9. Sequence VID LTMS Requirements

The following are the specific Sequence VID calibration test requirements.

A. Reference Oils and Critical Parameters

The critical parameters are Fuel Economy Improvement at 16 hours (FEI1) and Fuel Economy Improvement at 100 hours (FEI2). The reference oils required for test stand/engine calibration are reference oils accepted by the ASTM Sequence VI Surveillance Panel. The means and standard deviations for the current reference oils for each critical parameter are presented below.

FUEL ECONOMY IMPROVEMENT at 16 Hours
Unit of Measure: Percent

Reference Oil	Mean	Standard Deviation
540 (GF5A)	1.32	0.12
541 (GF5D)	0.87	0.12
542 (GF5X)	1.49	0.12
1010	1.31	0.12

FUEL ECONOMY IMPROVEMENT at 100 Hours
Unit of Measure: Percent

Reference Oil	Mean	Standard Deviation
540 (GF5A)	1.04	0.14
541 (GF5D)	0.71	0.14
542 (GF5X)	0.80	0.14
1010	1.23	0.14

B. Acceptance Criteria

1. New Test Stand/Engine

   a. A minimum of three (3) operationally valid calibration tests (uninterrupted by non-reference oil tests), with no Shewhart severity alarms (all parameters), are required to calibrate each stand/engine. Precision requirements and severity adjustments are only to be evaluated after the third operationally valid test that has successfully met the Shewhart severity requirement. Note that Special K limits may not be used for Shewhart severity control charts in the calibration of a new stand/engine. Special K limits may only be used for existing stand/engines.

   b. For every two (2) operationally invalid tests during the attempt to calibrate a new stand/engine after the first operationally valid test (the count does not start until after the first valid test), an additional operationally valid calibration test will be added to the stand/engine calibration requirement.

c. The first (3) tests must be conducted on reference oils 541 (GF5D), 542 (GF5X) and 1010. These oils will be assigned in random order by the TMC.

2. Existing Test Stand/Engine

a. The stand/engine must have previously been accepted into the system by meeting the LTMS requirements

b. All operationally valid tests must be charted to determine if the stand/engine is in control as defined by the control charts in the Lubricant Test Monitoring System. If there are two (2) or more operationally invalid tests during the attempt to calibrate an existing stand/engine, then two (2) operationally valid calibration tests, with no Shewhart severity alarms (all parameters), are required to calibrate the stand/engine.

3. Reference Oil Assignment:

a. For new stand/engines, see Section 1.c above.

b. Once a stand/engine has been accepted into the system, 100% of the scheduled calibration tests should be conducted on reference oils 540, 542, and 1010 or subsequent approved reblends. If possible, the same oil should not be used for successive calibration tests in a stand.

4. Control Charts

In Section 1, the construction of the control charts that contribute to the Lubricant Test Monitoring System is outlined. The constants used for the construction of the control charts for the VID, and the response necessary in the case of control chart limit alarms, are depicted below. *Note that laboratory control charts are only updated following an acceptable stand/engine calibration test.*

LUBRICANT TEST MONITORING SYSTEM CONSTANTS

		EWMA Chart				Shewhart Chart	
		LAMBDA		K		K	
Chart Level	Limit Type	Precision	Severity	Precision	Severity	Precision	Severity
Stand/Engine	Special K	--	--	--	--	--	2.96
	Warning	--	--	--	--	1.645	
	Action	0.1	0.3	1.645	0.000	2.325	1.96
Industry	Warning	0.1	0.2	1.645	1.96	--	--
	Action	0.1	0.2	2.33	2.575	--	--

Sequence VID Reference Oil Targets							
		Effective Dates		FEI1		FEI2	
Oil	n	From[1]	To[2]	$\overline{X}$	s[3]	$\overline{X}$	s[3]
540 (GF5A)	11[4]	12-29-08	12-2-09	1.32	0.14	1.04	0.16
540 (GF5A)	11[4]	12-3-09	***	1.32	0.12[5]	1.04	0.14[5]
GF5B	3[4]	12-29-08	***	0.97	0.14	0.63	0.16
GF5C	4[4]	12-29-08	***	1.24	0.14	0.59	0.16
541 (GF5D)	11[4]	12-29-08	12-2-09	0.87	0.14	0.71	0.16
541 (GF5D)	11[4]	12-3-09	***	0.87	0.12[5]	0.71	0.14[5]
542 (GF5X)	11[4]	12-29-08	12-2-09	1.49	0.14	0.80	0.16
542 (GF5X)	11[4]	12-3-09	***	1.49	0.12[5]	0.80	0.14[5]
1010	5	12-01-10	***	1.31	0.12[5]	1.23	0.14[5]

1 Effective for all tests completed on or after this date.
2 *** = currently in effect.
3 Pooled s from matrix analysis.
4 Matrix n-size.
5 November 2009 Pooled s calculation based on additional data– reference oil n-size used= 540-36, 541-24, 542-33, GF5B-3 and GF5C-4.

APPENDIX D
REFERENCE OIL VISCOSITY GRADES

Oil	SAE Viscosity Grade[1]
112	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
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
1006	5W-30
1007	5W-30
1008	5W-30
1009	5W-30
1010	5W-20

1 Viscosity grade applies to all subsequent reblends.