Once test stand-engines have been accepted into the system, the TMC will assign reference oils for continuing calibration according to the reference oil mix:

- Scheduled calibration tests should be conducted on reference oils 221 and 222 or subsequent approved reblends in equal proportion with random assignment.

4. Control Charts

In Section 1, the construction of the control charts that contribute to the Lubricant Test Monitoring System is outlined. For the Sequence IX, Z_0=Mean Y_i of all operationally valid tests in the initial stand-engine calibration sequence. The constants used for the construction of the control charts for the Sequence IX, and the response necessary in the case of control chart limit alarms, are depicted below.

LUBRICANT TEST MONITORING SYSTEM CONSTANTS

		EWMA Chart		Stand-Engine Prediction Error	
		Severity		Severity	
Chart Level	Limit Type	Lambda	Alarm	Limit Type	Limit
Stand-Engine		0.4		Level 0	±1.000
	Level 1		0.000	Level 1	±1.351
	Level 2		±1.500	Level 2	±1.734
				Level 3	±2.066
Industry	Level 1	0.2	±0.775	-	-
	Level 2		±0.859	-	-

27. T-8 / T-8E LTMS Requirements

The following are the specific T-8 and T-8E calibration test requirements.

A. Reference Oils and Parameters

The critical parameter is Relative Viscosity at 4.8% Soot, 100% DIN Shear Loss (T-8E only). Viscosity Increase at 3.8% Soot and Relative Viscosity at 4.8% Soot, 50% DIN Shear Loss are non-critical parameters (T-8 and T-8E). The reference oils required for test stand and test laboratory calibration are reference oils accepted by the ASTM Mack Test Surveillance Panel. The mean and standard deviation for the current reference oils for each critical and non-critical parameter are presented below.

VISCOSITY INCREASE @ 3.8% SOOT
Unit of Measure: cSt
NON-CRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
1005-3	5.01	0.56
1005-4	5.01	0.56
1005-5	5.01	0.56

RELATIVE VISCOSITY @ 4.8% SOOT
50% DIN Shear Loss
Unit of Measure: unitless
NON-CRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
1005-3	1.76	0.08
1005-4	1.76	0.08
1005-5	1.76	0.08

RELATIVE VISCOSITY @ 4.8% SOOT
100% DIN Shear Loss
Unit of Measure: unitless
CRITICAL PARAMETER

Reference Oil	Mean	Standard Deviation
1005-3	2.00	0.09
1005-4	2.00	0.09
1005-5	2.00	0.09

B. Acceptance Criteria

1. New Test Stand

   a. Less than four (4) Operationally Valid Calibration Results in Laboratory

34. DD13 Scuffing Test

The following are the specific DD13 Scuffing Test calibration test requirements.

A. Reference Oils and Critical Performance Criteria

The prediction error monitoring and severity adjustment parameter is Hours to Scuff. The reference oils required for calibration are reference oils accepted by the Daimler Surveillance Panel. The targets for the current reference oils for each parameter are presented below.

Hours to Scuff
Unit of Measure: Hrs

Reference Oil	Mean	Standard Deviation
864 (OIL X)	48	26
864-1	48	26

B. Acceptance Criteria

1. New Test Lab

a. The first stand in a laboratory

- A minimum of two (2) operationally valid calibration tests and/or matrix tests, with no Level 3 e_i or Level 2 Z_i alarms must be conducted in a new laboratory 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 Lab

b. Second and subsequent stands in a laboratory

- New test stands in an existing lab, and test stands that have not run an acceptable reference in the past two years in an existing test lab, may calibrate with one test provided e_i Level 1 limits are not exceeded. Otherwise a second test is required for calibration.
- For an existing test stand in an existing lab run one test.

APPENDIX E

APPLYING SEVERITY ADJUSTMENTS

In order to adjust non-reference oil test results for laboratory or stand severity, an exponentially weighted, moving average technique (EWMA) is applied to standardized calibration test results. See Section 1.A.3 of this document for an explanation.

When the EWMA laboratory or stand (for stand based test areas) chart action limit for severity is exceeded, a severity adjustment is calculated and applied to all subsequent non-reference oil tests. The following table lists the laboratory (or stand) EWMA severity alarm limit for all tests in the current LTMS. Alarm limits are calculated by the formula listed in Section 1.A.3.

Test Type	Alarm Level	Parameter(s)	Alarm Limit
IIIF	Laboratory	All	±0.653
IIIG	Laboratory	All	±0.000 (Continuous)
IIIGA	Laboratory	All	±0.550
IIIGB	Laboratory	All	±0.550
IIIH	Stand	All	±0.000 (Continuous)
IIIHA	Stand	All	±0.000 (Continuous)
IIIHB	Stand	All	±0.000 (Continuous)
IVA	Laboratory	All	±0.756
IVB	Stand	All	±0.000 (Continuous)
VG	Laboratory	All	±0.653
VH	Laboratory	All	±0.000 (Continuous)
IX	Stand/engine	All	±0.000 (Continuous)
X	Stand	All	±0.000 (Continuous
VIE	Stand	All	±0.000 (Continuous)
VIF	Stand	All	±2.0
			±2.8
VIII	Laboratory	TBWL	±0.600
1M-PC	Laboratory	All	±0.653
1K	Laboratory	WTD,TGF,TLHC	±0.653
1N	Laboratory	WTD,TGF,TLHC	±0.653
1P	Laboratory	All	±0.653
1R	Laboratory	All	±0.653
C13	None	None	None
COAT	Stand	All	±0.000 (Continuous)
ISB	Stand	All	±0.000 (Continuous)
ISM	None	None	None
T-8/T-8E	Laboratory	All	±0.653
T-11	Laboratory	All	±0.653
T-12	Laboratory	All	±0.653
T-13	Laboratory	All	±0.000 (Continuous)
RFWT	Laboratory	All	±0.600;

Test Type	Alarm Level	Parameter(s)	Alarm Limit
EOAT	Stand	All	±0.000 (Continuous)
DD13	Laboratory	None	None
L-33-1	Stand	All	±0.823
L-37	Stand	All	±0.653
L-37-1	Stand	All	±0.653
L-42	None	None	None
L-60-1	Stand	All	±0.653
HTCT	None	None	None
OSCT	None	None	None
D5800	Instrument	All	±0.000 (Continuous)

Severity Adjustment Calculation Procedure (except Sequence VIE, refer to Sequence VIE section):

Round Z_i to three decimal places.

If Z_i exceeds Alarm Limit shown, calculate the Severity Adjustment (SA) as follows:

$$SA = -1*(Z_i)*s_{SA}$$

where s_{SA} = specified severity adjustment standard deviation for each parameter as shown in each test area section.

Round the SA value, using the method specified in Practice E 29, to the precision level specified in the test area data dictionary. Add the SA to the test result in the appropriate Units of Measure.

EXAMPLES:

Non-transformed Result-Laboratory Level, Sequence IID, Average Engine Rust (AER)

If the absolute value of the EWMA exceeds 0.600, apply a severity adjustment to subsequent non-reference oil results. The following example illustrates the use of the EWMA in determining the application of a severity adjustment.

$$Z_i = (Lambda)*Y_i + (1-Lambda)*Z_{i-1}$$

For this example, Z_{i-1} is 0.572 and Y_i is 1.469. Lambda for the Sequence IID test area is 0.2.
Applying these values to the Z_i equation yields the following:

$$Z_i = 0.2*1.469 + (1-0.2)*0.572 = 0.7514.$$