Chevron Oronite

Mack T12 LTMS20170221 New Parts and ICF Review

Jim Rutherford

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ADDING UP For 100 Years

Contents

- Dataset – ltms 20170221
  - 821 and variants
  - Chart ≠ N (except VXYPD)
  - Testkey ≠ 98459, 98867 (goofy tests)
  - Testkey ≠ 109182 (thrown out last time)
  - Testkey ≠ 110864 (VUXPB)
  - ⇒ 110 tests
- Transformation discussion
- Proposed correction factors
- Data pictures

Transformations

- From the original precision matrix we determined for LTMS to use natural logarithm transformations for Pb, Pb2, and OC. We used no transformations for CLW and TRWL.
- For this data review to explore Industry Correction Factors for Batch X top rings, the high results raised the question of transformation for liner wear.
- Following are Box-Cox evaluations for transformations for all results using the models that have been most recently used to develop ICFs.
- There are indications that CLW and TRWL need ln transformation, Pb now needs square root transformation, and ln is still appropriate for Pb2 and OC.
- We need to consider that transformation considerations from the precision matrix were across oils of differing performance while the current analysis contains putatively one oil.
- Analyses and proposed ICFs are shown for traditional and potential new transformations.

ALW transformation

With higher wear now in the dataset, liner wear needs a natural logarithm transformation.

Obs	rmse	LAMBDA	confint
1	5.0972	-2	
2	4.9718	-1.9	
3	4.8547	-1.8	
4	4.7456	-1.7	
5	4.6441	-1.6	
6	4.55	-1.5	
7	4.463	-1.4	
8	4.3827	-1.3	
9	4.3091	-1.2	
10	4.2419	-1.1	
11	4.1809	-1	
12	4.126	-0.9	
13	4.0771	-0.8	
14	4.0341	-0.7	
15	3.9969	-0.6	
16	3.9656	-0.5	*
17	3.9401	-0.4	*
18	3.9205	-0.3	*
19	3.9068	-0.2	*
20	3.8992	-0.1	*
21	3.8979	0	Best
22	3.9031	0.1	*
23	3.9151	0.2	*
24	3.9341	0.3	*
25	3.9605	0.4	*
26	3.9949	0.5	
27	4.0377	0.6	
28	4.0896	0.7	
29	4.1513	0.8	
30	4.2235	0.9	
31	4.3072	1	
32	4.4034	1.1	
33	4.5132	1.2	
34	4.638	1.3	
35	4.779	1.4	
36	4.938	1.5	
37	5.1166	1.6	
38	5.3168	1.7	
39	5.5406	1.8	
40	5.7903	1.9	
41	6.0686	2	

TRWL transformation

Top ring weight loss also seems to need a natural logarithm transformation.

Obs	rmse	LAMBDA	confint
1	24.096	-2	
2	23.585	-1.9	
3	23.108	-1.8	
4	22.664	-1.7	
5	22.253	-1.6	
6	21.873	-1.5	
7	21.524	-1.4	
8	21.205	-1.3	
9	20.914	-1.2	
10	20.652	-1.1	
11	20.417	-1	
12	20.21	-0.9	
13	20.029	-0.8	
14	19.874	-0.7	*
15	19.746	-0.6	*
16	19.643	-0.5	*
17	19.565	-0.4	*
18	19.513	-0.3	*
19	19.486	-0.2	*
20	19.484	-0.1	Best
21	19.507	0	*
22	19.555	0.1	*
23	19.628	0.2	*
24	19.727	0.3	*
25	19.852	0.4	*
26	20.003	0.5	
27	20.18	0.6	
28	20.385	0.7	
29	20.616	0.8	
30	20.876	0.9	
31	21.165	1	
32	21.484	1.1	
33	21.833	1.2	
34	22.213	1.3	
35	22.626	1.4	
36	23.073	1.5	
37	23.555	1.6	
38	24.073	1.7	
39	24.629	1.8	
40	25.224	1.9	
41	25.86	2	

Pb, Pb2, and OC transformation

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Oil consumption and Pb2 look ok with their natural log transformations.

Pb would rather have a square root transformation but that might be stretching our mathematical tolerance.

OILCON				DPB2530_				DPBEOT_			
Obs	rmse	LAMBDA	confint	Obs	rmse	LAMBDA	confint	Obs	rmse	LAMBDA	confint
1	6.7296	-2		1	12.713	-2		1	8.8667	-2	
2	6.6621	-1.9		2	11.707	-1.9		2	8.6161	-1.9	
3	6.598	-1.8		3	10.804	-1.8		3	8.3851	-1.8	
4	6.5373	-1.7		4	9.9937	-1.7		4	8.1731	-1.7	
5	6.48	-1.6		5	9.2672	-1.6		5	7.9795	-1.6	
6	6.4261	-1.5		6	8.6163	-1.5		6	7.8038	-1.5	
7	6.3756	-1.4		7	8.0339	-1.4		7	7.6455	-1.4	
8	6.3285	-1.3		8	7.5138	-1.3		8	7.5043	-1.3	
9	6.2847	-1.2		9	7.0504	-1.2		9	7.3801	-1.2	
10	6.2442	-1.1		10	6.6389	-1.1		10	7.2727	-1.1	
11	6.207	-1		11	6.2752	-1		11	7.1822	-1	
12	6.1732	-0.9		12	5.9556	-0.9		12	7.1085	-0.9	*
13	6.1426	-0.8	*	13	5.6771	-0.8		13	7.0519	-0.8	*
14	6.1154	-0.7	*	14	5.437	-0.7		14	7.0126	-0.7	*
15	6.0915	-0.6	*	15	5.2332	-0.6		15	6.9909	-0.6	*
16	6.0708	-0.5	*	16	5.0639	-0.5		16	6.9874	-0.5	Best
17	6.0534	-0.4	*	17	4.9278	-0.4		17	7.0026	-0.4	*
18	6.0393	-0.3	*	18	4.8237	-0.3		18	7.0371	-0.3	*
19	6.0285	-0.2	*	19	4.7511	-0.2	*	19	7.0917	-0.2	*
20	6.021	-0.1	*	20	4.7094	-0.1	*	20	7.1672	-0.1	
21	6.0168	0	*	21	4.6985	0	Best	21	7.2646	0	
22	6.0158	0.1	Best	22	4.7186	0.1	*	22	7.3848	0.1	
23	6.0182	0.2	*	23	4.7699	0.2	*	23	7.5291	0.2	
24	6.0238	0.3	*	24	4.8532	0.3		24	7.6986	0.3	
25	6.0328	0.4	*	25	4.9692	0.4		25	7.8948	0.4	
26	6.045	0.5	*	26	5.1192	0.5		26	8.1192	0.5	
27	6.0606	0.6	*	27	5.3046	0.6		27	8.3733	0.6	
28	6.0795	0.7	*	28	5.5273	0.7		28	8.6589	0.7	
29	6.1017	0.8	*	29	5.7894	0.8		29	8.978	0.8	
30	6.1273	0.9	*	30	6.0934	0.9		30	9.3327	0.9	
31	6.1562	1		31	6.4423	1		31	9.7251	1	
32	6.1885	1.1		32	6.8397	1.1		32	10.158	1.1	
33	6.2242	1.2		33	7.2895	1.2		33	10.634	1.2	
34	6.2633	1.3		34	7.7964	1.3		34	11.155	1.3	
35	6.3057	1.4		35	8.3658	1.4		35	11.726	1.4	
36	6.3517	1.5		36	9.0035	1.5		36	12.35	1.5	
37	6.401	1.6		37	9.7166	1.6		37	13.03	1.6	
38	6.4538	1.7		38	10.513	1.7		38	13.771	1.7	
39	6.5102	1.8		39	11.401	1.8		39	14.577	1.8	
40	6.57	1.9		40	12.391	1.9		40	15.453	1.9	
41	6.6334	2		41	13.495	2		41	16.405	2	

OC, Liner Wear, and TRWL ICFs

VABC 3/3/2016 -- IL 16-1					
	TRNDPB	TRNDPB2	TRNOC	ALW_	ATRWL_
Predicted			4.353	16.7	68
Target			4.093	16.2	62
ICF			0.940	0.970	0.912

VXYPD proposed 2/23/2017					
	TRNOC	ALW_	lnALW	ATRWL_	lnTRWL
Predicted	4.422	44.8	3.749	52	3.9074
Target	4.093	16.2	2.785	62	4.1271
ICF	0.926	0.362	0.743	1.192	1.056

Pb Oil Consumption Correction

Natural logarithm transformation

(8) For all tests starting on or after February 25th, 2017 or using VXYPD hardware, determine the final ΔLead at EOT result by applying the correction factor calculated according to the following equations:

If $OC_{100\text{-}300} > 65.0$

$$\Delta Lead_{Final} = \exp[\ln(\Delta Lead) + (65.0 - OC_{100\text{-}300}) \times 0.03234] \qquad (8)$$

Square root transformation

(8) For all tests starting on or after February 25th, 2017 or using VXYPD hardware, determine the final ΔLead at EOT result by applying the correction factor calculated according to the following equations:

If $OC_{100\text{-}300} > 65.0$

$$\Delta Lead_{Final} = [\text{square root}(\Delta Lead) + (65.0 - OC_{100\text{-}300}) \times 0.09983]^{2} \qquad (8)$$

Pb2 Oil Consumption Correction

(8) For all tests starting on or after February 25th, 2017, determine the final ΔLead (250 to 300) h by applying the correction factor calculated according to the following equations:

If $OC_{100\text{-}300} > 65.0$

$$\Delta Lead\ (250\text{-}300)_{Final} = \exp[\ln(\Delta Lead(250\text{-}300)) + (65.0 - OC_{100\text{-}300}) \times 0.04089 \quad (17)$$

If $OC_{100\text{-}300} \leq 65.0$

$$\Delta Lead\ (250\text{-}300)_{Final} = \Delta Lead(250\text{-}300) \quad (18)$$

Where:

ΔLead (250-300) = final ΔLead (250 to 300) h

ΔLead (250-300) = value calculated per 11.6.5

$OC_{100\text{-}300}$ = average oil consumption calculated in 11.6.6

Report the data on the appropriate form.

Pb Original and Corrected (ln)

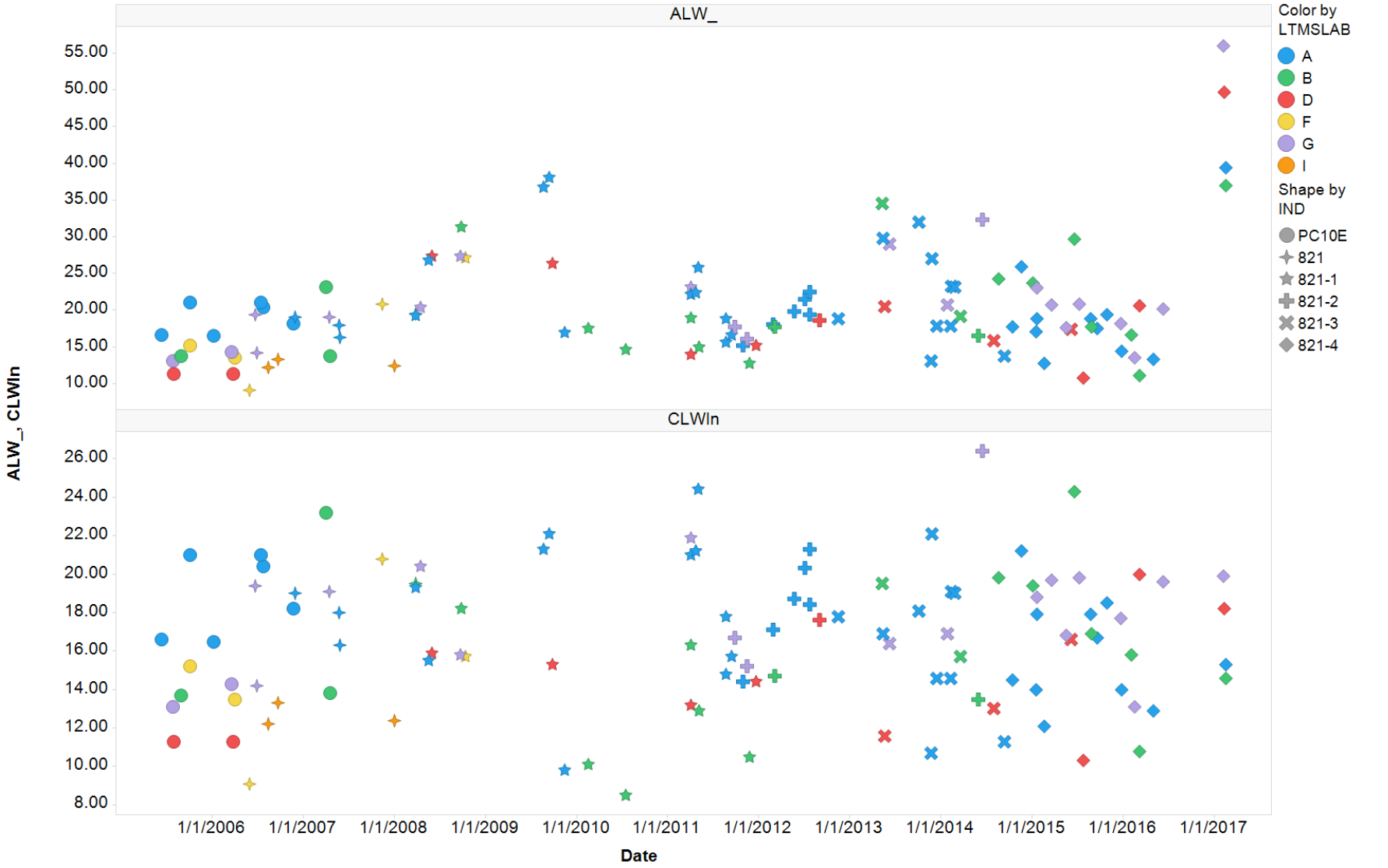
Pb Original and Corrected (square root)

Pb2 Original and Corrected

OC Original and Corrected

CLW Original and Corrected (no xform)

CLW Original and Corrected (ln)



TRWL Original and Corrected (no xform)

TRWL Original and Corrected (ln)