

## 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 96 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	0.14
541 (GF5D)	0.87	0.14
542 (GF5X)	1.49	0.14

#### FUEL ECONOMY IMPROVEMENT at 100 Hours Unit of Measure: Percent

Reference Oil	Mean	Standard Deviation
540 (GF5A)	1.04	0.16
541 (GF5D)	0.71	0.16
542 (GF5X)	0.80	0.16

### 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.

### 13. 1N LTMS Requirements

The following are the specific 1N calibration test requirements.

#### A. Reference Oils and Parameters

The critical parameters are Weighted Demerits and Top Groove Fill. The reference oils required for test stand and test laboratory calibration are reference oils accepted by the ASTM Single Cylinder Diesel Surveillance Panel. The means and standard deviations for the current reference oils for each critical and noncritical parameter are presented below.

**WEIGHTED DEMERITS**  
Unit of Measure: Demerits  
**CRITICAL PARAMETER**

Reference Oil	Mean	Standard Deviation
809-1	205.0	34.6
810-2	273.3	45.5
811-1	273.2	35.5
811-2	281.5	37.4
1004-2	204.0	25.7
1004-3	190.7	24.7

**TOP GROOVE FILL**  
Unit of Measure: Percent  
**CRITICAL PARAMETER**

Reference Oil	Mean	Standard Deviation
809-1	35.3	20.5
810-2	70.8	11.0
811-1	26.2	19.8
811-2	24.7	21.6
1004-2	30.4	16.8
1004-3	23.9	14.6

**TOP LAND HEAVY CARBON**  
Unit of Measure: LN(TLHC+1)  
**NONCRITICAL PARAMETER**

Reference Oil	Mean	Standard Deviation
809-1	1.1970	1.2130
810-2	2.5480	1.3000
811-1	0.454	0.6590
811-2	0.366	0.6000
1004-2	0.4900	0.8040
1004-3	0.1806	0.3977

### AVERAGE OIL CONSUMPTION

Unit of Measure: g/kW-h

#### NONCRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
809-1	0.308	0.175
810-2	0.540	0.410
811-1	0.218	0.053
811-2	0.223	0.052
1004-2	0.206	0.075
1004-3	0.148	0.038

#### B. Acceptance Criteria

##### 1. New Test Stand

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

- Two (2) operationally valid calibration tests, with no stand Shewhart severity alarms and no stand Shewhart precision alarms, must be conducted on any approved reference oils. The second run must be started not more than 14 days after the completion of the first.
- 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.

##### b. Six (6)\* or more Operationally Valid Calibration Results in Laboratory and no current laboratory level EWMA or Shewhart precision alarms

- The first operationally valid calibration 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 this 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. The most recent of those tests must have completed not more than twelve (12) months before the end of the test being considered for “Reduced K”.

Examples of stands required to meet New Test Stand acceptance criteria include:

- a. an entirely new stand installation that has never before been calibrated.
- d. a previously calibrated stand that has undergone significant hardware, software, or control system changes.
- e. a previously calibrated stand whose last calibration expired more than one calibration period ago.

1N Reference Oil Targets											
Oil	n	Effective Dates		WDN		TGF		TLHC <sup>3</sup>		BSOC	
		From <sup>1</sup>	To <sup>2</sup>	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s	$\bar{X}$	s
809-1	18	3-14-93	12-7-95	196.6	33.3	32.1	18.8	1.386	1.1	0.325	0.215
	20	12-8-95	12-6-07	198.1	33.1	33.9	20.5	1.363	1.1	0.322	0.204
	30	12-7-07	***	205.0	34.6	35.3	20.5	1.197	1.213	0.308	0.175
810-2	8 <sup>5</sup>	2-1-98	12-31-99	270.5	39.3	73.6	11.8	2.632	1.2	0.500	0.407
	4	1-1-00	***	273.3	45.5	70.8	11.0	2.548	1.3	0.540	0.410
811-1	10	3-22-93	3-28-96	293.8	38.6	28.9	26.5	0.262	0.5	0.249	0.051
	20	3-29-96	12-6-07	281.5	37.4	24.7	21.6	0.366	0.6	0.223	0.052
	30	12-7-07	***	273.2	35.5	26.2	19.8	0.454	0.659	0.218	0.053
811-2 <sup>7</sup>	--	11-26-06	***	281.5	37.4	24.7	21.6	0.366	0.6	0.223	0.052
1004	16	6-29-93	***	224.7	37.5	24.8	13.8	0.588	0.8	0.192	0.048
1004-1	30	2-6-94	***	212.4	27.1	24.7	14.6	0.693	0.9	0.201	0.045
1004-2 <sup>4</sup>	--	8-11-95	12-10-96	212.3	27.1	24.7	14.6	0.693	0.9	0.201	0.045
	12	12-11-96	12-21-97	205.9	28.9	31.7	14.8	0.552	0.904	0.206	0.093
	22	12-22-97	***	204.0	25.7	30.4	16.8	0.490	0.804	0.206	0.075
1004-3 <sup>6</sup>	--	4-17-99	3-13-04	204.0	25.7	30.4	16.8	0.490	0.804	0.206	0.075
	16	3-14-04	***	190.7	24.7	23.9	14.6	0.1806	0.3977	0.148	0.038

- 1 Effective for all tests completed on or after this date.
- 2 \*\*\* = currently in effect.
- 3 Transformation for TLHC is  $\ln(\text{TLHC}+1)$ .
- 4 Initial targets based on 1004-1.
- 5 Three runs on 810-1 and five runs on 810-2.
- 6 Initial targets based on 1004-2.
- 7 Initial targets based on 811-1

APPENDIX B  
HISTORY OF INDUSTRY CORRECTION FACTORS  
APPLICABLE TO LTMS DATA

Test Area	Effective Date	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
VG	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
VG	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
VG	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	None	None
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
T-8	None	None
T-8E	None	None
T-10A	None	None
T-11	September 14, 2005	Add -0.39% to Soot @ 12cSt Vis. Inc., Add 1274 cP to MRV Vis.
T-11	December 6, 2005	Add -0.36% to Soot @ 12cSt Vis. Inc., Add 713 cP to MRV Vis.
T-11	March 24, 2006	Add -0.35% to Soot @ 12cSt Vis. Inc., Add 956 cP to MRV Vis.
T-12	None	None
RFWT	None	None
EOAT	None	None
L-33-1	None	None
L-37	None	None
L-42	None	None
L-60-1	None	None
HTCT	None	None
OSCT	None	None