

42. D5800 Volatility by Noack Test LTMS Requirements

The following are the specific D5800 Volatility by Noack Test calibration requirements.

A. Reference Oils and Critical Parameters

The critical parameter is Sample Evaporation Loss, Mass %. The reference oils required for test stand and test laboratory calibration are reference oils accepted by the D02.B0.07 Volatility Surveillance Panel. The means and standard deviations for the current reference oils for the critical parameter are presented below.

## SAMPLE EVAPORATION LOSS

Unit of Measure: mass %

Reference Oil	Mean	Standard Deviation*
VOLC12	14.19	0.73
VOLD12	12.52	0.73
VOLE12	16.74	0.73

\*Values utilized for standard deviation to be periodically reevaluated by the D02.B0.07 Volatility Surveillance Panel

B. Acceptance Criteria

## 1. New Test Instrument (Test Instrument that has never previously calibrated)

- A minimum of two (2) operationally valid calibration tests and/or matrix tests, with no Level 3 e<sub>i</sub> alarms must be conducted in a new instrument 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 Instrument

- Instrument has previously been accepted into the system by meeting the requirements defined in this section.

## 3. Transitioning Instruments

- From the first day of implementation of this LTMS system, an instrument that had been calibrated in the “old” (Shewhart Chart) system will have up to 30 days to complete an operationally valid calibration test. This calibration test shall be analyzed in conjunction with historical calibration data from the same instrument to establish acceptance into the system.

#### 4. Calibration Test Requirements and Reference Oil Assignments

After test instruments have been accepted into the system, continuing calibration requires a reference oil assignment be obtained from TMC, and a calibration test performed, when either of the following occur:

- 30 days have passed since the last successful (“in control”) calibration test, OR
- the instrument has been retrofitted with a new thermocouple or new pump, or has received updated firmware.

100% of the scheduled calibration tests should be conducted on reference oils VOLC12, VOLD12 and VOLE12 or subsequent approved reblends. All operationally valid calibration tests must be charted to determine if the test instrument is currently “in control” as defined by the control charts defined in B.6.

#### 5. Mandatory Daily QC Check Sample and Data Submission

To maintain calibrated status and comply with the daily QC check requirement defined in the current revision of ASTM D5800, all TMC-monitored instruments must use a surveillance panel-approved daily quality control check fluid. The results from *all* daily QC checks (passes and fails, whether operationally valid or invalid) since the *last operationally-valid calibration attempt* must be included in the flat file submission (report form) for each calibration run. The data required for each daily QC check shall include unique cup and lid identifiers, among other mandatory data as defined on the TMC-maintained template. Daily QC sample data is not used to determine calibration status of an instrument but it may be used on an ad-hoc basis as an indicator of the ongoing effectiveness of the D5800 LTMS system.

The current approved daily QC check fluid ID’s, performance targets, and pass/fail limits are documented below. These pass/fail limits may be periodically re-evaluated by the ASTM D02.B.07 Volatility Surveillance Panel.

					<b>95% Acceptance Limits*</b>	
<b>Oil Code</b>	<b>Parameter</b>	<b>N</b>	<b>Mean</b>	<b>sR</b>	<b>Lower</b>	<b>Upper</b>
VOLD14	Mass % evaporation loss	33	12.99	0.62	11.8	14.2
VOLD18	Mass % evaporation loss	47	12.06	0.46	11.2	13.0

\*95% Acceptance Limits = Mean +/- (1.96 sR)

#### 6. Control Charts

In Section 1, the construction of the control charts that constitute the Lubricant Test Monitoring System is outlined. For the D5800,  $Z_0 = \text{Mean } Y_i$  of first two operationally valid

tests for the instrument. The constants used for the construction of the control charts for the D5800 Volatility by Noack Test, and the response necessary in the case of control chart limit alarms, are depicted below.

LUBRICANT TEST MONITORING SYSTEM CONSTANTS

		EWMA Chart		Instrument Prediction Error	
Chart Level	Limit Type	Lambda*	Alarm*	Limit Type	Limit*
Instrument	Level 1	0.3	0.000	Level 2	$\pm 1.734$
	Level 2		$\pm 1.800$	Level 3	$\pm 2.066$
Industry	Level 1	0.2	$\pm 0.775$	--	--
	Level 2		$\pm 0.859$	--	--

\*Values for Lambda and alarm limits to be periodically reevaluated by the D02.B.07 Volatility Surveillance Panel

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 instrument from the system.

- Exceed Instrument chart of Prediction Error (e<sub>i</sub>)

Level 3:

- Immediately conduct one additional reference test on the instrument that triggered the alarm. Do not update the control charts until the follow up reference test is completed and the Excessive Influence analysis (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, 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 instrument that triggered the alarm.

## Level 1:

- The Level 1 limit does not apply for the D5800.
- Exceed Instrument EWMA of Standardized Test Result ( $Z_i$ )

## Level 2:

- Immediately conduct one additional reference test in the instrument that triggered the alarm. The instrument 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 instrument calibration status in accordance with the surveillance panel's findings.

## Level 1:

- Calculate the instrument SA as follows and confirm the calculation with the TMC:

Sample Evaporation Loss:  $SA = (-Z_i) \times \text{Standard Deviation}$

Standard Deviation (D5800) = 0.73\*

\*Value utilized for standard deviation to be periodically reevaluated by the D02.B0.07 Volatility Surveillance Panel

- 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.

47. D7528 ROBO Test LTMS Requirements

The following are the specific D7528 ROBO Test calibration requirements.

A. Reference Oils and Critical Parameters

1. The critical pass/fail parameter is MRV Apparent Viscosity of the aged oil in transformed units. The reference oils, performance targets and acceptance criteria required for the test stand calibration with the TMC are listed in Table 1 and have been approved by the ASTM D02.B0.07 ROBO Surveillance Panel.

Table 1  
MRV VISCOSITY  
Unit of Measure: LN(MRV)

D7528 (ROBO) Aged Oil MRV Acceptance Bands, mPa·s and ln(mPa·s)								
Oil	n	Natural Log Transformed Mean (ln)	Mean in Original Units	s.d. (ln)	95% band in mPa·s		95% Bands	
					Min <sup>1</sup>	Max <sup>1</sup>	Min (ln)	Max (ln)
434-1	13	10.6599	42,612	0.1672	30,706	59,136	10.3322	10.9876
434-2	36	<sup>2</sup> 10.9284	<sup>2</sup> 55,737	0.1551	<sup>2</sup> 41,126	<sup>2</sup> 76,008	<sup>2</sup> 10.6244	<sup>2</sup> 11.2386
435	15	11.4895	97,685	0.2932	<sup>3</sup> 60,000	173,546	<sup>3</sup> 11.0021	12.0642
435-1	22	11.0416	62,420	0.20295	<sup>4</sup> 44570	92910	<sup>4</sup> 10.7048	11.4394
438	14	10.2676	28,785	0.2037	19,308	42,912	9.8683	10.6669

<sup>1</sup> 95% bands in mPa·s are listed for information purposes only, the transformed values will be used to judge acceptance in all cases.

<sup>2</sup> A correction factor (severity adjustment) has been applied to the mean of reference oil 434-2 to account for the mild bias observed during the period this dataset was generated. The 95% confidence range reflects the inclusion of the correction factor (severity adjustment).

<sup>3</sup> The minimum value for Reference oil 435 is fixed at 60,000 (11.0021 in transformed units) and not a true 95% minimum as calculated from the statistics.

<sup>4</sup> The minimum value for reference oil 435-1 is based on -1.66 standard deviations from the target mean (to match the range previously approved for oil 435 min), so is not actually a 95% confidence range. A 95% confidence range would use 1.96 standard deviations from target mean.

2. EOT MRV (MRVEOT) viscosity values >400,000 mPa·s shall be reported as >400000.
3. EOT volatiles (VOLEOT) for the reference oils, in a properly run test, should never reach or exceed 60%. Tests with EOT volatility >= 60% will be declared operationally invalid.
4. EOT yield stress (MRVYSEOT) for the reference oils, in a properly run test, should always be <35 Pa. Tests with EOT yield stress measured or reported at anything other than <35 will be declared operationally invalid.

B. Acceptance Criteria

1. New Test Stands

- a. A minimum of two (2) operationally valid calibration tests which fall within the acceptance bands for the oils assigned are required to calibrate a stand for the first time. These must be back-to-back consecutive runs on the same test