

### 37. 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 % (evaluated in natural log transformed units). 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: LN(mass % evaporation loss)  
CRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation*
VOLC12	2.6523	0.0465
VOLD12	2.5264	0.0465
VOLE12	2.8175	0.0465

\*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 To EWMA Monitoring Using Transformed Units

- On the approved effective date of the transition to evaluating tests using natural log transformed test results, February 7, 2020, the TMC will issue new TCR's for all instruments currently calibrated on that date with re-calculated severity adjustments (SA's) in natural log transformed units. On the effective date and forward, all candidate test results for final sample % mass volatilized will be calculated using the new SA's based on transformed test results. Calibration status will not be revoked or granted at the time of transition, only the SA's for each rig will be recalculated. Changes in calibration status will be issued with a respective rig's next calibration interval.

#### 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. Conversion of the QC check fluid test results to natural log is unnecessary. The QC fluid test results can be directly compared to the acceptance limits below for evaluating the acceptability of the QC test results:

					95% Acceptance Limits*	
Oil Code	Parameter	N	Mean	sR	Lower	Upper
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 ( $e_i$ )

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) = 0.0465\*

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

- SA's are not applied to TMC calibration test results
- SA's are instrument dependent and are to be applied to candidate test results over the instrument's active calibration period. SA's are to be applied to natural log transformed test results ( $\text{LN}(\% \text{ mass volatized})$ ) before conversion back to original units for the final, SA corrected, test result.
- If using translation factors, the translations factor is to be applied to the final, SA adjusted test result after conversion back to original units.
- At the expiration of the LTMS calibration period for an instrument, a new calibration is required for that instrument per Section B.4 of the D5800 LTMS specification. For acceptable (passing) calibration results, an updated SA will be calculated for the renewed calibration period on that instrument.

- 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.

The following are the steps that must be taken in the case of exceeding control chart limits.

- Exceed EWMA test stand chart action limit for severity
  - Calculate test stand Severity Adjustment (SA) for each parameter that exceeds action limit, using the current test stand EWMA ( $Z_i$ ) as follows:

Non-lubrited Test Hardware:

Ridging:  $SA = (-Z_i) \times (0.666)$

Rippling:  $SA = (-Z_i) \times (0.557)$

Pitting/Spalling:  $SA = (-Z_i) \times (0.847)$

Wear:  $SA = (-Z_i) \times (0.713)$

Lubrited Test Hardware:

Ridging:  $SA = (-Z_i) \times (n/a)$

Rippling:  $SA = (-Z_i) \times (n/a)$

Pitting/Spalling:  $SA = (-Z_i) \times (n/a)$

Wear:  $SA = (-Z_i) \times (n/a)$

Confirm calculations with the TMC.

- SA calculations are for information purposes only and are not to be used to adjust reported test results.
- Exceed Shewhart test stand chart action limit for severity
  - Conduct an additional calibration test.
- Exceed GL-5 minimum pass limits for all critical parameters, both lubrited and non-lubrited test hardware, reference oil 134 (and reblends) only
  - 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 the 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 surveillance panel required to discuss potential problem.

41. D7097 (MTEOS) Determination of Moderately High Temperature Piston Deposits by Thermo-Oxidation Engine Oil Simulation Test LTMS Requirements

The following are the specific D7097 Determination of Moderately High Temperature Piston Deposits by Thermo-Oxidation Engine Oil Simulation Test calibration requirements.

A. Reference Oils and Critical Parameters

The critical pass/fail parameter is Total Deposit Weight, in mg. 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 TEOST Surveillance Panel.

**Table 1**  
**D7097 (MTEOS) Reference Oil Targets and Acceptance Bands Effective 20060731**

Test	Oil Code	Parameter	n	Mean	sR	Acceptance Bands*	
						95%	
						Lower	Upper
MTEOS by D7097	432	Total Deposit wt. (mg)	30	47.04	4.50	38.2	55.9
	434	Total Deposit wt. (mg)	30	27.37	6.57	14.5	40.2
	434-3	Total Deposit wt. (mg)	8	28.39	6.46	15.7	41.0

\*95% Acceptance Bands = Mean +/- (1.960 x sR)

B. Acceptance Criteria

1. New Laboratory/Test Stand(s)

- a. The TMC calibration auditing system calibrates individual test stands (instruments) at individual laboratories. There are no special requirements to bring a LAB into TMC calibrated status, there are only requirements to bring individual test stands into TMC calibrated status, as follows:
- b. 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 stand, though exceptions can be made at the sole discretion of the TMC for operational fails for reasons that would be considered to have had no bearing on the operational performance of the test stand for subsequent tests (for example, a power failure)
- c. Passing two back-to-back consecutive TMC calibrations places the new test stand in TMC calibrated status. Both tests must pass on operational and statistical criteria.