# ISB Viscosity (ISBVIS) LTMS Requirements

 The following are the specific ISBVIS calibration test requirements.

 A. Reference Oils and Parameters

 The critical parameter is Soot at 12.0 cSt Viscosity Increase. Soot at 4.0 cSt Viscosity Increase, Soot at 15.0 cSt Viscosity Increase, and MRV Viscosity are noncritical parameters. The reference oils required for test stand and test laboratory calibration are reference oils accepted by the ASTM Cummins Test Surveillance Panel. The mean and standard deviation for the current reference oils for critical and noncritical parameters are presented below.

SOOT @ 4.0 cSt VISCOSITY INCREASE

Unit of Measure: %

NONCRITICAL PARAMETER

|  |  |  |
| --- | --- | --- |
| Reference Oil | Mean | Standard Deviation |
| 822-2 |  |  |
| 834 |  |  |

SOOT @ 12.0 cSt VISCOSITY INCREASE

Unit of Measure: %

CRITICAL PARAMETER

|  |  |  |
| --- | --- | --- |
| Reference Oil | Mean | Standard Deviation |
| 822-2 |  |  |
| 834 |  |  |

SOOT @ 15.0 cSt VISCOSITY INCREASE

Unit of Measure: %

NONCRITICAL PARAMETER

|  |  |  |
| --- | --- | --- |
| Reference Oil | Mean | Standard Deviation |
| 822-2 |  |  |
| 834 |  |  |

MRV VISCOSITY

Unit of Measure: cP

NONCRITICAL PARAMETER

|  |  |  |
| --- | --- | --- |
| Reference Oil | Mean | Standard Deviation |
| 822-2 |  |  |
| 834 |  |  |

B. Acceptance Criteria

 1. New Test Stand

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

 • A minimum of three (3) operationally valid calibration tests with no Level 3 ei or Level 2 Zi alarms after the third operationally valid test must be conducted. One on each of the approved reference oils and a third as a repeat of one of the two oils.

 • 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. Four (4) or more Operationally Valid Calibration Results in Laboratory\*

* A minimum of two (2) operationally valid calibration tests with no Level 3 ei or Level 2 Zi alarms, must be conducted. One on each of the approved reference oils.

\* Only test results from calibrated stands in the laboratory count toward the tally of four (4) required operationally valid calibration tests. The fourth test must complete (date and time) before the first test completes (date and time) on a New Test Stand that is seeking calibration with a single test result. In addition, the first test for the stand is to begin within six (6) months of the completion of the last acceptable calibration test.

 c. Stand for which a lapse in calibration is greater than two years.

* A single operationally valid calibration tests with no Level 1 ei alarms.

 2. Existing Test Stand

 • The test stand must have been an ASTM TMC calibrated test stand previously accepted into the system by meeting LTMS calibration requirements.

 • All operationally valid calibration tests 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.

 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:

 • Alternating tests between oils 822 and 834, or subsequent reblends

 4. Control Charts

 In Section 1, the construction of the control charts that constitute the Lubricant Test Monitoring System is outlined. For the ISBVIS, Z0=mean Yi of the first two operationally valid tests in the stand. The constants used for the construction of the control charts for the ISBVIS, 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 (ei)

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 ei limits.

Level 1 (critical parameters only):

* + The Level 1 limit also applies to a stand in an existing test lab that has not run an acceptable reference in the past two years. The stand can calibrate with one test if the Level 1 limits are not exceeded. Otherwise, conduct another reference test in the stand.
* Exceed Stand EWMA of Standardized Test Result (Zi)

Level 2 (critical parameters only):

* + Conduct one additional reference test in the stand that triggered the alarm. The stand 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 stand calibration status in accordance with the surveillance panel’s findings.

Level 1 (all parameters):

* + The Level 1 limit applies to all reference tests that are control charted, even when other alarms have been triggered. Level 1 uses Zi to determine the laboratory severity adjustment (SA). Calculate the laboratory SA as follows and confirm the calculation with the TMC:
	+ Calculate stand Severity Adjustment (SA) using the current laboratory EWMA (Zi) as follows:

 Soot at 4.0 cSt Viscosity Increase: SA = (-Zi) x (0.XXXX)

 Soot at 12.0 cSt Viscosity Increase: SA = (-Zi) x (0.XXXX)

 Soot at 15.0 cSt Viscosity Increase: SA = (-Zi) x (0.XXXX)

 MRV Viscosity: SA = (-Zi) x (XXXX)

* + Confirm calculations with the TMC.
* Exceed Industry EWMA of Standardized Test Result (Zi)

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.