

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%	95%	95%	95%
					band in mPa·s Min ¹	band in mPa·s Max ¹	Bands Min (ln)	Bands Max (ln)
434-1	13	10.6599	42,612	0.1672	30,706	59,136	10.3322	10.9876
434-2	36	² 10.9284	² 55,737	0.1551	² 41,126	² 76,008	² 10.6244	² 11.2386
435	15	11.4895	97,685	0.2932	³ 60,000	173,546	³ 11.0021	12.0642
435-1	22	11.0416	62,420	0.20295	⁴ 44570	92910	⁴ 10.7048	11.4394
438	14	10.2676	28,785	0.2037	19,308	42,912	9.8683	10.6669
438-2	10	² 10.4421	² 34,273	0.2322	² 21,742	² 54,025	² 9.9870	² 10.8972

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

² A bias adjustment has been applied to the mean of reference oils 434-2 and 438-2 to account for biases observed in the TMC reference data during the periods that each oil target dataset was generated. The 95% confidence range reflects the inclusion of the bias adjustments.

³ 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.

⁴ 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

44. D6335 (TEOST) Thermo-Oxidation Engine Oil Simulation Test LTMS Requirements

The following are the specific D6335 Determination of High Temperature 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
D6335 (TEOST) Reference Oil Targets and Acceptance Bands Effective 20190404

						Acceptance Bands*	
						95%	
Test	Oil Code	Parameter	n	Mean	sR	Lower	Upper
	75	Total Deposit wt. (mg)	30	53.66	6.56	40.8	66.5
TEOST by	75-1	Total Deposit wt. (mg)	16	56.9	5.02	47.1	66.7
D6335	435-2	Total Deposit wt. (mg)	30	28.71	4.76	19.4	38.0

*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.
- d. TMC calibrated status of a test stand is valid for no more than 90 days from date completed of a valid TMC calibration (that is, the end of the test's 24-hour

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:

- 100% of the scheduled calibration tests should be conducted on reference oil 1005-2 or subsequent approved reblends.

4. Control Charts

In Section 1, the construction of the control charts that constitute the Lubricant Test Monitoring System is outlined. For the T8 and T-8E, $Z_0 = \text{mean } Y_i$ of the first two operationally valid tests in the stand. The constants used for the construction of the control charts for the T-8 and T-8E, and the responses necessary in the case of control chart limit alarms, are depicted below.

LUBRICANT TEST MONITORING SYSTEM CONSTANTS

		EWMA Chart		Stand Prediction Error	
Chart Level	Lambda	Limit Type	Limit	Limit Type	Limit
Stand	0.3	Level 1	0	Level 1	± 1.351
		Level 2	± 1.800	Level 2	± 1.734
			--	Level 3	± 2.066
Industry	0.2	Level 1	± 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)

Level 3 (critical parameters only):

- 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 the Excessive Influence analysis (refer to Section 1.A.5) has been performed.

Level 2 (critical parameters only):

- 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. Evaluate any subsequent test(s) using Level 3 e_i limits.