Adjust the liner to indicated level on the measurement device.
- 2) Measure the liner wear step at 12 equally-spaced positions.
- 3) The amount of wear at each location is the distance from the zero datum line to the valley of the profile.
- 4) Average/Max/Min the results

Q-EGR TEST HARDWARE 9/20/00

Piston Crown	Y4016		
Piston Skirt	Y4015		
Top Ring	Y4014		
2nd Ring	Y4013		
Oil Ring	Y4012		
Cooling Jet	Y401		
Cooling Jet Bolt	Y4010		
P Jet Aim Fixture	Y3980		
ECM Eprom	54 8352	Date Code	Jan 00

1Q/ EGR SCOTE Warm- Up And Operating Conditions

Att 9, pg 2/3

PARAMETER	UNITS	TOL	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
			5 Min	5 Min	5 Min	10 Min	60 Min
Speed	RPM	+/- 3	1000	1000	1400	1800	1800
Power	kW		Idle	10	28	51	67
Torque	Nm	(a) +/- 5	-	100	175	270	355
Fuel Rate	g/ min	(b) +/- 1	-	45	95	192	240
B.S.F.C.	g/ kW-hr		-	-	220	220	220
Fuel Timing	BTC		13	13	13	13	13
Fuel Rack Pos.	mm		2.6	3.8	6	8.6	10.3
Humidity	g/kg	+/- 1.7		-	-	-	17.8
TEMPERATURES		DEG C					
Fuel Into Head		+/- 3	~31	~32	~33	~36	42
Coolant Into Jug				~55	101	101	101
Coolant From Head		+/- 3		57	105	105	105
Oil To Cooler				-	93	102	124
Oil Manifold		+/- 3		-	92	101	120
Oil Fr Extern. Heater				-	97	104	~110
Air To Orifice						45 - 60	45 - 60
Inlet Air Manifold		+/- 3		40	45	68	85
Exhaust Manifold			~120	300	430	590	645
EGR H/E - Exh To				48	249	390	515
- Exh From		+/- 10		45	80	135	230
- Coolant In				57	98	99	100
- Coolant Out				57	101	102	103
PRESSURES		kPa					
Fuel From Head		+/- 20	275	275	275	275	275
Coolant Into Jug		(c)	~44	~44	60	80	80
Oil Manifold		+/- 20	415	415	415	415	415
Air To Orifice (abs)				120	155	250	295
Inlet Air Barrel (abs)		+/- 1	120	120	155	250	292
Exhaust Barrel (abs)			-	120	155	250	303
EGR H/E - Exh From (abs)							301
- Water Out						150	100
Oil Filter Delta Pressure					30	36	44
Crankcase							~.2
FLOWS							
% EGR Flow							
Coolant	L/ min	+/- 3	~40	40	~55	65	65
Blowby	L/ min					~30	~30
Air	kg/ hr				165	230	325
EGR H/E Coolant Flow	L/ min	min					30
Oil Scale Cart Reading	Grams						
EMISSIONS							
CO2 % Inlet Manif	%	+/- .05		-	-	-	1.55
CO2 % Exh Stack							10.4

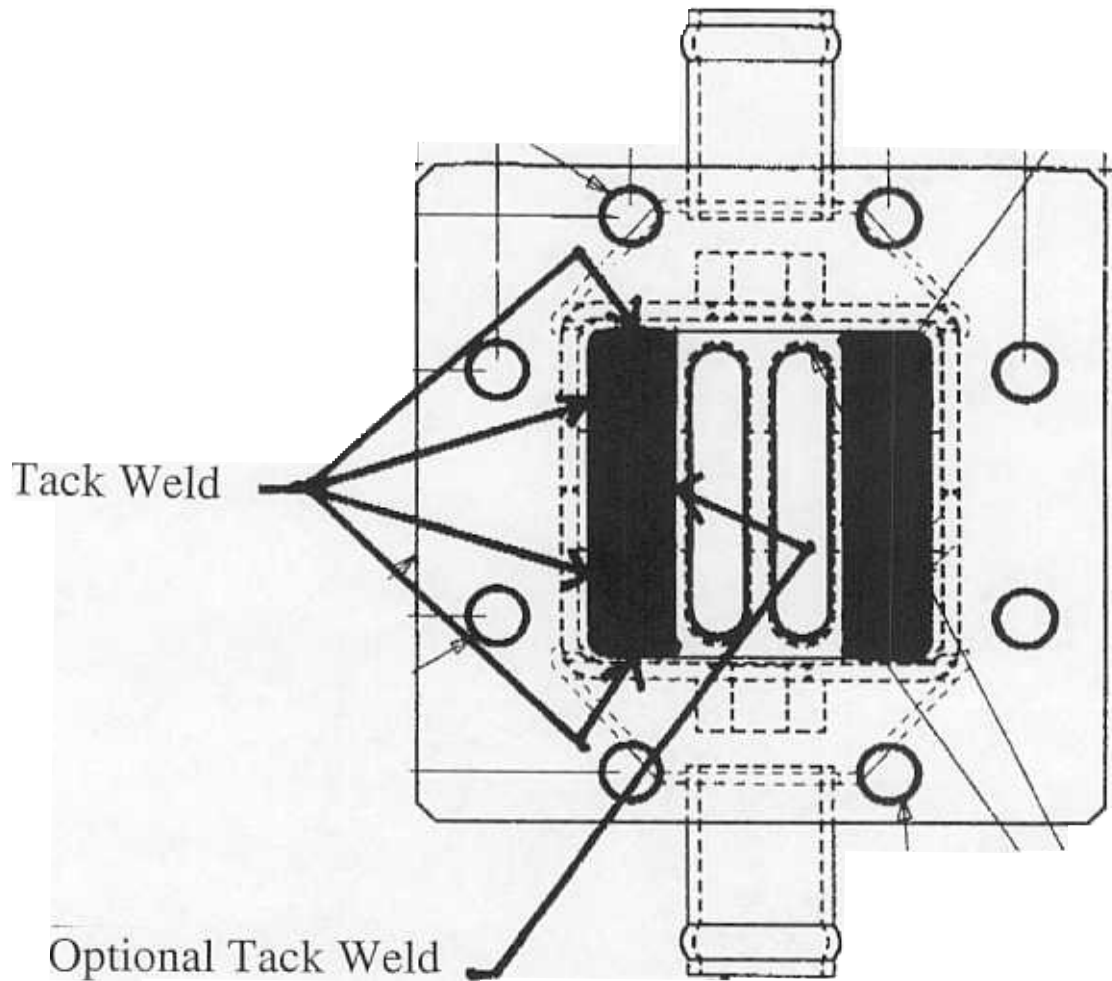
Note:

- (a) Engine controlled to Torque Spec for Steps #2, #3, #4 and 5 minutes of Step #5
- (b) Engine controlled to Fuel Rate for last 55 minutes of Step #5
- (c) Air Pressure at coolant tower controlled to 35 kPa

Ramp Up Conditions Between Warm- Up Steps

Torque	At 5 minutes (beginning at step #2)	20 Nm/ min
Speed	At 10 minutes (beginning at step #3)	100 rpm/ min
Inlet Air Press	At 10 minutes (beginning at step #3)	12 kPa/ min
Exhaust Press	At 10 minutes (beginning at step #3)	12 kPa/ min
Inlet Air Temp	At 0 minutes (at start of test)	5 deg C/ min

EGR Cooler - Probable Modifications



.06 inch Stainless Steel Plate
Fit Into Recess

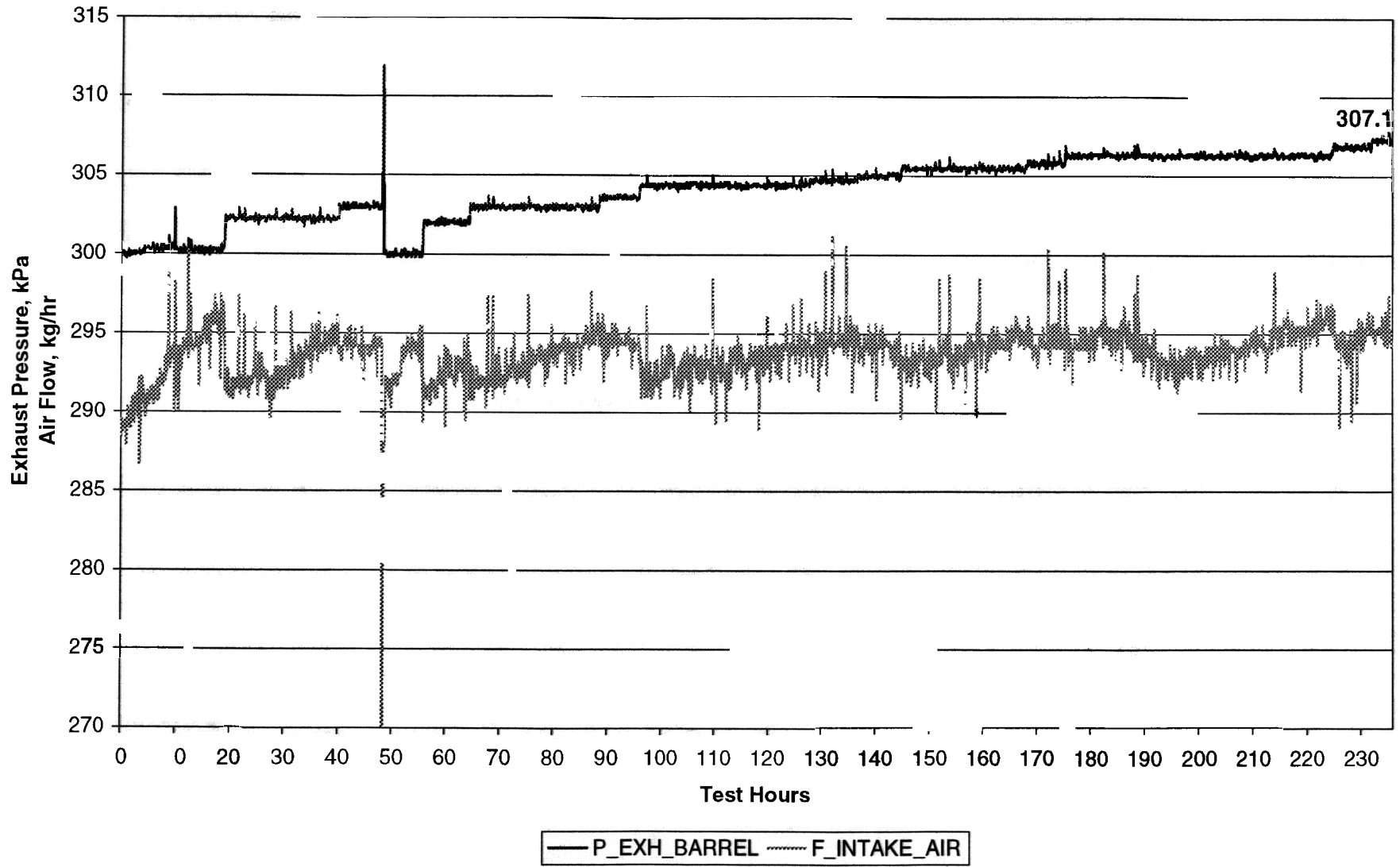
Att 10, pg 1/1

Ethyl 1Q Test With Modified EGR Cooler

		<u>@ 216 hrs*</u>	<u>@ 217 hrs</u>
Ex. BP (kPa)	~300	306	300
Ex. Temp	660	675	664
H.E. In	517	517	516
H.E. Out	169	169	162
H2O In	99	99	99
H2O Out	101	101	101

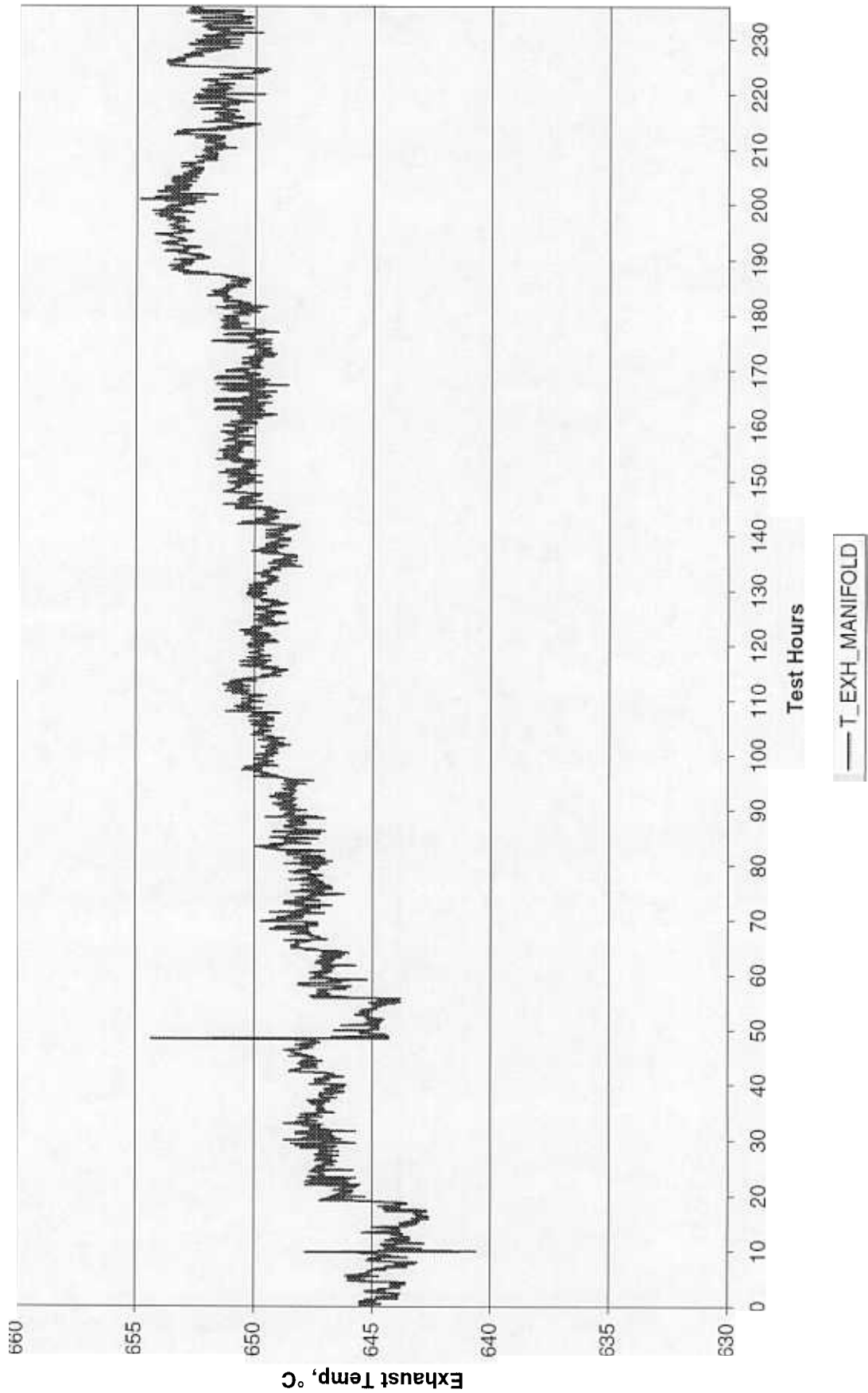
* Blowdown EGR cooler in place

Exhaust Pressure and Air Flow

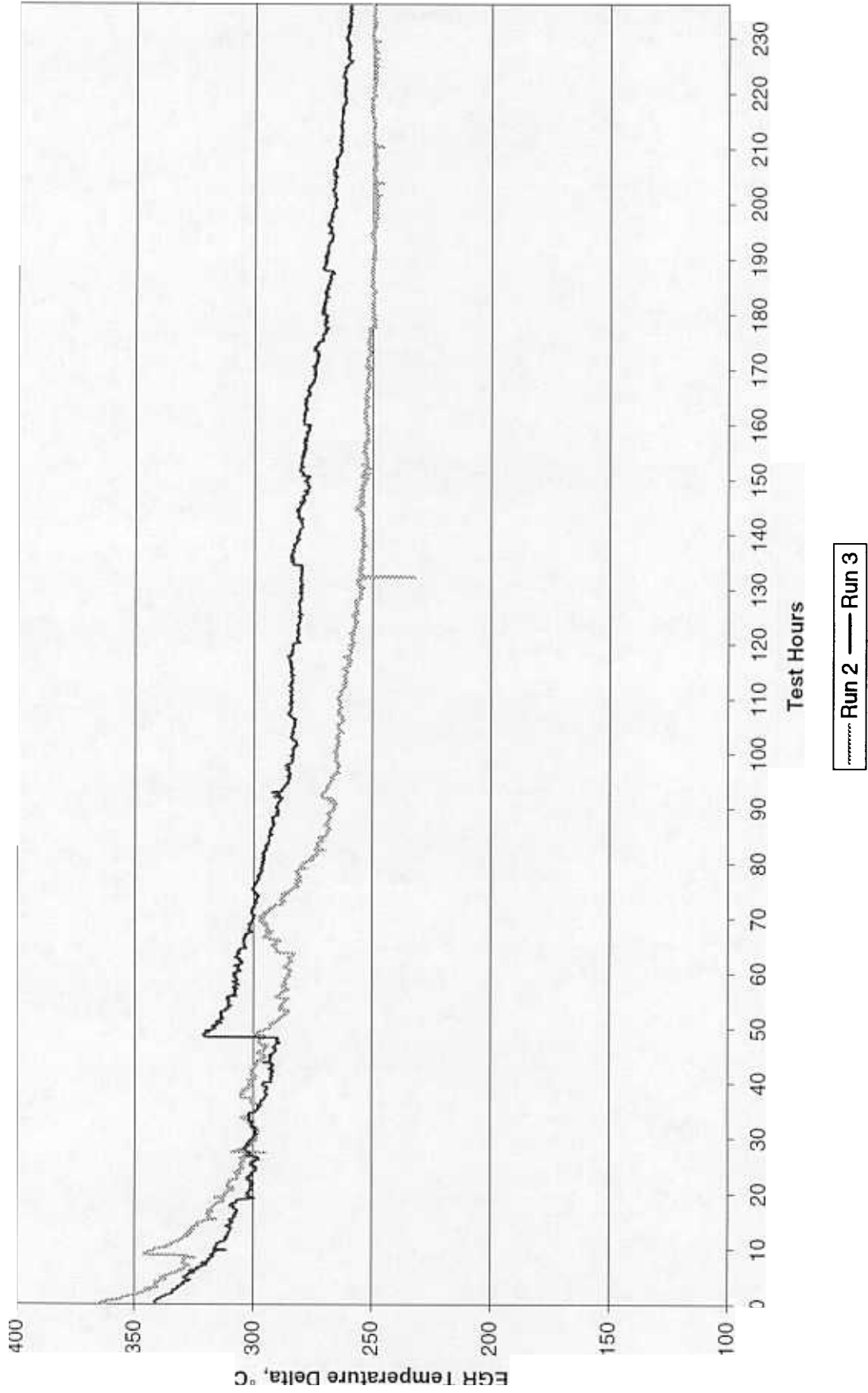


Att 11, pg 1/4

Exhaust Temperature



EGR Temperature Delta



EGR Temperature



	34619	33595	35227	34779	36812	EG	EV
CMIR	EG	SR	EG	MB	LZ		
LAB	41	58	45	6	607		
STAND	52	20	24	39	22		
ENRUN	20000330	20000605	20000622	20000511	20000803		
DTSTRT	20000505	20000628	20000716	20000625	20000829		
DTCOMP	1005-1	1005-1	1005-1	1005-1	1005-1	OIL E	1005-1
IND	21.8	402.4	417.5	419.9	450.4	484.5	381.2
WD	1.00	30.50	26.00	24.00	36.50	43.00	29.25
TGC	1.00	18.75	18.00	8.25	7.75	17.25	19.50
TLC	13.6	9.9	8.6	10.5	9.34*	6.6	9.1
OC	14.0	6.9	7.0	9.0	7.7	8.1	7.4
ETOC	NA	24	NA	18	NA	38	
TGF%	NA	0	NA	0	NA	3	
TLHC%	32.00	62.50	52.00	48.48	73.00		
G1WD	33.00	62.88	78.00	49.92	61.17		
G2WD	31.27	20.85	20.52	10.70	13.73		
L1WD	72.13	69.69	67.80	45.09	83.55		
L2WD	34.20	55.80	52.60	81.60	60.40		
G3WD	36.60	47.40	44.20	74.80	49.20		
L3WD	99.60	67.20	89.40	93.60	85.80		
L4WD	1.75	5.06	7.46	4.62	5.28		
OGWD	4.20	11.00	5.10	10.67	18.27		
UCWD	1800.0	1800.0	1800.0	1800.0	1800.0		
ARPM	240.0	240.0	240.0	240.0	240.0		
AFFLO	7.9	17.8	17.8	18.0	17.9		
AHUMID	67.0	75.2	65.1	65.0	65.3		
ACOLFLO	104.7	105.0	105.1	104.9	105.2		
ACOLOUT	120.2	120.0	120.0	120.0	120.3		
AOMANTMP	68.0	77.2	80.0	79.5	85.0	85.0	85.0
AINAIRT	42.0	42.0	41.9	41.9	42.1		80.0
AFUELTMP	414.9	415.0	417.1	414.9	414.8		
AOMANPR	292.0	292.0	292.0	292.0	292.0		
AINAIRP	297.1	300.9	304.7	302.9	303.2		
AEBP	275.3	275.1	275.4	278.5	276.1		
AFUELPR	NA	1.52	NA		1.54		
ACO2	300.7	376.8	323.6	NA	NA		
AAIRFLO	66.3	64.0	63.9	63.9	67.0		
APWR	351.7	343.8	339.1	339.4	355.4		
ATORQUE	35.1	21.7	38.6	31.9	38.9		
ABLOBY	99.9	99.9	100.1	98.2	99.8		
ACOLIN	4.8	3.9	5.0	6.7	5.3		
ACOLDT	123.7	122.2	123.7	123.0	124.2		
AOCOOLIN	35.4	NA	89.7		70.2		
AHEATOIL	630.6	633.4	653.2	640.0	649.2		
AEXHTMP	0.16	0.14	0.18	0.10	0.11		
ACCV	71.2	68.9	76.1	71.0	91.1		
ACOLPR	NA	90.6	NA		68.0		
AOILD							

*The first four data points were affected by an oil leak.
 The OC from 180h-504h (8.75 g/hr) is a more accurate value.

1Q - EGR SCOTE DATA SUMMARY Att 13, pg 2/3

	1Q -EGR	1Q - EGR	1Q - EGR		
Test Lab	TCL	TCL	P E	Industry	Industry
Oil Type	CH-4	CF-4	E-4	TMC 1005	TMC 1005
Test Hrs	504	504	504		
				Range	Ave
Piston Dep.					
TLHC	20	0	3	0 / 14	3
T L Carbon	40	3	17	8 / 36	20
TGF	41	27	38	18 / 30	24
TG Carbon	37	37	43	24 / 41	31
2GF	14	24	12	1 / 18	11
2G Carbon	11	34	23	12 / 26	18
WD-1P	333	399	484	381/ 450	412
Un Weighted	127	132	142		
Un Crown Carbon	0.7	0	0	0 / 16	5
BSOC g/hr					
36 hrs	11	11	7	11/ 14	13
72 hrs	15	9	7	10 / 14	12
216 hrs	11	8	6	7 / 14	10
360 hrs	14	8	6	7 / 14	10
504 hrs	11	9	9	7 / 14	9
EOT Anal					
Fe ppm	133	106			
Al ppm	4	2			
Cu ppm	19	6			
Cr ppm	7	4			
Pb ppm	6	1			
TBN EOT	6.4	6			
TBN Decrease	4.2	2.5			
% Allow	192	160			
% TGA	2.9	1.4			
Visc Incr @ 100c	9.5	5.7			
IR O2	5	2			
Liner Bore Polish %	3	5.5			
Liner Wear Step mm	0.003				
Loss Side Clear.mm					
Top Ring	0.025	0.012			
Inter Ring	0	0.012			
Ring Gap Incr mm					
Top	0	0.014			
Inter	0.042	0.036			
Hardware Distress					
Top Ring	none	none	none		
Inter Ring	none	none	none		
Oil Ring	none	none	none		
Liner	none	none	none		

CAT SCOTE DATA

	Non-EGR	1Q - EGR	1Q - EGR	1Q - EGR	1Q - EGR
	TMC 1005	TMC 1005	E-4	CF-4	CH-4
	5 Tests	7 Tests	1 Test	1 Test	1 Test
WDP	298	412	484	397	333
TGC	30	31	43	37	37
TLC	18	20	17	3	40

Time Line for the 1Q Test

Brent Shoffner - 9/20/2000

ID	Task Name	Start	Finish	2000														
				Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Design EGR Hardware	03/01/99	11/30/99	█														
2	Produce and ship test kits to labs	12/01/99	02/18/00		█													
3	Specify Installation/Prelim. Procedure	12/01/99	01/12/00		█													
4	Install test kits	02/21/00	05/15/00				█											
5	Write final procedure	03/01/99	05/15/00	█														
6	Develop EGR rate measurement	03/01/99	01/12/00	█														
7	Lab Visits Complete	08/25/00	08/25/00															
8	Run Discrimination Tests	04/03/00	09/12/00															
9	Data Analysis	09/13/00	09/18/00															
10	Approved by Surveillance Panel	09/19/00	09/19/00															
11	HDEOCP Approves Proof of Concept	09/20/00	09/20/00															

Att 14, P9 1/1

Q STATUS

- > RESULTS ON OIL E4 INDICATE DISCRIMINATION ON WEIGHTED DEMERITS
- > LAB VISITS COMPLETE LABS ARE READY
- > DRAFT PROCEDURE IS COMPLETE
- > THERE IS REASONABLE PRECISION ON ALL PARAMETERS EXCEPT "UNDERCROWN WEIGHTED DEMERITS" ON 1005
- > DESIRE ANOTHER RUN ON E4 (A VOLUNTEER IS NEEDED NOW)
- > ONE LAB MUST COMPLETE 1005