Committee D-2 ON PETROLEUM PRODUCTS AND LUBRICANTS

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July 22, 1999

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APPROVED MINUTES OF THE T-10 OPERATIONS AND HARDWARE

TASK FORCE MEETING #1

Hagerstown, MD

Chairman Jim Collum convened the first meeting of the T-10 Operations and Hardware Task Force at 8:30 am at Mack Trucks, Inc. in Hagerstown, MD. The attendance roster is included as Attachment 1. The meeting agenda is included as Attachment 2.

ETEC Engine and EGR Hardware Overview

Ken Goshorn of Mack lead the task force through the review of the E-TECH engine and the EGR hardware. Mack is anticipating that the engines will be available in mid or late August. Ken will provide the E-TECH Manual and the V-MAC III Manual with the engines. The engine power section is essentially the same as that in the T-9. The camshaft has been moved to accommodate the six individual injection pumps. Mack recommends that the test labs mount the engine ECU and the fuel filters remotely. The new bracket for mounting the fuel filters is threaded such that each filter can only be installed in the proper location. The labs indicated to Mack that they would prefer longer (~ 40 ft.) wiring harnesses as opposed to shorter (~ 20 ft.) harnesses. Mack indicated that the oil scale rig is to be the same as the T-8 / T-9 rig.

The EGR arrangement is shown in Attachment 3. EGR flow is controlled with a flapper valve which bypasses the venturi. Fresh air mass flow is measured at the inlet, and O_2/NO_2 is measured in the tailpipe. The sensor is to be 2 feet downstream from the turbo, at the 12:00 o'clock position. With the EGR rig installed, there is not enough room to remove the centrifugal oil filter. To remove the filter, first remove the canister, lift and hold the rotor, put a drill rod through the oil supply hole in the spindle, loosen the spindle, and remove the filter by moving it horizontally until it clears the EGR rig.

Dave Snyder of Mack reviewed the EGR instrumentation. An instrumentation power box is located between the engine and the control pots for throttle, timing, and EGR bypass. The wiring harness from the engine to the power box will be 40 ft. as requested by the labs, while the harness from the power box to the control pots will remain 20 ft. The instrumentation power box has to be provided with compressed air for the EGR shut-off valves, 12 volts DC for the EGR bypass controller and 120 volts AC for the O_2/NO_2 sensor power unit. The O_2/NO_2 sensor is to be mounted on a M18x1.5 boss located 2 ft downstream of the turbocharger connection at the 12:00 o'clock position. It must be activated only when the engine is running to preserve its integrity. A dual display provides O_2 in % and NO_2 in ppm. Injection timing is dialed through the intake manifold temperature. The linear correlation which maps temperature to timing is Attachment 4. Air flow can be measured using a J-TEC VI800 TR (approx. cost $1300), a vortex shedding device which measures volumetric air flow. Mass air flow is then calculated.

Ken indicated that the initial parts supply for the EGR rigs will be very limited. He encouraged the test labs, if possible, to make any minor repairs on there own as opposed to waiting for replacement parts. He also indicated that the labs may want to obtain the gasket material from Mack so that they may cut their own gaskets.

During further discussion of the EGR setup, Steve Trevitz of Mack indicated that the dual turbo setup was necessary to maintain AFR and horsepower. The group then discussed the issue

of compressor discharge temperature. It was agreed that (for safety) the following temperature guidelines be followed: maximum compressor discharge temp of 425 °F, maximum pre-turbine temp of 1250 °F. The group also decided to follow the same warm-up procedure as the T-9, but also specified that the warm-up injection timing is to be set at 9° BTDC.

TEST PROCEDURE

Mack and the TMC will work toward the first draft of the procedure, with the goal of having something to present at the September meeting.

LAB VISITATION GROUP PROTOCOL

Jim Collum and Jeff Clark will work on the protocol and present at the September meeting.

CRITICAL PARTS

Ken Goshorn will provide a complete list of critical parts. This list will be put into the procedure as two groups: those parts that directly affect test severity, and those parts that are specific and crucial to operation of the test.

The group agreed that TEI will supply the cylinder kits, rod bearings and main bearings for the T-10 similarly to the T-9 (same measurements, serialization, laser etching, etc.)

TEST FUEL

The bid for the test fuel goes out this week. Until the bid is resolved, labs should use either Specified LSRD4 or Specified XRD9.

LINER MEASUREMENTS

Following a lengthy discussion regarding the liner measurements, the group decided that any lab's device that is calibrated for T-9 liner measurements may make T-10 measurements as well. The TMC will present the round robin data at the next meeting for discussion.

INLET AIR HUMIDITY

The group identified humidity as a major issue for the development of the T-10 test. The discussion centered on the labs' abilities to control humidity, the cost associated with humidity control, and running the test so that condensation does not occur. It was decided that the issue would need to be discussed again in September. In the meantime every attempt should be made to prevent condensation from occurring in the engine. A guideline to be used is to stay at least 20° F away from the dew point. The issues of whether to set a dew point limit or actively control humidity will be addressed later.

AFR / FUEL FLOW CONTROL

There was a great deal of confusion regarding the effect that controlling fuel flow has on the ability to control AFR. It was decided to re-consult with Steve Trevitz on the matter. NOTE: Steve was consulted after the meeting. He stated that if torque is controlled as opposed to directly controlling fuel flow (this is the common practice at the labs), then the AFR is used as the feedback control for EGR rate. The relative EGR rate (%) is not important, it is actual EGR mass flow that is critical and this is controlled by AFR. The torque / fuel flow control should not impact the ability to control AFR/EGR.

OIL TEMPERATURE CONTROL

The group unanimously passed a motion (Campbell, Schaus second) to control oil temp using process water (similar to the M11) as opposed to engine coolant.

TIMELINE

The group reviewed the development timeline. Some of the dates are likely to be pushed back a bit, but there may be places in the schedule that will allow the development to 'catch-up'.

NEXT MEETING

If needed, there may be an August conference call. The group will also meet in Richmond, VA in conjunction with the T-10 Task Force meeting. The meeting has been set for 10a – 12p on Thursday, September 9th at Ethyl Research Lab.

Attachment 1 - Attendance

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Attachment 2 - Agenda

Mack T-10 Operations and Hardware Task Force

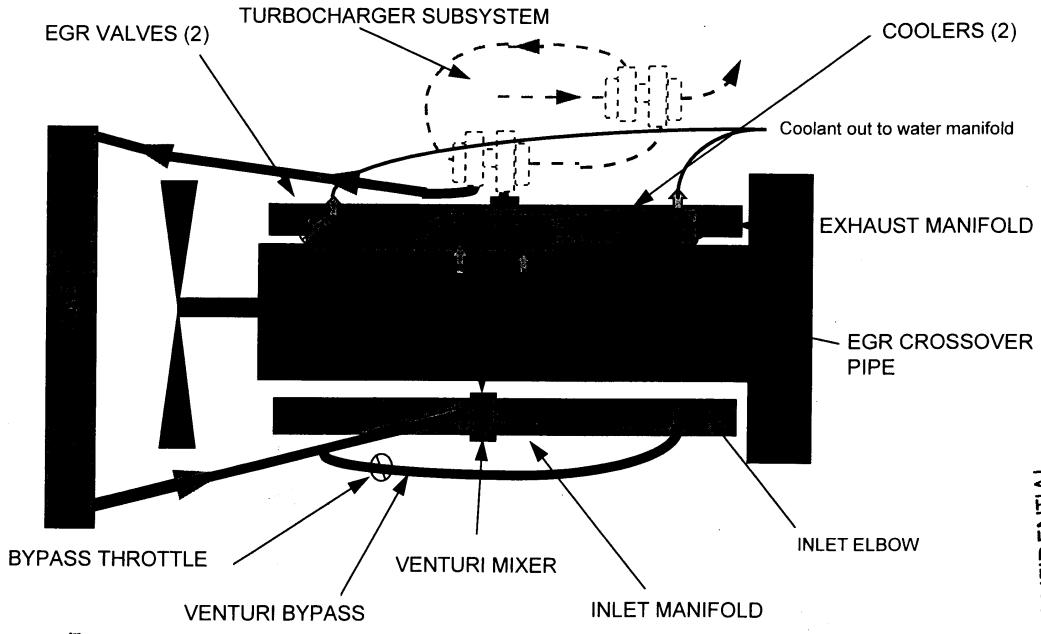
Date: July 22, 1999
Time: 8:30 AM
Location: Mack Trucks Inc., Hagerstown, Md.

Agenda:

1.	ETEC Engine Overview	Ken Goshorn
2.	EGR Hardware Overview	Ken Goshorn
3.	Engine Software Overview	TBD
4.	T-10 Test Procedure	Ken Goshorn / Jeff Clark
5.	Liner Measurement Devices	Jeff Clark
	A. Taly-Surf	
	B. PDI	
	C. Other	
6.	Test Development Template	Group
	A. Timeline	
	B. Lab visitation protocol	
	C. Reference oil supply	
	D. Define Critical Parts	
	E. Test Fuel	
	F. Other	

Attachment 3

E-TECH with EGR ARRANGEMENT



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cjs 3 feb 1999

Attachment 4 – Temperature to Timing Correlation

Intake Manifold Temperature	Injection Timing
30	21
40	18
50	15
60	12
70	9
80	6
90	3