Mack / Volvo Surveillance Panel Meeting

November 11, 2024

David Brass (chair)

Agenda

- Volvo T-13 oil consumption with Brazil Rings
- Volvo T-13 Batched Parts Timelines
- Volvo T-13 New Reference Oil Testing
- Mack T-12 Reference Testing with Chevron Delo 50/50 Coolant
- Volvo T-13 Procedure Wording
- AOB

Volvo T-13 oil consumption

- Candidate tests have been tested at multiple labs. Labs provided OC measurements to help bring comfort with the new Brazil Rings

	Lab A	Lab G
48 hr	42.4 (external oil leak repaired at 48 hr)	17.9
72 hr	25.0	17.7
96 hr	22.6	17.8
120 hr	28.3	17.5
144 hr	22.4	18.5
168 hr	23.0	18.7
192 hr	21.1	17.8
Avg 48-96 hr	**30.0 (23.8 w/o 48hr sample)**	**17.8**
Avg 48-192 hr	**26.4 (23.7 w/o 48hr sample)**	**18.0**

Volvo T-13 Parts Batching

- TEI is actively trying to obtain batches of the following parts:

Part	Batch	Part Number	Production Expectation
Liner	E	21334768	Produced Early November
Piston	A	21170742	January 31, 2025
Piston Pin	A	20569833	5-6 Weeks from PO received
Top Ring	A	21251596	February 28, 2025
2nd Ring	A	20590309	February 28, 2025
Oil Ring	A	20568155	To be provided after PO received

All parts batches are expected to be delivered by March 2025. Goal would be to reference all new parts batches together.

TEI is having difficulty with order fulfillment from Jegs.com. Orders have had delays due to lack of one of the rings. At the moment we might have to revert to Portugal rings for some or all of the rings used for tests.

TEI recently received 66 more ring kits, to make 11 more engine kits.

Volvo T-13 Reference Oil Matrix Testing

Lab A / Stand 1	Lab B / Stand 1	Lab D / Stand 1	Lab G / Stand 1
New Reference Oil	New Reference Oil	New Reference Oil	New Reference Oil
New Reference Oil	New Reference Oil	New Reference Oil	New Reference Oil

Both tests must be conducted in the same stand and run consecutively (no candidates in between)

Current Reference Status

Lab	Stand	Reference Date	Date Reference Expires
A	2	3/5/24	1/16/25
A	4	4/20/23	3/23/24
A	8	10/4/24	8/4/25
B	3	6/3/24	4/3/25
D	1	3/3/25	1/3/25
D	2	5/4/24	3/4/25
G	1	7/4/24	5/4/25
G	2	7/22/23	5/22/24
G	3	5/2/25	3/2/25

Mack T-12 Reference Testing with Chevron Delo 50/50 Coolant

- A4 completed **acceptable calibration** reference using Chevron Delo Extended Life Coolant 50/50 on 9/11/24
- G4 completed **out of calibration** reference using Chevron Delo Extended Life Coolant 50/50 on 9/9/24
- G4 completed **acceptable calibration** reference using Chevron Delo Extended Life Coolant 50/50 on 10/9/24
- D1 completed **out of calibration** reference using Chevron Delo Extended Life Coolant 50/50 on 10/27/24
- D1 will need to complete another test to gain calibration status

- All tests have been mild of target on the Pb parameters
- Suggest that an operational and statistical review of recent Mack T-12 reference tests
  - Can labs include Coolant in and out temps as part of this analysis (not in LTMS)

T12 Data Review

With Emphasis on 4 Test Results with New Coolant

By: Todd Dvorak

Date: 11/06/2024

T12 New Coolant – Data Analysis

- For the 4 new coolant test results, no significant shift found in terms of the Cylinder Liner Wear or Top Ring Weight Loss
  - Includes all chartable data (n = 65) with Ring/Liner Hardware ID Factor
    - Note: Cylinder Liner confounded with Ring Hardware

Response CLW

Whole Model

Actual by Predicted Plot | Lack Of Fit | Residual by Predicted Plot | Summary of Fit | Analysis of Variance | Parameter Estimates | Effect Tests

Coolant | IND | LTMSLAB | LINBATCH

RSquare	0.262574
RSquare Adj	0.126014
Root Mean Square Error	3.048546
Mean of Response	16.13692
Observations (or Sum Wgts)	65

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	19.258544	1.653801	11.65	<.0001*
Coolant[New]	-0.432897	0.886687	-0.49	0.6274
IND[821-1]	9.2436505	3.246601	2.85	0.0062*
IND[821-2]	3.2936505	1.889495	1.74	0.0870
IND[821-3]	-6.037591	2.44095	-2.47	0.0166*
LTMSLAB[A]	-0.548131	0.640541	-0.86	0.3959
LTMSLAB[B]	0.4408784	0.819197	0.54	0.5927
LTMSLAB[D]	-0.265132	0.804121	-0.33	0.7429
LINBATCH[S]	-7.407476	2.9642	-2.50	0.0155*
LINBATCH[U]	2.3737657	3.002797	0.79	0.4327
LINBATCH[V]	3.0425238	1.347686	2.26	0.0280*

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Coolant	1	1	2.21521	0.2384	0.6274
IND	3	3	113.92254	4.0860	0.0110*
LTMSLAB	3	3	11.10133	0.3982	0.7548
LINBATCH	3	3	82.90854	2.9737	0.0396*

Response TRWL

Whole Model

Actual by Predicted Plot | Lack Of Fit | Residual by Predicted Plot | Summary of Fit | Analysis of Variance | Parameter Estimates | Effect Tests

Coolant | IND | LTMSLAB | LINBATCH

RSquare	0.152732
RSquare Adj	-0.00417
Root Mean Square Error	16.16725
Mean of Response	62.95385
Observations (or Sum Wgts)	65

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	60.749983	8.770546	6.93	<.0001*
Coolant[New]	4.9008074	4.702337	1.04	0.3020
IND[821-1]	-5.420434	17.21759	-0.31	0.7541
IND[821-2]	-8.420434	10.02049	-0.84	0.4044
IND[821-3]	7.2756013	12.945	0.56	0.5764
LTMSLAB[A]	2.6714678	3.396957	0.79	0.4351
LTMSLAB[B]	3.5302921	4.344418	0.81	0.4200
LTMSLAB[D]	-2.796915	4.264469	-0.66	0.5147
LINBATCH[S]	1.9761029	15.71994	0.13	0.9004
LINBATCH[U]	-6.719932	15.92463	-0.42	0.6747
LINBATCH[V]	-0.023897	7.147137	-0.00	0.9973

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Coolant	1	1	283.90962	1.0862	0.3020
IND	3	3	220.29694	0.2809	0.8389
LTMSLAB	3	3	533.72077	0.6806	0.5677
LINBATCH	3	3	229.24955	0.2924	0.8307

T12 New Coolant – Data Analysis

- For the 4 new coolant test results, a significant shift has occurred with the 2 Pb parameters
  - Includes all chartable data (n = 65) observations with Liner/Ring Hardware ID factor

Response PB

Whole Model

Actual by Predicted Plot

Lack Of Fit

Residual by Predicted Plot

Summary of Fit

RSquare	0.324859
RSquare Adj	0.199833
Root Mean Square Error	0.280765
Mean of Response	3.043712
Observations (or Sum Wgts)	65

Analysis of Variance

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	2.972229	0.152312	19.51	<.0001*
Coolant[New]	-0.270586	0.081662	-3.31	0.0016*
IND[821-1]	0.1684124	0.299006	0.56	0.5756
IND[821-2]	-0.045588	0.174019	-0.26	0.7943
IND[821-3]	0.1047674	0.224807	0.47	0.6431
LTMSLAB[A]	-0.051528	0.058993	-0.87	0.3863
LTMSLAB[B]	0.1211535	0.075447	1.61	0.1141
LTMSLAB[D]	-0.177118	0.074058	-2.39	0.0203*
LINBATCH[S]	-0.10332	0.272997	-0.38	0.7066
LINBATCH[U]	-0.042575	0.276552	-0.15	0.8782
LINBATCH[V]	-0.02472	0.124119	-0.20	0.8429

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Coolant	1	1	0.86547829	10.9792	0.0016*
IND	3	3	0.25423884	1.0751	0.3674
LTMSLAB	3	3	0.72717202	3.0749	0.0352*
LINBATCH	3	3	0.33930349	1.4348	0.2428

Response PB2

Whole Model

Actual by Predicted Plot

Lack Of Fit

Residual by Predicted Plot

Summary of Fit

Analysis of Variance

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.8364189	0.242984	7.56	<.0001*
Coolant[New]	-0.371395	0.130276	-2.85	0.0062*
IND[821-1]	0.3293767	0.477005	0.69	0.4928
IND[821-2]	-0.127273	0.277613	-0.46	0.6485
IND[821-3]	0.1736442	0.358635	0.48	0.6302
LTMSLAB[A]	-0.197668	0.094111	-2.10	0.0404*
LTMSLAB[B]	0.2413174	0.12036	2.00	0.0500*
LTMSLAB[D]	-0.211492	0.118145	-1.79	0.0790
LINBATCH[S]	-0.372633	0.435514	-0.86	0.3960
LINBATCH[U]	-0.107401	0.441184	-0.24	0.8086
LINBATCH[V]	0.1067168	0.198008	0.54	0.5921

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Coolant	1	1	1.6304825	8.1272	0.0062*
IND	3	3	0.7269239	1.2078	0.3157
LTMSLAB	3	3	2.3198759	3.8545	0.0143*
LINBATCH	3	3	0.7999789	1.3292	0.2745

T12 New Coolant – Data Analysis

- For the 4 new coolant test results, no significant shift found in terms of the Cylinder Liner Wear or Top Ring Weight Loss
  - Includes all chartable data (n = 150) without Liner/Ring Hardware ID Factor

Response CLW

Whole Model

Coolant IND LTMSLAB

Actual by Predicted Plot

Lack Of Fit

Residual by Predicted Plot

Summary of Fit

RSquare	0.188194
RSquare Adj	0.123485
Root Mean Square Error	3.382083
Mean of Response	16.48933
Observations (or Sum Wgts)	150

Analysis of Variance

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	15.557422	0.939154	16.57	<.0001*
Coolant[New]	-0.758398	0.880523	-0.86	0.3906
IND[PC10B]	-3.688267	1.357517	-2.72	0.0074*
IND[PC10E]	-0.160091	0.888023	-0.18	0.8572
IND[820-2]	3.2223666	0.932453	3.46	0.0007*
IND[821]	0.9220565	1.174153	0.79	0.4336
IND[821-1]	-0.102554	0.698949	-0.15	0.8836
IND[821-2]	1.0048346	0.919444	1.09	0.2764
IND[821-3]	-0.604167	0.801685	-0.75	0.4524
LTMSLAB[A]	1.0622371	0.433519	2.45	0.0155*
LTMSLAB[B]	0.126571	0.536096	0.24	0.8137
LTMSLAB[D]	-1.696002	0.568522	-2.98	0.0034*

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Coolant	1	1	8.48559	0.7418	0.3906
IND	7	7	234.60796	2.9301	0.0069*
LTMSLAB	3	3	131.87669	3.8431	0.0111*

Response TRWL

Whole Model

Coolant IND LTMSLAB

Actual by Predicted Plot

Lack Of Fit

Residual by Predicted Plot

Summary of Fit

RSquare	0.14537
RSquare Adj	0.077247
Root Mean Square Error	18.746
Mean of Response	61.22
Observations (or Sum Wgts)	150

Analysis of Variance

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	64.552779	5.205482	12.40	<.0001*
Coolant[New]	7.2866002	4.880506	1.49	0.1377
IND[PC10B]	-6.004045	7.52436	-0.80	0.4263
IND[PC10E]	-3.059002	4.922078	-0.62	0.5353
IND[820-2]	6.8382216	5.168342	1.32	0.1880
IND[821]	-8.779278	6.508024	-1.35	0.1795
IND[821-1]	8.4588506	3.87409	2.18	0.0307*
IND[821-2]	-8.819977	5.096238	-1.73	0.0857
IND[821-3]	5.1484588	4.443529	1.16	0.2486
LTMSLAB[A]	1.6893293	2.402882	0.70	0.4832
LTMSLAB[B]	5.5493766	2.97144	1.87	0.0639
LTMSLAB[D]	-1.563481	3.15117	-0.50	0.6206

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Coolant	1	1	783.3163	2.2291	0.1377
IND	7	7	4998.7032	2.0321	0.0552
LTMSLAB	3	3	2160.2194	2.0491	0.1099

T12 New Coolant – Data Analysis

- For the 4 new coolant test results, a significant shift has occurred with the 2 Pb parameters
  - Includes all chartable data (n = 150) without Liner/Ring Hardware ID factor

Response PB

Whole Model

Coolant IND LTMSLAB

Actual by Predicted Plot

Lack Of Fit

Residual by Predicted Plot

Summary of Fit

RSquare	0.225086
RSquare Adj	0.163317
Root Mean Square Error	0.252067
Mean of Response	3.081641
Observations (or Sum Wgts)	150

Analysis of Variance

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	2.9192854	0.069995	41.71	<.0001*
Coolant[New]	-0.200858	0.065625	-3.06	0.0027*
IND[PC10B]	0.2611829	0.101176	2.58	0.0109*
IND[PC10E]	0.0014317	0.066184	0.02	0.9828
IND[820-2]	-0.110899	0.069496	-1.60	0.1128
IND[821]	-0.147012	0.08751	-1.68	0.0952
IND[821-1]	0.0394009	0.052093	0.76	0.4507
IND[821-2]	0.0588087	0.068526	0.86	0.3923
IND[821-3]	-0.023837	0.05975	-0.40	0.6905
LTMSLAB[A]	-0.02103	0.03231	-0.65	0.5162
LTMSLAB[B]	0.0747473	0.039955	1.87	0.0635
LTMSLAB[D]	-0.136058	0.042372	-3.21	0.0016*

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Coolant	1	1	0.59520159	9.3677	0.0027*
IND	7	7	0.94160906	2.1171	0.0456*
LTMSLAB	3	3	0.86674405	4.5471	0.0045*

Response PB2

Whole Model

Coolant IND LTMSLAB

Actual by Predicted Plot

Lack Of Fit

Residual by Predicted Plot

Summary of Fit

RSquare	0.18828
RSquare Adj	0.123577
Root Mean Square Error	0.388486
Mean of Response	2.044519
Observations (or Sum Wgts)	150

Analysis of Variance

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	1.8259661	0.107877	16.93	<.0001*
Coolant[New]	-0.272987	0.101142	-2.70	0.0078*
IND[PC10B]	0.2452942	0.155933	1.57	0.1180
IND[PC10E]	0.0025925	0.102004	0.03	0.9798
IND[820-2]	0.031936	0.107107	0.30	0.7660
IND[821]	-0.126943	0.13487	-0.94	0.3482
IND[821-1]	0.0279321	0.080285	0.35	0.7284
IND[821-2]	-0.041783	0.105613	-0.40	0.6930
IND[821-3]	-0.02694	0.092086	-0.29	0.7703
LTMSLAB[A]	-0.047139	0.049797	-0.95	0.3455
LTMSLAB[B]	0.1315565	0.061579	2.14	0.0344*
LTMSLAB[D]	-0.229313	0.065304	-3.51	0.0006*

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
Coolant	1	1	1.0994427	7.2849	0.0078*
IND	7	7	0.9343042	0.8844	0.5207
LTMSLAB	3	3	2.6209364	5.7887	0.0009*