



**ORONITE**

# **Mack T-12 Precision Matrix Final Dataset Consensus Analyses**

**Statistics Edition, Version 3  
October 20, 2005**

**Jim Rutherford  
(510) 242-3410  
jaru@chevron.com**



# Dataset

**October 14, 2005 LTMS dataset specified by the T-12 Task Force  
Containing 26 tests:**

- **4 Pre-matrix tests with old rings run with matrix test procedure**
- **3 Matrix tests with old rings**
- **13 Matrix tests with new rings**
- **6 Concurrent tests with new rings**

# Cylinder Outliers

**Using 19 tests of 26 with new rings  
Profiles applied for TRWL and CLW, not for BWLU  
Repeated measures analyses:**



BWLU



TRWL



CLW

**Profile summaries:**



Profiles Summary

**Calculation procedures:**



TRWL&CLWos



Pbos

# Modeling Summary

Compromising between all data (26 tests) with the full model (oil, lab, stand(lab), rings) and new rings data (19 tests) with rings deleted from the full model, the following transformations were used in the analyses.

Box-Cox Transformations		All data, Full Model		New Rings, Full Model		New Rings, Reduced Model	
		Significant Effects	"Outliers"	Significant Effects	"Outliers"	Significant Effects	"Outliers"
DPBFNL	natural log	Oil	55713		55713	Oil	55713
DPB2FNL	natural log		55713		55713		55713
CLW	none	Oil, Lab	55716	Oil, Lab, Marginal Stand(Lab)	56726	Oil & Lab	55937
TRWL	none	Rings					
OCFNL	natural log	Marginal Rings	55729	Oil, Marginal Lab		Oil & Lab	
Mack Merit							
BWLU	none						
IR250300	natural log		49991	Oil, Lab, Marginal Stand(Lab)		Oil & Marginal Lab	55715



BoxCox



All data, Full model



NewRingsFullModel

NewRingsReduced  
ModelNewRingsMeritMod  
el

# Modeling with new rings – significant effects

			Pairwise Tukey P		
Oil	CLWos		820-2	PC10B	PC10E
820-2	19.1			<.0001	0.00
PC10B	12.5		<.000		0.16
PC10E	14.6		0.00	0.16	
Oil	lnOCFNL	OCFNL	820-2	PC10B	PC10E
820-2	4.204	66.9		0.12	0.01
PC10B	4.124	61.8	0.12		0.55
PC10E	4.083	59.3	0.01	0.55	
Oil	lnDIR250300	DIR250300	820-2	PC10B	PC10E
820-2	4.673	107.0		0.04	0.03
PC10B	5.150	172.4	0.04		1.00
PC10E	5.154	173.1	0.03	1.00	

Lab	CLWos		A	B	D	F	G
A	18.6			0.69	0.00	0.84	0.01
B	17.0		0.69		0.00	1.00	0.14
D	10.6		0.00	0.00		0.01	0.10
F	17.1		0.84	1.00	0.01		0.21
G	13.8		0.01	0.14	0.10	0.21	

# Precision Analyses

	All Data, Full Model		New Rings, Reduced Model		Anchor	MAD Survey Median
	S <sub>pp</sub>	E <sub>p</sub>	S <sub>pp</sub>	E <sub>p</sub>		
In( $\Delta$ Pb0-300os)*	0.293	0.77	0.288	0.78	20	4.5
In( $\Delta$ Pb250-300)*	0.382	0.75	0.363	0.79	7	2
Cylinder Liner Wear os	2.0	2.00	1.7	2.35	20	4
Top Ring Weight Loss os	20.9	0.60	24.9	0.50	50	12.5
In(Oil Consumption)*	0.108	1.08	0.061	1.91	60	7
Mack Merit**			208	0.96		200
BWLUos***	43.7	1.76	36.4	2.12		77
In(IR250300)	0.411		0.282			

\* $E_p = (\ln(\text{anchor} + \text{median}/2) - \ln(\text{anchor} - \text{median}/2)) / ((\ln(\text{anchor}) + S_{pp}/2) - (\ln(\text{anchor}) - S_{pp}/2))$

\*\*\* "Mad Survey Median" for Mack Merit estimated by informal survey in Mack T-12 Task Force meeting 10/11/05

\*\*\* "Mad Survey Median" for BWLUos estimated from equation relating lead and bearing weight loss applied to 4.5.

# Targets?

Oil	Variable	Arithmetic Average	LSMean	Arithmetic Std Dev	Model RMSE
820-2	InDPb0300os	2.946	2.925	0.259	0.288
PC10B		3.377	3.377	0.246	
PC10E		3.246	3.259	0.289	
820-2	InDPb2	2.019	2.002	0.364	0.363
PC10B		2.335	2.245	0.324	
PC10E		2.268	2.251	0.448	
820-2	CLWos	18.1	19.1	3.7	1.7
PC10B		12.8	12.5	3.2	
PC10E		15.1	14.6	3.4	
820-2	TRWLos	52.4	54.6	21.4	24.9
PC10B		51.7	54.5	25.4	
PC10E		65.9	66.4	27.9	
820-2	InOCFNL	4.216	4.204	0.090	0.061
PC10B		4.097	4.124	0.075	
PC10E		4.072	4.083	0.054	

# Correlations Among Pass Criteria (original)

Here are correlations using original data.

Pearson Correlation Coefficients, N = 19 Prob >  r  under H0: Rho=0					
	InDPb0300os	InDPb2	CLWos	TRWLos	InOCFNL
<b>InDPb0300os</b> InDPb0300os	1.00000	0.84433 <.0001	-0.33022 0.1674	-0.25718 0.2878	-0.29827 0.2148
<b>InDPb2</b> InDPb2	0.84433 <.0001	1.00000	-0.00810 0.9738	-0.37883 0.1097	-0.28004 0.2456
<b>CLWos</b> CLWos	-0.33022 0.1674	-0.00810 0.9738	1.00000	-0.18229 0.4551	0.21921 0.3672
<b>TRWLos</b> TRWLos	-0.25718 0.2878	-0.37883 0.1097	-0.18229 0.4551	1.00000	-0.29162 0.2257
<b>InOCFNL</b> InOCFNL	-0.29827 0.2148	-0.28004 0.2456	0.21921 0.3672	-0.29162 0.2257	1.00000



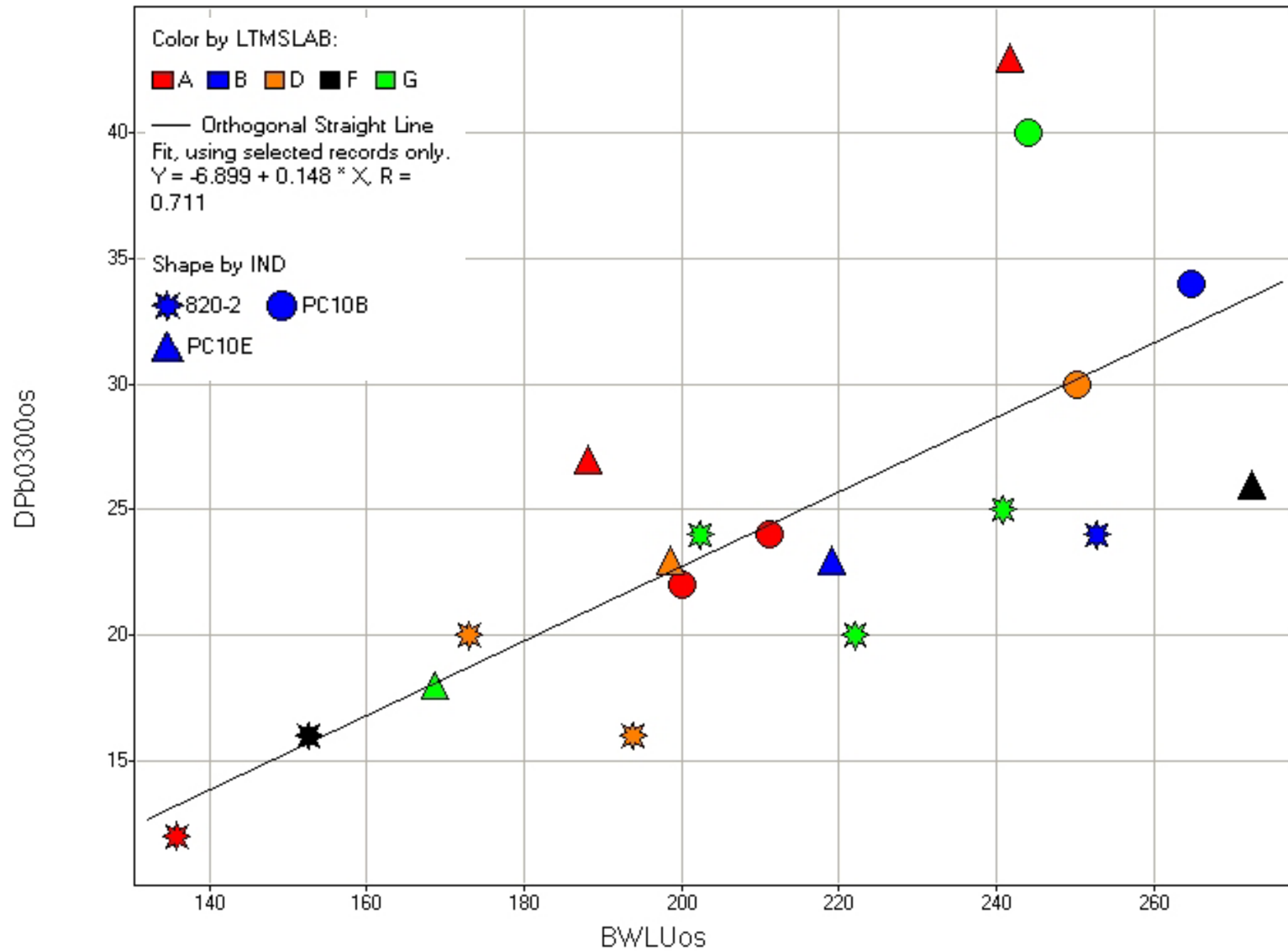
# Correlations Among Pass Criteria (residuals)

Here are correlations using residuals from final models for the new rings data.

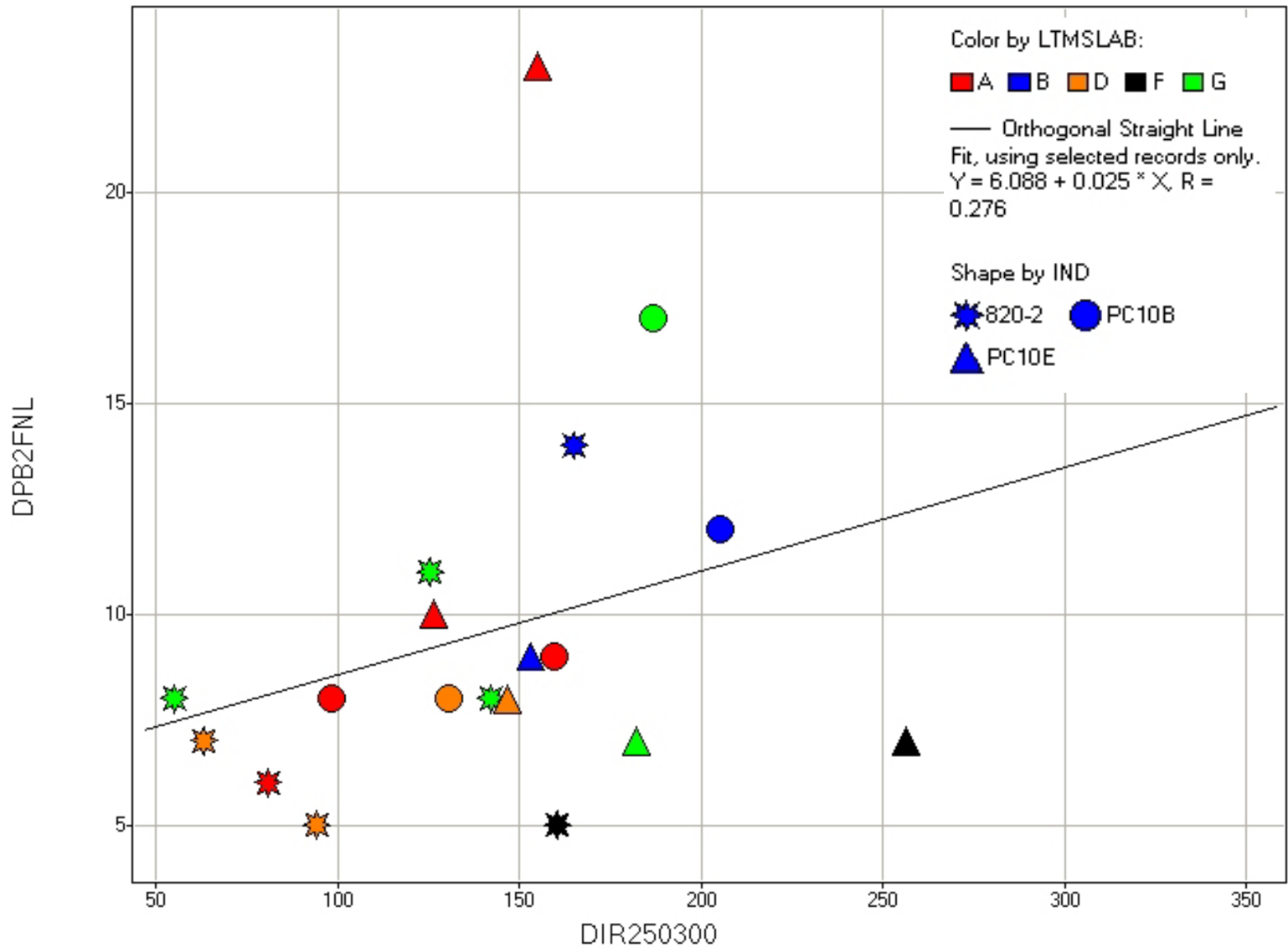
The strong correlation between the Pb's shows both places. This says for these oils, they tell us pretty much the same thing and they usually give the same relative indication of performance.

Pearson Correlation Coefficients, N = 19 Prob >  r  under H0: Rho=0					
	residual_InDPb0300 os	residual_InDP b2	residual_CLW os	residual_TRWL os	residual_InOCF NL
residual_InDPb0300 os	1.00000	0.91423 <.0001	0.15400 0.5290	-0.32789 0.1705	0.01592 0.9484
residual_InDPb2	0.91423 <.0001	1.00000	0.17741 0.4675	-0.31508 0.1889	0.01749 0.9433
residual_CLWos	0.15400 0.5290	0.17741 0.4675	1.00000	-0.18915 0.4380	0.13844 0.5719
residual_TRWLos	-0.32789 0.1705	-0.31508 0.1889	-0.18915 0.4380	1.00000	-0.24552 0.3110
residual_InOCFNL	0.01592 0.9484	0.01749 0.9433	0.13844 0.5719	-0.24552 0.3110	1.00000

# Lead and Bearing Weight Loss



# Lead 250 to 300 and DIR 250 to 300



# Mack Merit

Testkey	Oil	Lab	Delta Pb 0300	Delta PB 250300	Cylinder Liner Wear	Top Ring Weight Loss	Oil Consumption	Calculated Merit	Final Merit
55205	820-2	F	16	5	22	56	77	785	Fail
55213	820-2	G	25	11	18	30	76	959	959
55216	820-2	B	24	14	22	44	63	672	672
55217	820-2	A	12	6	22	42	64	1022	1022
55715	820-2	G	20	8	18	56	67	1019	1019
55722	820-2	D	20	7	15	45	60	1275	1275
55723	820-2	D	16	5	15	101	66	1022	Fail
56153	820-2	G	24	8	16	45	71	1084	1084
55712	PC10B	A	24	8	15	46	60	1194	1194
55728	PC10B	B	34	12	15	44	62	980	980
55935	PC10B	A	22	9	15	96	53	993	Fail
56010	PC10B	D	30	8	9	31	61	1193	1193
56562	PC10B	G	40	17	11	41	65	783	Fail
55713	PC10E	A	43	23	16	35	57	717	Fail
55718	PC10E	G	18	7	12	36	63	1326	1326
55725	PC10E	D	23	8	11	106	62	868	Fail
55937	PC10E	A	27	10	21	65	55	749	749
55940	PC10E	F	26	7	15	87	59	987	987
56726	PC10E	B	23	9	12	67	57	1099	1099