

6. Sequence IIIH LTMS Requirements

The following are the specific IIIH calibration test requirements.

A. Reference Oils and Critical Performance Criteria

The critical performance criteria are Percent Viscosity Increase (PVIS), and Weighted Piston Deposits (WPD). The reference oils required for test stand and test laboratory referencing are reference oils accepted by the ASTM Sequence III Surveillance Panel. The means and standard deviations for the current reference oils for each critical performance criterion are presented below.

Percent Viscosity Increase (PVIS)

Unit of Measure: ln(PVIS)

CRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
434-2	4.7191	0.4310
434-3	5.7602	0.6598
436	3.3289	0.3138
438-1	3.9754	0.9558

Weighted Piston Deposits

Unit of Measure: Merits

CRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
434-2	4.16	0.70
434-3	4.16	0.70
436	4.63	0.28
438-1	3.66	0.43

Average Piston Varnish

Unit of Measure: Merits

NONCRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
434-2	9.16	0.381
434-3	9.16	0.375
436	9.71	0.124
438-1	9.39	0.276

B. Acceptance Criteria

1. New Test Stands

- A minimum of two (2) operationally valid calibration tests and/or matrix tests, with no Level 3 e_i or level 2 Z_i alarms after the second operationally valid test must be conducted in a new stand on any approved reference oils.
- Note that industry matrix runs may be included, as well as reference runs, at the discretion of the surveillance panel.
- Following the necessary tests, check the status of the control charts and follow the prescribed actions.

2. Existing Test Stands

- The stand must have previously been accepted into the system by meeting the LTMS requirements.
- Existing test stands that have run an acceptable reference in the past 18 months may calibrate with 1 test.
- Following the necessary tests, check the status of the control charts and follow the prescribed actions.

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 reference oil mix:

- Scheduled calibration tests should be conducted on reference oils 436, 434-2, and 438-1 or subsequent approved reblends in equal proportion with random assignment.

4. Control Charts

In Section 1, the construction of the control charts that constitute the Lubricant Test Monitoring System is outlined. For the IIIH, $Z_0 = \text{Mean } Y_i$ of first two operationally valid tests in the stand. The constants used for the construction of the control charts for the IIIH, and the response necessary in the case of control chart limit alarms, are depicted below. Note that control charting all parameters is required.

LUBRICANT TEST MONITORING SYSTEM CONSTANTS

		EWMA Chart		Stand Prediction Error	
		Severity		Severity	
Chart Level	Limit Type	Lambda	Alarm	Limit Type	Limit
Stand	Level 1	0.3	0.000	Level 1	N/A
	Level 2		± 1.800	Level 2	± 1.734
				Level 3	± 2.066
Industry	Level 1	0.2	± 0.775	--	--
	Level 2		± 0.859	--	--

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. The laboratory always has the option of removing any stand from the system.

- Exceed Stand chart of Prediction Error (e_i) Critical parameters only

Level 3:

- Immediately conduct one additional reference test in the stand that triggered the alarm. Do not update the control charts until the follow up reference test is completed and Excessive Influence (refer to Section 1.A.5) has been performed.

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.

- Exceed Stand EWMA of Standardized Test Result (Z_i)

Level 2 (Critical parameters only):

- 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 (All parameters):

- 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:

Percent Viscosity Increase (ln(PVIS)): $SA = (-Z_i) \times (0.4641)$

Weighted Piston Deposits (WPD): $SA = (-Z_i) \times (0.47)$

Average Piston Varnish (APV): $SA = (-Z_i) \times (0.327)$

- 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.

Sequence IIIH Reference Oil Targets									
Oil	n	Effective Dates		Average Piston Varnish		Percent Viscosity Increase		Weighted Piston Deposits	
		From ¹	To ²	\bar{X}	s	\bar{X}	s	\bar{X}	s
434-2 ³	10	07-01-15	10-10-18	9.16	0.34	4.7191	0.4310	4.16	0.70
434-2 ⁴	46	10-11-18	***	9.16	0.381	4.7191	0.4310	4.16	0.70
434-3 ⁴	46	07-01-15	11-12-18	9.16	0.381	4.7191	0.4310	4.16	0.70
434-3 ⁵	11	11-13-18	***	9.16	0.381	5.7602	0.6598	4.16	0.70
436 ³	9	07-01-15	10-10-18	9.71	0.10	3.3289	0.3138	4.63	0.28
436 ⁴	61	10-11-18	***	9.71	0.124	3.3289	0.3138	4.63	0.28
438-1 ³	9	07-01-15	10-10-18	9.39	0.31	3.9754	0.9558	3.66	0.43
438-1 ⁴	61	10-11-18	***	9.39	0.276	3.9754	0.9558	3.66	0.43

- 1 Effective for all tests completed on or after this date
- 2 *** = Currently in effect
- 3 Targets based on precision matrix analysis
- 4 Targets based on all data reported for APV standard deviation only
- 5 Targets updated for Percent Viscosity Increase only

APPENDIX C
HISTORY OF SEVERITY ADJUSTMENT (SA)
STANDARD DEVIATIONS

Test	Parameter	s	Effective Dates	
			From	To
Sequence IIIF	VIS80	0.0129546	20000610	20130513
		0.0000000	20130514	***
	HRS	7.701	20130514	***
	APV	0.220	20000610	***
	WPD	0.658	20000610	***
	VIS60	0.17334	20011115	20130513
	VIS60	0.5*HRS SA	20130514	***
Sequence IIIG	PVIS	0.2919	20030501	***
	WPD	0.60	20030501	***
	ACLW	0.1936	20030501	20040120
		0.1903	20040121	***
Sequence IIIGA	MRV Viscosity	0.30763	20031103	20040526
Sequence IIIGB	Phos. Retention	2.33	20081112	***
Sequence IIIH	APV	0.327	20150701	***
	PVIS	0.4641	20150701	***
	WPD	0.47	20150701	***
Sequence IIIHA	MRV Viscosity	0.4725	20150701	***
Sequence IIIHB	Phos. Retention	1.53	20150701	***
Sequence IVA	ACW	9.47	19980819	20010524
		12.50	20010525	20050630
		12.52	20050701	20120208
		15.72	20120209	20120710
		14.87	20120711	***
Sequence IVB	AVLI	0.2003	20171027	***

13. Sequence IX LTMS Requirements

The following are the specific Sequence IX calibration test requirements.

A. Reference Oils and Critical Performance Criteria

The critical performance criteria is Average Number of Preignitions (AVPIE). Additionally, an upper limit is set on Maximum Pre-ignition events. The reference oils required for test stand and test laboratory referencing are reference oils accepted by the ASTM Sequence IX Surveillance Panel. The means and standard deviations for the current reference oils for each critical performance criterion are presented below.

Average Number of Preignitions (AVPIE)
Unit of Measure: Square Root (AVPIE+0.5)

Reference Oil	Mean	Standard Deviation
221	3.3819	0.3609
222	4.2644	0.2694

Maximum Number of Preignitions (MAXPIE)
Unit of Measure: Square Root (MAXPIE+0.5)

Reference Oil	Targets
All Oils	N/A

B. Acceptance Criteria

1. New Test Stand/Engines

- A minimum of two (2) operationally valid calibration tests, with no Level 0 e_i or Level 2 Z_i alarms after the second operationally valid test must be conducted in a new stand-engine on any approved reference oils. If the above criteria cannot be met then a minimum of three (3) operationally valid calibration tests, with no Level 3 e_i or level 2 Z_i alarms after the third operationally valid test must be conducted in a new stand-engine on any approved reference oils.
- Following the necessary tests, check the status of the control charts and follow the prescribed actions.

2. Existing Test Stand/Engine

- The stand/engine must have previously been accepted into the system by meeting the LTMS requirements
- Existing test stand-engines that have run an acceptable reference in the past 180 days may calibrate with 1 test.

- Conduct one additional reference test in the stand-engine that triggered the alarm. The stand-engine 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-engine 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:

$$\text{AVPIE SA} = (-Z_i) \times (0.3775)$$

$$\text{MAXPIE SA} = \text{AVPIE SA}$$

- When $\text{MAXPIE} \geq \text{AVPIE} + 1.3199$
 - Conduct one additional reference test in the stand-engine that triggered the alarm. The stand-engine that triggered the alarm is not qualified for non-reference tests until the alarm is cleared.

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

- Exceed Industry EWMA of Standardized Test Result (Z_i)

Level 2:

- The 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.

5. Removal of Test Stand/Engines from the System

The laboratory must notify the TMC and the ACC Monitoring Agency when removing a stand/engine from the system. No reference oil data shall be removed from the control charts from test stand/engines that have been used for registered candidate oil testing. Reintroduction of a stand/engine into the system requires completion of new stand/engine

Sequence IX Oil Targets					
Oil	n	Effective Dates		AVGPIE	
		From ¹	To ²	\bar{X}	s^3
221	8 ⁴	4-21-17	6-27-19	3.3819	0.3609
221	8 ⁴	6-28-19	***	3.3819	0.3775
222	16 ⁴	4-21-17	***	4.2644	0.2694
224	9	6-28-19	***	2.0445	0.3775

- 1 Effective for all tests completed on or after this date.
- 2 *** = currently in effect.
- 3 Pooled s from matrix analysis.
- 4 Matrix + additional tests n-size.

HISTORY OF SEVERITY ADJUSTMENT (SA)
STANDARD DEVIATIONS (Continued)

Test	Parameter	s	Effective Dates	
			From	To
Sequence IX	AVPIE	0.2856	20170421	20190627
	AVPIE	0.3775	20190628	***
Sequence X	CHST	0.17856	20170101	***
Sequence VIE	FEI1	0.29	20151213	20180313
	FEI2	0.25	20151213	20180313
	FEI1	0.235	20180314	***
	FEI2	0.281	20180314	***
Sequence VIF	FEI1	0.22	20151122	***
	FEI2	0.30	20151122	***
Sequence VIII	TBWL	3.40	19980829	19991116
		5.28	19991117	20020205
		4.80	20020206	***
	10hr. Stripped Vis.	None	--	--
1M-PC	WTD	50.5	19930914	***
	TGF	16.1	19930914	***
1K	WDK	35.6	19900506	***
	TGF	15.7	19900506	***
	TLHC	1.1	19900506	***
	OC	None	--	--
1N	WDN	27.1	19930314	***
	TGF ¹	14.6	19930314	20150331
		0.488165	20150401	***
	TLHC	0.9	19930314	***
OC	None	--	--	
1P	TGC	7.740	19970219	***
	TLC	13.150	19970219	***
	AOC	0.3238	19970219	***
	WDP	57.60	19970219	***
	EOTOC	0.5177	19970219	***
1R	WDR	29.0	20010701	***
	TGC	9.70	20010701	***
	TLC	7.84	20010701	***
	IOC	1.32	20010701	***
	EOTOC	1.35	20010701	***
C13	TGC	None	--	--
	TLC	None	--	--
	OCA	None	--	--
	R2TC	None	--	--
C13 Aeration	AOA40-50	0.285	20141101	***

1 Transformation $\ln(\text{TGF}+1)$ adopted 20150401

APPENDIX D
REFERENCE OIL VISCOSITY GRADES

Oil	SAE Viscosity Grade ¹
112	90
113	90
114	90
115	80W-90
116	80W-90
117	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
169	75W-90
221	0W-16
222	10W-30
224	5W-30
270	5W-30
271	5W-30
433	5W-30
434	5W-30
435	5W-20
436	5W-20

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

COAST SIDE PINION SCORING

Unit of Measure: % Scoring

Gear Batch P8T025A

Reference Oil	Mean	Standard Deviation
116-1	23.0	5.49
117	23.0	5.49

COAST SIDE PINION SCORING

Unit of Measure: % Scoring

Gear Batch P8AD078X

Reference Oil	Mean	Standard Deviation
116-1	23.0	5.49
117	23.0	5.49

COAST SIDE PINION SCORING

Unit of Measure: % Scoring

Gear Batch P8AD132

Reference Oil	Mean	Standard Deviation
116-1	23.0	5.49
117	23.0	5.49

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 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 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.

L-42 Reference Oil Targets (continued)						
Oil	Gear Batch	N	Effective Dates		Coast Side Pinion Scoring	
			From ¹	To ²	\bar{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	10	11-9-17	***	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	Target based on 116/116-1. A +6% correction factor is used with this oil to maintain parity with 116/116-1

41. Oil Seal Compatibility Test LTMS Requirements

The following are the specific Oil Seal Compatibility Test calibration test requirements.

A. Reference Oils and Critical Parameters

The critical parameters are Elongation, Shore Hardness, and Volume Change. The reference oils required for test stand and test laboratory calibration are the reference oils accepted by the ASTM Oil Seal Compatibility Test Surveillance Panel. The means and standard deviations for the current reference oils for the critical parameters are presented below.

ELONGATION

Unit of Measure: Percent

Reference Oil	Elastomer	Mean	Standard Deviation
160-1	Polyacrylate	23.04	14.289
160-1	Fluoroelastomer	-47.65	5.506
161-1	Polyacrylate	68.88	17.850
161-1	Fluoroelastomer	-34.57	6.989
161-1	Nitrile	10.43	10.691
162	Nitrile	-65.35	7.330
168	Nitrile	-74.52	6.965
169	Polyacrylate	49.2	21.82
169	Fluoroelastomer	-39.5	6.99
169	Nitrile	-16.2	10.69
170	Nitrile	-70.68	3.007
171	Polyacrylate	24.167	20.929
171	Fluoroelastomer	-42.6	4.2

SHORE HARDNESS

Unit of Measure: Points

Reference Oil	Elastomer	Mean	Standard Deviation
160-1	Polyacrylate	-1.8	1.16
160-1	Fluoroelastomer	1.6	1.36
161-1	Polyacrylate	-24.9	2.83
161-1	Fluoroelastomer	1.6	1.30
161-1	Nitrile	-16.1	2.18
162	Nitrile	2.0	2.03
168	Nitrile	3.0	1.89
169	Polyacrylate	-16.0	2.83
169	Fluoroelastomer	0.1	1.30
169	Nitrile	-8.6	2.18
170	Nitrile	2.325	0.341
171	Polyacrylate	0.333	0.577
171	Fluoroelastomer	-0.667	0.577

VOLUME CHANGE
Unit of Measure: Percent

Reference Oil	Elastomer	Mean	Standard Deviation
160-1	Polyacrylate	0.343	0.4473
160-1	Fluoroelastomer	2.053	0.4075
161-1	Polyacrylate	19.624	1.4348
161-1	Fluoroelastomer	6.199	0.7080
161-1	Nitrile	18.444	1.7057
162	Nitrile	2.460	1.5821
168	Nitrile	1.326	1.4730
169	Polyacrylate	13.1	1.43
169	Fluoroelastomer	4.4	0.71
169	Nitrile	11.8	1.71
170	Nitrile	1.500	0.718
171	Polyacrylate	-0.233	0.306
171	Fluoroelastomer	1.467	0.306

B. Acceptance Criteria

1. New Test Stand

- For each elastomer type, an operationally valid calibration test, with no Shewhart severity alarms, must be conducted on each of the two approved reference oils.

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.

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:

Elastomer Type	Oil Assignments
PA	Assign reference oils 160, 161, 169 or 171 (or subsequent reblends) for every calibration sequence.
FL	Assign reference oils 160, 161, 169 or 171 (or subsequent reblends) for every calibration sequence.
NI	Assign reference oils 161, 162, 168 or 170 (or subsequent reblends) for every calibration sequence.

Oil Seal Compatibility Test Reference Oil Targets										
Oil	n	Elastomer	Effective Dates		Elongation		Shore Hardness		Volume Change	
			From ¹	To ²	\bar{X}	s	\bar{X}	s	\bar{X}	s
160 ³	--	Polyacrylate	11-18-94	***	23.04	14.289	-1.8	1.16	0.343	0.4473
	--	Fluoroelastomer	11-18-94	***	-47.65	5.506	1.6	1.36	2.053	0.4075
160-1	144	Polyacrylate	11-18-94	***	23.04	14.289	-1.8	1.16	0.343	0.4473
	141	Fluoroelastomer	11-18-94	***	-47.65	5.506	1.6	1.36	2.053	0.4075
161 ⁴	--	Polyacrylate	11-18-94	***	68.88	17.850	-24.9	2.83	19.624	1.4348
	--	Fluoroelastomer	11-18-94	***	-34.57	6.989	1.6	1.30	6.199	0.7080
	--	Nitrile	11-18-94	***	10.43	10.691	-16.1	2.18	18.444	1.7057
161-1	144	Polyacrylate	11-18-94	***	68.88	17.850	-24.9	2.83	19.624	1.4348
	141	Fluoroelastomer	11-18-94	***	-34.57	6.989	1.6	1.30	6.199	0.7080
	119	Nitrile	11-18-94	***	10.43	10.691	-16.1	2.18	18.444	1.7057
162	119	Nitrile	11-18-94	***	-65.35	7.330	2.0	2.03	2.460	1.5821
168	13	Nitrile	7-7-06	2-28-09	-74.22	2.422	3.0	1.49	1.424	0.1295
	38	Nitrile	3-1-09	3-10-09	-74.52	1.599	3.0	0.79	1.326	0.1388
	38	Nitrile	3-11-09	***	-74.52	6.965 ⁵	3.0	1.89 ⁵	1.326	1.4730 ⁵
169	19	Polyacrylate	3-7-12	***	49.2	21.82	-16.0	2.83 ⁶	13.1	1.430 ⁶
	18	Fluoroelastomer	3-7-12	***	-39.5	6.99 ⁶	0.1	1.30 ⁶	4.4	0.71 ⁶
	22	Nitrile	3-7-12	***	-16.2	10.69 ⁶	-8.6	2.18 ⁶	11.8	1.710 ⁶
170	12	Nitrile	1-24-16	8-20-18	-72.75	3.416	1.500	0.674	2.275	0.449
	32	Nitrile	8-21-18	***	-70.68	3.007	2.325	0.341	1.500	0.718
171	3	Polyacrylate	8-21-18	***	24.167	20.929	0.333	0.577	-0.233	0.306
171	3	Fluoroelastomer	8-21-18	***	-42.6	4.2	-0.667	0.577	1.467	0.306

3 Effective for all tests completed on or after this date.

4 *** = currently in effect.

5 Targets based on oil 160-1.

6 Targets based on oil 161-1.

7 Standard deviation based on oil 162 (n=138).

8 Standard deviation based on oil 161-1.