Level 2:

– The Level 2 limit applies in situations that have been pre-determined by the surveillance panel to have a potential impact on test results. These situations may include the introduction of new critical parts, fuel batches, reference oil reblends, or other test components. When these conditions have been met and a Level 2 alarm is triggered, immediately conduct one additional reference test in the stand that triggered the alarm. Evaluate any subsequent test(s) using Level 3 e_i limits.

Exceed Stand EWMA of Standardized Test Result (Z_i)

Level 2:

– Conduct one additional reference test in the stand that triggered the alarm. The stand that triggered the alarm is not qualified for non-reference tests until the Level 2 alarm is cleared.
– In instances where surveillance panel has deemed that industry-wide circumstances are impacting the Level 2 alarm, the TMC may be asked to review stand calibration status in accordance with the surveillance panel's findings.

Level 1:

– The Level 1 limit applies to all reference tests that are control charted, even when other alarms have been triggered. Level 1 uses Z_i to determine the stand severity adjustment (SA). Calculate the stand SA as follows and confirm the calculation with the TMC:

Average Cam Shaft Wear: $SA = (-Z_i) \times (0.2302)$
Average Tappet Weight Loss: $SA = (-Z_i) \times (1.1755)$

- Exceed Industry EWMA of Standardized Test Result (Z_i)

Level 2:

- TMC informs the surveillance panel that the limit has been exceeded. The surveillance panel then investigates and pursues resolution of the alarm.

Level 1:

- The TMC investigates whether severity adjustments are adequately addressing the trend, investigates the possible causes, and communicates as appropriate with industry.

PITTING/SPALLING
Unit of Measure: Merits

Pinion Batch	Hardware	Reference Oil	Mean	Standard Dev.	Acceptance Bands
All Gleason	UNCOATED	134/134-1	-	-	5 - 10
		152-2	-	-	9.8 - 10
Gleason 04-2014, 06-2018, 2019/20	UNCOATED	155-1/155-2	9.9	0.0	-
Gleason 04-2014	MNP-COATED	134/134-1	9.9	0.1	-
		152-2	9.7	0.6	-
		155-1/155-2	9.9	0.0	-
Gleason 04-2021		134/134-1	-	-	9.8 - 9.9
		152-2	-	-	9.9 – 10.0
		155-1/155-2	-	-	9.8 – 10.0

WEAR
Unit of Measure: Merits

Pinion Batch	Hardware	Reference Oil	Mean	Standard Dev.	Acceptance Bands
All Gleason	UNCOATED	134/134-1	-	-	5 - 7
		152-2	-	-	6 - 9
Gleason 04-2014, 06-2018, 2019/20	UNCOATED	155-1/155-2	7.5	0.7	-
Gleason 04-2014	MNP-COATED	134/134-1	6.8	0.9	-
		152-2	8.2	0.7	-
		155-1/155-2	7.9	0.8	-
Gleason 04-2021		134/134-1	-	-	6 - 7
		152-2	-	-	7 – 8
		155-1/155-2	-	-	7 – 8

SCORING
Uncoated & MNP-coated 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.

COAST SIDE PINION SCORING
Unit of Measure: % Scoring
Gear Batch P2DA01

Reference Oil	Mean	Standard Deviation
117	23.0	5.49

COAST SIDE PINION SCORING
Unit of Measure: % Scoring
Gear Batch P2AD8

Reference Oil	Mean	Standard Deviation
117	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, 117 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, 119 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, 117, 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, 119 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.
P8T025A	Assign three 116 or 117 oils (or subsequent reblend) or see the test procedure for alternate single test calibration requirements. Every 6 months or fourth calibration sequence, also assign one discrimination oil 112, 113 or subsequent reblends.
P8AD078X	Assign three 116 or 117 oils (or subsequent reblend) or see the test procedure for alternate single test calibration requirements. Every 6 months or fourth calibration sequence, also assign one discrimination oil 112, 113, 119 or subsequent reblends.
P8AD132	Assign three 116 or 117 oils (or subsequent reblend) or see the test procedure for alternate single test calibration requirements. Every 6 months or fourth calibration sequence, also assign one discrimination oil 112, 113, 119 or subsequent reblends.
P2DA01	Assign three 117 oils (or subsequent reblend) or see the test procedure for alternate single test calibration requirements. Every 6 months or fourth calibration sequence, also assign one discrimination oil 119 or subsequent reblends.
P2AD8	Assign three 117 oils (or subsequent reblend) or see the test procedure for alternate single test calibration requirements. Every 6 months or fourth calibration sequence, also assign one discrimination oil 119 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 for the L-42, 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	Warning	--	--	--	--	--	--
	Action	--	--	-	--	--	1.80
Lab	Action	--	--	--	--	--	--
Industry	Warning	0.2	0.2	2.19	2.45	--	--
	Action	0.2	0.2	2.88	3.08	--	--

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
  - Conduct an additional calibration test.

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 surveillance panel chairman. Meeting of TMC and the surveillance panel required to determine course of action.
- Exceed EWMA industry chart warning limit
  - TMC to notify surveillance panel chairman. Coordination of TMC and the surveillance panel chairman is required to discuss potential problem.

L-37-1 Reference Oil Targets

Hardware	Pinion Batch	Oil	n	From[1]	To[2]	Ridging			Rippling			Spitting			Wear		
						$\bar{X}$	s	Bands	$\bar{X}$	s	Bands	$\bar{X}$	s	Bands	$\bar{X}$	s	Bands
UNCOATED	Gleason 04-2014	134/134-1	6	20170503	20190630	3.8	1.2	-	7.8	1.2	-	7.7	1.9	-	4.8	1.2	-
		152-2	8	20170503	20190630	9.3	0.7	-	8.9	1.6	-	9.9	0.0	-	7.8	0.9	-
		155-1	7	20170503	20190630	9.6	0.5	-	9.6	0.5	-	9.9	0.0	-	7.9	0.7	-
	Gleason 04-2014	134/134-1	10	20190701	20190806	3.8	0.9	-	7.2	1.3	-	7.9	1.5	-	5.1	1.0	-
		152-2	11	20190701	20190806	9.3	0.6	-	8.7	1.4	-	9.9	0.1	-	7.5	0.8	-
		155-1	11	20190701	20190806	9.6	0.5	-	8.7	1.3	-	9.9	0.0	-	7.5	0.7	-
	Gleason 04-2014,06-2018	134/134-1	14	20190807	20200520	3.9	0.9	-	7.1	1.5	-	8	1.7	-	5.1	0.9	-
		152-2	15	20190807	20200520	9.3	0.6	-	8.7	1.3	-	9.9	0.1	-	7.5	0.8	-
		155-1	16	20190807	20200520	9.6	0.5	-	8.8	1.1	-	9.9	0.0	-	7.6	0.7	-
	Gleason 04-2014, 06-2018, 2019/20	134/134-1	24	20200521	20250812	4.1	0.9	-	7.4	1.4	-	7.9	2.0	-	5.3	0.9	-
		152-2	28	20200521	20250812	9.0	0.8	-	8.3	1.2	-	9.9	0.1	-	7.6	0.7	-
		155-1/155-2	21	20200521	***	9.5	0.5	-	8.6	1.1	-	9.9	0.0	-	7.5	0.7	-
	Gleason 04-2014, 06-2018, 2019/20, 07-2024	134-1	38	20250813	***	-	-	3 - 6	-	-	5 - 10	-	-	5 - 10	-	-	5 - 7
		152-2	44	20250813	***	-	-	8 - 10	-	-	7 - 10	-	-	9.8 - 10	-	-	6 - 9

L-42 Reference Oil Targets (continued)						
Oil	Gear Batch	N	Effective Dates		Coast Side Pinion Scoring	
			From[1]	To[2]	$\overline{X}$	s
116-1	P8L123[7]	--	3-1-09	***	22.9	4.81
	P8L205[7]	--	3-1-09	***	22.9	4.81
	P8L327[7]	--	3-1-09	***	22.9	4.81
	P8L604[7]	--	3-1-09	***	22.9	4.81
	P4L806[7]	--	3-1-09	***	25.1	5.49
	P8L119	10	3-22-09	***	23.0	5.49[8]
	P8T025A	10	4-17-12	***	23.0[9]	5.49[9]
	P8AD078X	10	3-7-15	***	23.0[9]	5.49[9]
117	P8T025A	10	5-29-14	***	23.0[10]	5.49[10]
	P8AD078X	10	3-7-15	***	23.0[9,10]	5.49[9,10]
	P8AD132 (Pinion ID's C1L446, C1L637)	10	11-9-17	***	23.0[9,10]	5.49[9,10]
	P2DA01	10	10-30-23	***	23.0[9,10]	5.49[9,10]
	P2AD8	10	08-13-25	***	23.0[9,10]	5.49[9,10]

1 Effective for all tests completed on or after this date	6 Targets based on gear batch P8L604
2 ***currently in effect	7 Targets based on oil 116
3 Targets based on oil 114	8 Standard deviation based on gear batch P4L806
4 Targets based on oil 114-1	9 Carried over from previous hardware batch
5 Targets based on gear batch P8L327	10 Target based on 116/116-1. A +6% correction factor is used with this oil to maintain parity with 116/116-1