

COAST SIDE PINION SCORING

Unit of Measure: % Scoring

Gear Batch P8L604

Reference Oil	Mean	Standard Deviation
115	25.3	4.58
116	22.9	4.81
116-1	22.9	4.81

COAST SIDE PINION SCORING

Unit of Measure: % Scoring

Gear Batch P4L806

Reference Oil	Mean	Standard Deviation
116	25.1	5.49
116-1	25.1	5.49

COAST SIDE PINION SCORING

Unit of Measure: % Scoring

Gear Batch P8L119

Reference Oil	Mean	Standard Deviation
116	23.0	5.49
116-1	23.0	5.49

B. Acceptance Criteria

1. New Test Stand

- A minimum of four (4) operationally valid calibration tests, with no stand Shewhart severity alarms, must be conducted. Three (3) tests must be conducted on reference oil 114, 115, 116, or subsequent approved reblends. All three tests must be completed on the same reference oil. The remaining one (1) calibration test must be conducted on discrimination reference oil 112, 113 or subsequent approved reblends. The end of test coast side pinion scoring value of the discrimination oil must be a minimum of twice the average value of the preceding three (3) acceptable reference oil tests. If a second discrimination oil test is needed, the test, if acceptable, will count as one (1) of the 15 non-reference oil tests. In the event that neither discrimination oil test meets the above requirement, a complete new calibration sequence must be performed. The results from tests conducted on discrimination oils are not charted.
- All operationally valid calibration test results must be charted to determine if the test stand is currently “in control” as defined by the control charts from the Lubricant Test Monitoring System.

2. Existing Test Stand

- The test stand must have been an ASTM TMC calibrated test stand prior to LTMS introduction or previously accepted into the system by meeting LTMS calibration requirements.
- A test stand must complete three (3) operationally valid calibration tests, with no stand Shewhart severity alarms, on reference oil 114, 115, 116, or subsequent approved reblends. All three tests must be completed on the same reference oil. Every six months or fourth calibration sequence, an additional test must be conducted on discrimination reference oil 112, 113 or subsequent approved reblends. The end of test coast side pinion scoring value of the discrimination oil must be a minimum of twice the average value of the preceding three (3) acceptable reference oil tests. If a second discrimination oil test is needed, the test, if acceptable, will count as one (1) of the 15 non-reference oil tests. In the event that neither discrimination oil test meets the above requirement, a complete new calibration sequence must be performed. The results from tests conducted on discrimination oils are not charted.

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:

Gear Batch	Oil Assignments
P8L123	Assign either three 116, three 115, or three 114 oils (or subsequent reblend). Every 6 months or fourth calibration sequence, also assign one discrimination oil 112.
P8L119	Assign three 116 oils (or subsequent reblend). Every 6 months or fourth calibration sequence, also assign one discrimination oil 112 or 113.
P8L205	Assign either three 116, three 115, or three 114 oils (or subsequent reblend). Every 6 months or fourth calibration sequence, also assign one discrimination oil 112.
P8L737	Assign either three 115 or three 114 oils (or subsequent reblend). Every 6 months or fourth calibration sequence, also assign one discrimination oil 112.
P8L327	Assign either three 116 or three 115 oils (or subsequent reblend). Every 6 months or fourth calibration sequence, also assign one discrimination oil 112.
P8L604	Assign either three 116 or three 115 oils (or subsequent reblend). Every 6 months or fourth calibration sequence, also assign one discrimination oil 112.
P4L806	Assign three 116 oils (or subsequent reblend). Every 6 months or fourth calibration sequence, also assign one discrimination oil 112, 113 or subsequent reblends.

Note: See Sections 1 & 2 above for more details on oil assignments.

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

30. High Temperature Cyclic Durability Test LTMS Requirements

The following are the specific High Temperature Cyclic Durability calibration test requirements.

A. Reference Oils and Critical Parameter

The critical parameter is Cycles to Unsyncronized Shifts. The reference oils required for test stand and test laboratory calibration are the reference oils accepted by the ASTM High Temperature Cyclic Durability Test Surveillance Panel. The means and standard deviations for the current reference oils for the critical parameter are presented below.

CYCLES TO UNSYCHRONIZED SHIFTS Unit of Measure: Cycles

Reference Oil	Mean	Standard Deviation
150-2	24271	4623
151-3	74489	9662
154	24271	4623
155	74489	9662
155-1	65963	15022

B. Acceptance Criteria

1. New Test Stand

- A minimum of three (3) operationally valid calibration tests, with no stand Shewhart severity alarms, must be conducted. Two (2) tests must be conducted on reference oils 151 or 155 or subsequent approved reblends, and one (1) test must be conducted on reference oil 150 or 154 or subsequent approved reblends.

2. Existing Test Stand

- The test stand must have been TMC calibrated prior to LTMS introduction or previously accepted into the system by meeting LTMS calibration requirements.
- A test stand must complete one test on reference oil 151 or 155, or subsequent approved reblends, with no stand Shewhart severity alarm.
- Every other calibration sequence, a test stand must complete one test on reference oil 151 or 155, or subsequent approved reblends, and one test on reference oil 150 or 154, or subsequent approved reblends, with both tests having no stand Shewhart severity alarms. The only exception would be if reference oil 150 or 154, or subsequent reblends fails in the severe direction.

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 oils 150, 151, and 155, or subsequent approved reblends.
- See Sections 1 and 2 above for detailed oil assignment instructions.

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 High Temperature Cyclic Durability Test, and the response necessary in the case of control limit alarms, are depicted below.

LUBRICANT TEST MONITORING SYSTEM CONSTANTS

		EWMA				Shewhart Chart	
		LAMBDA		K		K	
Chart Level	Limit Type	Precision	Severity	Precision	Severity	Precision	Severity
Stand	Action	--	--	--	--	--	1.96
Industry	Warning	0.2	0.3	1.46	1.80	--	--
	Action	0.2	0.3	2.33	2.58	--	--

The following are the steps that must be taken in the case of exceeding control chart limits.

- Exceed Shewhart test stand chart limit for severity (all parameters)
 - For reference oils 151 and 155 or subsequent reblends, conduct an additional calibration test.
 - For reference oil 150 and 154 or subsequent reblends, conduct an additional calibration test only if the test exceeds the Shewhart limit in the mild direction.

The following industry issues are handled by the TMC and do not require individual laboratory action.

- Exceed EWMA industry chart action limit
 - TMC to notify test developer and surveillance panel chairman. Meeting of TMC, test developer, and surveillance panel chairman required to determine course of action.

High Temperature Cyclic Durability Test Reference Oil Targets					
Oil	n	Effective Dates		Cycles	
		From ¹	To ²	\bar{X}	s
150	27	7-1-96	10-2-97	25823	3867
150-1	11	7-1-96	3-9-99	28932	5338
150-2	--	1-26-98	9-10-06	28932 ³	5338 ³
	18	9-11-06	***	24271	4623
151	42	7-1-96	12-20-96	76254	12828
151-1	28	7-1-96	9-4-97	82584	14195
151-2	6	7-1-96	11-10-96	87277	14340
	11	11-11-96	3-17-98	81804	13416
	21	3-18-98	2-19-00	80294	11675
151-3	--	1-1-00	9-10-06	80294 ⁴	11675 ⁴
	20	9-11-06	***	74489	9662
154	--	5-13-09	***	24271	4623
155	--	2-9-06	9-10-06	80294 ⁴	11675 ⁴
	--	9-11-06	***	74489 ⁵	9662 ⁵
155-1	16	5-21-12	***	65963	15022

- 1 Effective for all tests completed on or after this date.
- 2 *** = currently in effect.
- 3 Targets based on oil 150-1.
- 4 Targets based on oil 151-2.
- 5 Targets based on oil 151-3.

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
830 (PC-9E)	15W-40
831 (PC10B)	15W-40
873	40
925	5W-30
1004	15W-40
1005	15W-40

REFERENCE OIL VISCOSITY GRADES (continued)

Oil	SAE Viscosity Grade ¹
1006	5W-30
1007	5W-30
1008	5W-30
1009	5W-30
1010	5W-20

¹ Viscosity grade applies to all subsequent reblends.