

6. Sequence IVA LTMS Requirements

A. Reference Oils and Parameters

The critical parameter is Average Camshaft Wear. The reference oils required for stand calibration are the reference oils accepted by the ASTM Sequence IVA Surveillance Panel. The means and standard deviations for the current reference oils for the critical parameter are presented below.

AVERAGE CAMSHAFT WEAR
Unit of Measure: micrometers

Reference Oil	Mean	Standard Deviation
1006-2	102.18	13.54
1007	84.76	15.40

B. Acceptance Criteria

1. New Test Stand

a. Less than six (6) Operationally Valid Calibration Results in Laboratory

- A minimum of two (2) operationally valid calibration tests, with no stand Shewhart severity alarms (all parameters) and no stand Shewhart precision alarms (critical parameters only) on any approved reference oils.
- All operationally valid calibration results must be charted to determine if the test stand is currently “in control” as defined by the control chart from the Lubricant Test Monitoring System.

b. Six (6) or more Operationally Valid Calibration Results in Laboratory*

- The first operationally valid test run on any approved reference oil must have no stand Shewhart severity alarm and no stand Shewhart precision alarm using the “Reduced K” values. If the first operationally valid calibration test does not meet these acceptance criteria, then the New Test Stand criteria listed above in 1.a must be followed.

- * Only test results from calibrated stands in the laboratory count towards the tally of six (6) required operationally valid calibration tests. The sixth test must complete (date and time) before the first test completes (date and time) on a new test stand that is seeking calibration with a single test result. In addition, the first test for the stand is to begin within six (6) months of the completion of the last acceptable calibration test. Also, there must not be any outstanding precision alarms for the laboratory.

21. T-11 LTMS Requirements

The following are the specific T-11 calibration test requirements.

A. Reference Oils and Parameters

The critical parameter is Soot at 12.0 cSt Viscosity Increase. Soot at 4.0 cSt Viscosity Increase, Soot at 15.0 cSt Viscosity Increase, and MRV Viscosity are noncritical parameters. The reference oils required for test stand and test laboratory calibration are reference oils accepted by the ASTM Mack Test Surveillance Panel. The mean and standard deviation for the current reference oils for critical and noncritical parameters are presented below.

SOOT @ 4.0 cSt VISCOSITY INCREASE

Unit of Measure: %

NONCRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
822-1	3.99	0.21

SOOT @ 12.0 cSt VISCOSITY INCREASE

Unit of Measure: %

CRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
822-1	5.65	0.54

SOOT @ 15.0 cSt VISCOSITY INCREASE

Unit of Measure: %

NONCRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
822-1	6.35	0.66

MRV VISCOSITY

Unit of Measure: cP

NONCRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
822-1	14408	314

3. Reference Oil Assignment

Once test stands have been accepted into the system, the TMC will assign reference oils for continuing calibration according to the following reference oil mix:

- 100% of the scheduled calibration tests should be conducted on reference oil 820-3, 822-1 or subsequent approved reblends.

4. Control Charts

In Section 1, the construction of the control charts that constitute the Lubricant Test Monitoring System is outlined. The constants used for the construction of the control charts for the T-11, and the response necessary in the case of control chart limit alarms, are depicted below.

LUBRICANT TEST MONITORING SYSTEM CONSTANTS

		EWMA Chart				Shewhart Chart	
		LAMBDA		K		K	
Chart Level	Limit Type	Precision	Severity	Precision	Severity	Precision	Severity
Stand	Reduced	--	--	--	--	--	1.43
	Action	0.3	0.3	1.74	2.05	1.74	1.75
Lab	Warning	0.2	--	1.74	--	--	--
	Action	0.2	0.2	2.58	1.96	1.74	1.75
Industry	Warning	0.2	0.2	1.74	2.05	--	--
	Action	0.2	0.2	2.58	2.81	--	--

The following are the steps that must be taken in the case of exceeding control chart limits. The steps are listed in order of priority, although charts should be studied simultaneously to determine the cause(s) of a problem. In the case of multiple alarms, contact the TMC for guidance.

- Exceed EWMA laboratory chart action limit for precision (critical parameter only)
 - Immediately provide written notice of the alarm and its meaning to all Test Purchasers and the TMC. This notice shall be appended to all test reports during the alarm period.
- Exceed EWMA laboratory chart warning limit for precision (critical parameter only)
 - Immediately provide written notice of the alarm and its meaning to all Test Purchasers and the TMC. This notice shall be appended to all test reports during the alarm period.
- Exceed EWMA test stand chart limit for precision (critical parameter only)
 - Immediately provide written notice of the alarm and its meaning to all Test Purchasers and the TMC. This notice shall be appended to all test reports for the stand in question during the alarm period.

27. L-37 LTMS Requirements

The following are the specific L-37 calibration test requirements.

A. Reference Oils and Parameters

The critical parameters are Pinion Ridging, Pinion Rippling, Pinion Pitting/Spalling, Pinion Wear, and Pinion Scoring. The reference oils required for test stand and test laboratory calibration are reference oils accepted by the ASTM L-37 Surveillance Panel. The means and standard deviations for the current reference oils for each critical parameter are presented below.

RIDGING Unit of Measure: Merits

Hardware	Pinion Batch	Reference Oil	Mean	Standard Dev.	Acceptance Band
LUBRITED	L247/T758A	128-1	7.40	0.516	6 - 8
		151-3	8.80	0.422	8 - 10
		155	9.00	0.000	9 - 9
	V1L686/P4L626A	128-1	6.35	0.813	5 - 8
		151-3	6.43	1.207	4 - 9
		152	5.25	0.500	4 - 6
		153	5.00	0.000	5 - 5
		155	7.00	0.000	7 - 7
	V1L528/P4T883A	134	7.00	1.155	4 - 10
		152-1	8.00	0.632	7 - 10
		152-2	8.00	0.632	7 - 10
		155	8.29	0.488	7 - 10
NONLUBRITED	V1L417/P4L792	151-3	9.47	0.507	9 - 10
		152	9.17	0.408	8 - 10
		152-1	9.47	0.640	8 - 10
		153	9.00	0.816	8 - 10
		153-1	8.80	0.616	8 - 10
		155	9.50	0.527	9 - 10
	V1L500/P4T813	152-1	8.85	0.689	8 - 10
		155	9.07	0.594	8 - 10
	V1L528/P4T883A	134	6.40	1.673	3 - 9
		152-1	8.75	0.707	7 - 10
		152-2	8.75	0.707	7 - 10
		155	8.56	0.882	7 - 10

RIPPLING
Unit of Measure: Merits

Hardware	Pinion Batch	Reference Oil	Mean	Standard Dev.	Acceptance Band
LUBRITED	L247/T758A	128-1	7.60	1.075	6 - 10
		151-3	8.60	0.516	8 - 10
		155	8.00	0.000	8 - 8
	V1L686/P4L626A	128-1	7.20	1.473	5 - 10
		151-3	8.71	0.463	8 - 10
		152	8.25	0.500	7 - 9
		153	8.00	0.000	8 - 8
	V1L528/P4T883A	155	9.00	0.000	9 - 9
		134	7.00	1.414	4 - 10
		152-1	8.83	0.753	7 - 10
		152-2	8.83	0.753	7 - 10
	NONLUBRITED	V1L417/P4L792	155	8.86	0.690
151-3			9.33	0.606	8 - 10
152			9.17	0.408	8 - 10
152-1			9.40	0.507	8 - 10
153			8.25	0.500	7 - 9
153-1			8.90	0.447	8 - 10
V1L500/P4T813		155	9.60	0.516	9 - 10
		152-1	9.39	0.506	8 - 10
V1L528/P4T883A		155	9.33	0.488	8 - 10
		134	8.40	0.894	6 - 10
		152-1	8.63	0.916	7 - 10
		152-2	8.63	0.916	7 - 10
		155	8.44	1.014	6 - 10

PITTING/SPALLING
Unit of Measure: Merits

Hardware	Pinion Batch	Reference Oil	Mean	Standard Dev.	Acceptance Band
LUBRITED	L247/T758A	128-1	9.02	0.892	7 - 10
		151-3	9.49	0.586	8 - 10
		155	9.30	0.000	9.3 - 9.3
	V1L686/P4L626A	128-1	9.77	0.421	9 - 10
		151-3	9.68	0.632	9 - 10
		152	9.53	0.359	9 - 10
		153	9.30	0.424	9 - 10
		155	9.90	0.000	9.9 - 9.9
	V1L528/P4T883A	134	8.83	0.974	7 - 10
		152-1	9.88	0.041	9.3 - 10
		152-2	9.88	0.041	9.3 - 10
		155	9.90	0.436	9 - 10
NONLUBRITED	V1L417/P4L792	151-3	9.71	1.080	8 - 10
		152	9.90	0.000	9.9 - 9.9
		152-1	9.44	1.782	6 - 10
		153	9.88	0.050	9.8 - 10
		153-1	9.89	0.049	9.8 - 10
		155	9.90	0.040	9.8 - 10
	V1L500/P4T813	152-1	9.89	0.028	9.8 - 9.9
		155	9.84	0.124	9.6 - 10
	V1L528/P4T883A	134	3.80	1.483	1 - 7
		152-1	9.45	1.003	7 - 10
		152-2	9.45	1.003	7 - 10
		155	8.70	1.578	5 - 10

WEAR
Unit of Measure: Merits

Hardware	Pinion Batch	Reference Oil	Mean	Standard Dev.	Acceptance Band
LUBRITED	L247/T758A	128-1	5.80	0.422	5 - 7
		151-3	6.00	0.000	6 - 6
		155	6.00	0.000	6 - 6
	V1L686/P4L626A	128-1	6.40	0.598	5 - 7
		151-3	6.57	0.598	5 - 8
		152	6.25	0.500	5 - 7
		153	5.50	0.707	4 - 7
		155	7.00	0.000	7 - 7
	V1L528/P4T883A	134	6.00	0.242	5 - 7
		152-1	7.00	0.242	6 - 8
		152-2	7.00	0.242	6 - 8
		155	6.86	0.378	6 - 8
NONLUBRITED	V1L417/P4L792	151-3	8.00	0.587	7 - 9
		152	8.00	0.632	7 - 9
		152-1	8.00	0.378	7 - 9
		153	7.50	0.577	6 - 9
		153-1	7.55	0.605	6 - 9
		155	8.00	0.289	7 - 9
	V1L500/P4T813	152-1	7.46	0.519	7 - 8
		155	7.47	0.516	7 - 8
	V1L528/P4T883A	134	5.60	0.894	4 - 8
		152-1	7.00	0.500	6 - 8
		152-2	7.00	0.500	6 - 8
			155	6.78	0.441

SCORING
Non-lubrited & Lubrited Test Hardware
Unit of Measure: Merits

At the present time, no targets are available for Scoring. As a result, Pinion Scoring cannot be charted. However, the TMC will monitor the reporting of scoring values for results that are different from 10.00 and report occurrences to the surveillance panel. Any reference oil test exhibiting Pinion Scoring less than 10.00 is unacceptable for calibration.

3. Reference Oil Assignment

Once test stands have been accepted into the system, the TMC will assign reference oils for continuing calibration according to the following reference oil mix:

Test Hardware	Pinion/Ring Batch	Reference Oil	Assignment Frequency
Lubrited	C1L308/P4L309R	128-1	100%
		128-2	
	C1L426/P4L404A	128-1	100%
		128-2	
	V1L303/P4L514A	128-1	100%
		128-2	
	V1L686/P4L626A	128-1	25%
		128-2	
		155	25%
		152	25%
	L247/T758A	153	25%
		128-1	33.3%
		128-2	33.3%
	V1L528/P4T883A	155	33.3%
		134	20%
152-1 or -2		40%	
		155	40%
Non-Lubrited	C1L308/P4L318R	128-1	100%
		128-2	
	C1L426/P4L415A	128-1	100%
		128-2	
	V1L303/P4L514A	128-1	100%
		128-2	
	V1L686/P4L626A	128-1	50%
		128-2	
		155	50%
	V1L176/P4L741A	155	50%
		128-1	50%
		128-2	
	V1L351/P4T771	155	50%
		152	25%
		153	25%
	V1L417/P4L792	155	50%
		152	25%
		153	25%
	V1L500/P4T813	152-1	25%
		153-1	25%
		155	50%
V1L528/P4T883A	134	20%	
	152-1 or -2	40%	
	155	40%	

Sequence IVA Reference Oil Targets					
Oil	n	Effective Dates		Average Camshaft Wear	
		From ¹	To ²	\bar{X}	s
1006	24 ⁴	8-19-98	9-30-99	115.80	9.47 ³
	5 ⁵	10-1-99	1-25-00	117.14 ⁵	12.23 ⁵
	10	1-26-00	5-23-01	121.38	9.86
	77	5-24-01	***	121.76	12.50
1006-2	6	2-11-02	7-18-02	88.74	12.50 ⁶
	11	7-19-02	1-20-04	90.72	11.16
	22	1-21-04	2-01-12	91.15	8.93
	4	2-2-12	7-10-12	100.18	18.65
	15	7-11-12	3-19-13	103.39	13.68
	29	3-20-13	***	102.18	13.54
1007	24 ⁴	8-19-98	9-30-99	95.58	9.47 ³
	11	5-24-01	12-31-02	92.12	16.76
	21	1-1-03	7-27-04	86.94	16.22
	31	7-28-04	***	84.76	15.40
1008	24 ⁴	8-19-98	9-30-99	40.16	9.47 ³
1009	5	12-18-02	4-30-04	21.03	6.23
	11	5-1-04	11-13-07	19.08	5.60
	29	11-14-07	6-1-11	18.76	7.05

- 1 Effective for all tests completed on or after this date
- 2 *** = currently in effect
- 3 Pooled s from GF-3 matrix analysis
- 4 GF-3 matrix n-size
- 5 Individual oil 1006 statistics from prove-out matrix
- 6 Standard deviation based on oil 1006

T-11 Reference Oil Targets											
Oil	n	Effective Dates		Soot @ 4.0 cSt Vis. Inc		Soot @ 12.0 cSt Vis. Inc		Soot @ 15.0 cSt Vis. Inc.		MRV Viscosity	
		From	To ¹	\bar{X}	S	\bar{X}	s	\bar{X}	s	\bar{X}	s
820-2	32	3-8-03	***	--	--	5.78	0.21	--	--	14969	1097
820-2	16	5-28-05	5-31-10	3.81	0.23	5.78 ²	0.21 ²	6.36	0.26	14969 ²	1097 ²
	-- ³	6-1-10	***	3.95	0.30	5.92	0.22	6.51	0.20	14981	916
820-3	11	9-7-07	***	3.95	0.30	5.92	0.22	6.51	0.20	14981	916
822-1	4	2-1-2013	***	3.99	0.21	5.65	0.54	6.35	0.66	14408	314

1 *** = currently in effect

2 Value based on earlier data set (n=32)

3 Targets based on oil 820-3

L-37 Reference Oil Targets

L-37 Reference Oil Targets																	
Hardware	Pinion Batch	Oil	n	From	To	Ridging			Rippling			Spitting			Wear		
						x	s	Bands	x	s	Bands	x	s	Bands	x	s	Bands
LUBRICATED	C1L308	128	15	19000101	***	6.53	1.407	4 - 9	7.63	1.420	5 - 10	8.83	1.754	6 - 10	5.60	1.298	3 - 8
		128-1	7	19000101	***	7.00	0.000	7 - 7	8.00	0.577	7 - 9	8.84	1.723	6 - 10	5.57	0.535	5 - 7
		129	5	19000101	***	9.00	0.000	9 - 9	8.40	0.894	7 - 10	9.56	0.089	9.4 - 9.7	6.80	1.483	4 - 9
	C1L426	128	7	19000101	***	7.57	0.976	6 - 9	8.29	1.380	6 - 10	6.83	2.357	3 - 10	5.71	0.488	5 - 7
		128-1	7	19000101	***	7.71	1.113	6 - 10	7.86	0.690	7 - 9	7.57	3.187	2 - 10	6.00	0.577	5 - 7
		129	2	19000101	***	9.00	0.000	9 - 9	9.50	0.707	8 - 10	9.60	0.141	9.3 - 9.9	7.50	0.707	6 - 9
	L247	128-1	10	19000101	***	7.40	0.516	6 - 8	7.60	1.075	6 - 10	9.02	0.892	7 - 10	5.80	0.422	5 - 7
		151-3	10	19000101	***	8.80	0.422	8 - 10	8.60	0.516	8 - 10	9.49	0.586	8 - 10	6.00	0.000	6 - 6
		155	1	19000101	***	9.00	0.000	9 - 9	8.00	0.000	8 - 8	9.30	0.000	9.3 - 9.3	6.00	0.000	6 - 6
	V1L303	128	1	19000101	***	7.00	0.000	7 - 7	7.00	0.000	7 - 7	8.00	0.000	8 - 8	6.00	0.000	6 - 6
		128-1	30	19000101	***	7.30	1.264	5 - 10	6.97	1.497	4 - 10	5.26	3.144	0 - 10	5.67	0.959	4 - 7
		129	9	19000101	***	8.11	0.601	7 - 9	8.56	0.527	8 - 10	9.61	0.366	9 - 10	6.56	0.527	6 - 8
	V1L686	128-1	20	19000101	***	6.35	0.813	5 - 8	7.20	1.473	5 - 10	9.77	0.421	9 - 10	6.40	0.598	5 - 7
		151-3	21	19000101	***	6.43	1.207	4 - 9	8.71	0.463	8 - 10	9.68	0.632	9 - 10	6.57	0.598	5 - 8
		152	4	19000101	***	5.25	0.500	4 - 6	8.25	0.500	7 - 9	9.53	0.359	9 - 10	6.25	0.500	5 - 7
		153	2	19000101	***	5.00	0.000	5 - 5	8.00	0.000	8 - 8	9.30	0.424	9 - 10	5.50	0.707	4 - 7
		155	1	19000101	***	7.00	0.000	7 - 7	9.00	0.000	9 - 9	9.90	0.000	9.9 - 9.9	7.00	0.000	7 - 7
	V1L528	134	4	19000101	***	7.00	1.155	4 - 10	7.00	1.414	4 - 10	8.83	0.974	7 - 10	6.00	0.242	5 - 7
		152-1	6	19000101	***	8.00	0.632	7 - 10	8.83	0.753	7 - 10	9.88	0.041	9.3 - 10	7.00	0.242	6 - 8
		152-2	6	19000101	***	8.00	0.632	7 - 10	8.83	0.753	7 - 10	9.88	0.041	9.3 - 10	7.00	0.242	6 - 8
		155	8	19000101	***	8.29	0.488	7 - 10	8.86	0.690	7 - 10	9.90	0.436	9 - 10	6.86	0.378	6 - 8

L-37 Reference Oil Targets																	
Hardware	Pinion Batch	Oil	n	From	To	Ridging			Rippling			Spitting			Wear		
						x	s	Bands	x	s	Bands	x	s	Bands	x	s	Bands
NONLUBRITED	C1L308	127	17	19000101	***	6.41	2.033	3 - 10	6.06	1.784	3 - 9	9.54	0.450	9 - 10	6.82	2.038	3 - 10
		128	30	19000101	***	7.93	0.980	6 - 10	5.90	2.426	2 - 10	9.71	0.306	9.2 - 10	6.37	0.718	5 - 8
		128-1	8	19000101	***	8.38	0.744	7 - 10	5.75	1.982	2 - 9	9.43	0.883	8 - 10	6.50	0.535	6 - 7
		128-2	1	19000101	***	8.00	0.000	8 - 8	6.00	0.000	6 - 6	8.00	0.000	8 - 8	6.00	0.000	6 - 6
		129	19	19000101	***	9.26	0.933	8 - 10	9.89	0.315	9 - 10	9.89	0.091	9.7 - 10	8.11	0.875	7 - 10
	C1L426	127	10	19000101	***	7.25	1.752	4 - 10	8.30	1.767	5 - 10	9.40	1.039	8 - 10	6.50	0.972	5 - 8
		128	10	19000101	***	7.90	0.738	7 - 9	8.20	0.789	7 - 10	9.21	0.998	7 - 10	5.80	0.422	5 - 7
		128-1	11	19000101	***	8.36	0.674	7 - 10	8.00	1.095	6 - 10	9.54	0.785	8 - 10	5.73	0.467	5 - 7
		128-2	2	19000101	***	8.00	0.000	8 - 8	7.50	0.707	6 - 9	9.90	0.000	9.9 - 9.9	6.00	0.000	6 - 6
		129	8	19000101	***	9.50	0.535	9 - 10	9.75	0.463	9 - 10	9.96	0.052	9.9 - 10	7.00	1.195	5 - 9
	V1L176	127	2	19000101	***	7.00	2.828	2 - 10	8.00	0.000	8 - 8	6.45	4.879	0 - 10	6.00	1.414	3 - 9
		128-1	12	19000101	***	8.25	0.754	7 - 10	7.17	2.038	4 - 10	9.72	0.208	9.3 - 10	6.08	0.289	6 - 7
		128-2	1	19000101	***	7.00	0.000	7 - 7	9.00	0.000	9 - 9	9.90	0.000	9.9 - 9.9	6.00	0.000	6 - 6
		151-3	14	19000101	***	9.14	0.363	8 - 10	8.86	0.363	8 - 10	9.56	1.314	7 - 10	6.64	0.633	6 - 8
	V1L303	127	3	19000101	***	6.67	1.155	5 - 9	6.67	2.082	3 - 10	9.80	0.173	9.5 - 10	6.00	0.000	6 - 6
		128-1	13	19000101	***	8.08	0.494	7 - 9	6.92	1.656	4 - 10	8.07	2.451	4 - 10	5.85	0.376	5 - 7
		129	4	19000101	***	9.50	0.577	8 - 10	9.00	0.816	8 - 10	9.93	0.050	9.8 - 10	6.75	0.957	5 - 8
	V1L351	151-3	5	19000101	***	9.20	1.304	7 - 10	9.20	0.447	8 - 10	9.92	0.045	9.8 - 10	7.00	1.000	5 - 9
		152	5	19000101	***	9.40	0.548	8 - 10	8.80	0.447	8 - 10	9.88	0.045	9.8 - 10	7.20	0.837	6 - 9
		153	9	19000101	***	7.22	0.972	5 - 9	7.22	0.972	5 - 9	9.62	0.618	9 - 10	6.44	0.726	5 - 8
		155	3	19000101	***	9.33	0.577	8 - 10	8.67	0.577	8 - 10	9.90	0.000	9.9 - 9.9	7.00	1.000	5 - 9
	V1L417	151-3	30	19000101	***	9.47	0.507	9 - 10	9.33	0.606	8 - 10	9.71	1.080	8 - 10	8.00	0.587	7 - 9
		152	6	19000101	***	9.17	0.408	8 - 10	9.17	0.408	8 - 10	9.90	0.000	9.9 - 9.9	8.00	0.632	7 - 9
		152-1	15	19000101	***	9.47	0.640	8 - 10	9.40	0.507	8 - 10	9.44	1.782	6 - 10	8.00	0.378	7 - 9
		153	4	19000101	***	9.00	0.816	8 - 10	8.25	0.500	7 - 9	9.88	0.050	9.8 - 10	7.50	0.577	6 - 9
		153-1	20	19000101	***	8.80	0.616	8 - 10	8.90	0.447	8 - 10	9.89	0.049	9.8 - 10	7.55	0.605	6 - 9
		155	10	19000101	***	9.50	0.527	9 - 10	9.60	0.516	9 - 10	9.90	0.040 ¹	9.8 - 10	8.00	0.289 ¹	7 - 9

¹ Values adjusted from actual data per 20110511 Surveillance Panel action.

L-37 Reference Oil Targets

L-37 Reference Oil Targets																	
Hardware	Pinion Batch	Oil	n	From	To	Ridging			Rippling			Spitting			Wear		
						x	s	Bands	x	s	Bands	x	s	Bands	x	s	Bands
NONLUBRITED	V1L500	152-1	13	19000101	***	8.85	0.689	8 - 10	9.39	0.506	8 - 10	9.89	0.028	9.8 - 9.9	7.46	0.519	7 - 8
		155	15	19000101	***	9.07	0.594	8 - 10	9.33	0.488	8 - 10	9.84	0.124	9.6 - 10	7.47	0.516	7 - 8
	V1L686	127	9	19000101	***	7.00	2.000	3 - 10	7.56	1.236	5 - 10	9.71	0.643	9 - 10	6.67	0.500	6 - 8
		128-1	8	19000101	***	7.50	0.926	6 - 9	5.63	1.188	3 - 8	9.93	0.046	9.8 - 10	6.88	0.641	6 - 8
		129	2	19000101	***	9.50	0.707	8 - 10	10.00	0.000	10 - 10	10.00	0.000	10 - 10	8.00	1.414	5 - 10
		151-2	11	19000101	***	9.09	0.701	8 - 10	8.73	0.647	8 - 10	9.92	0.040	9.8 - 10	7.55	0.688	6 - 9
		151-3	1	19000101	***	9.00	0.000	9 - 9	8.00	0.000	8 - 8	9.90	0.000	9.9 - 9.9	7.00	0.000	7 - 7
	V1L528	134	5	19000101	***	6.40	1.673	3 - 9	8.40	0.894	6 - 10	3.80	1.483	1 - 7	5.60	0.894	4 - 8
		152-1	8	19000101	***	8.75	0.707	7 - 10	8.63	0.916	7 - 10	9.45	1.003	7 - 10	7.00	0.500	6 - 8
		152-2	8	19000101	***	8.75	0.707	7 - 10	8.63	0.916	7 - 10	9.45	1.003	7 - 10	7.00	0.500	6 - 8
		155	9	19000101	***	8.56	0.882	7 - 10	8.44	1.014	6 - 10	8.70	1.578	5 - 10	6.78	0.441	7 - 8

APPENDIX B
HISTORY OF INDUSTRY CORRECTION FACTORS
APPLICABLE TO LTMS DATA

Test Area	Effective	Description
IIIF	None	None
IIIG	None	None
IIIGA	None	None
IIIGB	July 24, 2009	Add 1.61 to PHOS
IVA	None	None
VG	July 1, 2005	For Fuel Batch TF2221LS20, Add 0.19 to AEV; Add 2.175 to AES and divide by 1.192 Add 0.54 to APV; Add 0.627 to RCS and divide by 1.041
	November 10, 2007	For Fuel Batch TF2221LS20, Add 0.12 to AEV; Add 0.42 to AES ; Add 0.39 to APV; Add 0.23 to RCS
	May 26, 2009	For Fuel Batch XC2721NX10, Add 3.011 to AEV and divide by 1.356; Add 1.325 to APV and divide by 1.207
	October 1, 2009	For Fuel Batch XC2721NX10, Subtract 0.24 from APV; subtract 0.12 from AEV.
VIB	None	None
VID	None	None
VIII	None	None
1M-PC	None	None
1K	None	None
1N	May 1, 2004	Add -1.135 to ln(TLHC+1)
1P	None	None
1R	None	None
C13	None	None
ISB	April 21, 2011	For Batch B Tappets with Batch E, F, and G Cams; Multiply ATWL by 0.637; Add -9.5 to ACSW
ISB	December 11, 2011	For Batch C Tappets with Batch H Cams; Multiply ATWL by 0.637; Add -9.5 to ACSW
ISB	November 13, 2012	For Batch C Tappets with Batch H and J Cams; Multiply ATWL by 0.711; Add -5.6 to ACSW
ISM	June 28, 2007	Add +1.7 to Crosshead Wear At 3.9% Soot Add +19.1 to Injector Adjusting Screw Wear At 3.9% Soot
	March 4, 2010	Add +1.3 to Crosshead Wear At 3.9% Soot
	April 30, 2011	Add +2.5 to Crosshead Wear At 3.9% Soot
T-8	September 17,2011	Add +0.40 to Viscosity Increase at 3.8% Soot
T-8E	September 17,2011	Add +0.08 to Relative Viscosity at 4.8% Soot (50% DIN Shear Loss) Add +0.09 to relative Viscosity at 4.8% Soot (100% DIN Shear Loss)
T-10A	None	None

APPENDIX B (continued)
HISTORY OF INDUSTRY CORRECTION FACTORS
APPLICABLE TO LTMS DATA

Test Area	Effective			Description
T-11	September 14, 2005			Add -0.39% to Soot @ 12cSt Vis. Inc., Add 1274 cP to MRV Vis.
	December 6, 2005			Add -0.36% to Soot @ 12cSt Vis. Inc., Add 713 cP to MRV Vis.
	March 24, 2006			Add -0.35% to Soot @ 12cSt Vis. Inc., Add 956 cP to MRV Vis.
T-12	Batch R Piston Ring & Cylinder Liner Hardware			Multiply Average Cylinder Liner Wear by 0.58
	SWTN Hardware Completed On or Before May 18, 2011	Multiply Average Top Ring Weight Loss by 0.95		
		Multiply Average Cylinder Liner Wear by 0.86		
		$\Delta\text{Lead}_{\text{Final}} = \exp[(\ln(\Delta\text{Lead}) \times 0.95)]$		
		$\Delta\text{Lead (250-300)}_{\text{Final}} = \exp[(\ln(\Delta\text{Lead 250-300}) \times 1.03)]$		
	SWTN Hardware Completed On or After May 19, 2011	OC = $\exp[(\ln(\text{OC}_{100-300}) \times 0.96)]$		
		Multiply Average Top Ring Weight Loss by 0.92		
		Multiply Average Cylinder Liner Wear by 0.83		
		$\Delta\text{Lead}_{\text{Final}} = \exp[(\ln(\Delta\text{Lead}) \times 0.92)]$		
	SWTN Hardware Started On or After June 5, 2012	$\Delta\text{Lead (250-300)}_{\text{Final}} = \exp[(\ln(\Delta\text{Lead 250-300}) \times 0.93)]$		
		OC = $\exp[(\ln(\text{OC}_{100-300}) \times 0.95)]$		
		Multiply Average Top Ring Weight Loss by 0.705		
Multiply Average Cylinder Liner Wear by 0.946				
RFWT	$\Delta\text{Lead}_{\text{Final}} = \exp[(\ln(\Delta\text{Lead}) \times 0.923)]$			
	$\Delta\text{Lead (250-300)}_{\text{Final}} = \exp[(\ln(\Delta\text{Lead 250-300}) \times 0.956)]$			
	OC = $\exp[(\ln(\text{OC}_{100-300}) \times 0.961)]$			
	None			
EOAT	None			
L-33-1	None			
L-37	V1L686/P4L 626A	Lubrited Ring	Canadian	Ridging add 0.9922. Effective for any tests completing on or after June 12, 2001
	V1L686/P4L 626A	Lubrited Pinion & Ring	Canadian	Ridging add 0.6065. Effective for any tests completing on or after August 25, 2004
	L247/T758A	Lubrited Pinion	Canadian	Ridging add 0.5878, Pitting/Spalling add 0.7340
	V1L528	Nonlubrited Pinion	Standard	Rdging add 0.3365, Rippling add 0.3365
			Canadian	Rippling add 0.7885
		Lubrited Pinion	Standard	Ridging add 0.3365
			Canadian	Ridging add 0.5878, Rippling add 0.5878
Lubrited Ring	Canadian	Ridging add 0.3365		
L-42	None			
L-60-1	None			
HTCT	None			
OSCT	None			

APPENDIX D
REFERENCE OIL VISCOSITY GRADES

Oil	SAE Viscosity Grade ¹
112	90
113	90
114	90
115	80W-90
116	80W-90
121	90
123	90
127	80W-90
128	80W-90
129	90
131	90
133	85W-140
134	80W-90
143	80W-90
148	80W-90
150	80W-90
151	80W-90
152	75W-90
153	75W-90
154	90
155	90
160	80W-90
161	75W-90
162	80W-90
168	80W-90
433	5W-30
434	5W-30
435	5W-20
438 (538)	5W-20
539	10W-30
540 (GF5A)	5W-20
541 (GF5D)	10W-30
542 (GF5X)	0W-20
704	10W-30
809	15W-40
810	15W-40
811	15W-40
820 (PC-9A)	15W-40
821 (PC10E)	15W-40
822	15W-40
830 (PC-9E)	15W-40
831 (PC10B)	15W-40
873	40
925	5W-30
940	5W-30
1004	15W-40
1005	15W-40