ISB LTMS Requirements

 The following are the specific ISB calibration test requirements.

* + 1. Reference Oils and Parameters

 The critical performance criteria are Average Cam Shaft Wear and Average Tappet Weight Loss. 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 each critical parameter are presented below.

AVERAGE CAM SHAFT WEAR

Unit of Measure: Micrometers

|  |  |  |
| --- | --- | --- |
| Reference Oil  | Mean  | Standard Deviation  |
| 831  | 42.5  | 8.7  |
| 831-1  | 42.5  | 8.7  |
| 831-2  | 42.5  | 8.7  |

AVERAGE TAPPET WEIGHT LOSS

Unit of Measure: Milligrams

|  |  |  |
| --- | --- | --- |
| Reference Oil  | Mean  | Standard Deviation  |
| 831  | 97.2  | 14.8  |
| 831-1  | 97.2  | 14.8  |
| 831-2  | 97.2  | 14.8  |

* + 1. Acceptance Criteria

 1. New Test Lab

 a. First Test Stand in a Laboratory

* ~~A minimum of two (2) operationally valid calibration tests with no stand Shewhart severity alarms must be conducted on any approved reference oil~~
* A minimum of two (2) operationally valid calibration tests with no level 3 ei or
Level 2 Zi alarms must be conducted in a new laboratory on any approved reference oil.
	+ - * 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.

 b. All Subsequent New Test Stands in a Laboratory

* ~~One operationally valid test with no stand Shewhart severity alarms must be conducted on any approved reference oil.~~
* One operationally valid test with no level 1 ei or Level 2 Zi alarms must be conducted on any approved reference oil.

 2. Existing Lab

* + - * + The test stand must have been previously accepted into the system by meeting LTMS calibration requirements.
				+ ~~One operationally valid test with no stand Shewhart severity alarms must be conducted on any approved reference oil.~~
* One operationally valid test with no level 3 ei or level 2 Zi alarms must be conducted on any approved reference oil.
	+ - * + Following the necessary tests, check the status of the control charts and follow the prescribed actions.

1. 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 831 (or subsequent approved reblends).

1. Control Charts

 In Section 1, the construction of the control charts that constitute the Lubricant Test Monitoring System is outlined. For the ISB, Z0 = Mean Yi of the first two operationally valid tests in the laboratory. The constants used for the construction of the control charts for the ISB, and the response necessary in the case of control chart limit alarms, are depicted below. Note that control charting all parameters is required.

LUBRICANT TEST MONITORING SYSTEM CONSTANTS

|  |  |  |  |
| --- | --- | --- | --- |
|  | ~~EWMA Chart~~  |  | ~~Shewhart Chart~~  |
|  | ~~LAMBDA~~  |  |  ~~K~~  | ~~K~~  |
| ~~Chart Level~~  | ~~Limit Type~~  | ~~Precision~~  | ~~Severity~~  | ~~Precision~~  | ~~Severity~~  | ~~Precision~~  | ~~Severity~~  |
| ~~Stand~~  | ~~Action~~  | ~~0.3~~  | ~~0.3~~  | ~~2.10~~  | ~~2.36~~  | ~~2.10~~  | ~~1.96~~  |
| ~~Industry~~  | ~~Warning~~  | ~~0.2~~  | ~~0.2~~  | ~~2.10~~  | ~~2.36~~  | ~~--~~  | ~~--~~  |
| ~~Action~~  | ~~0.2~~  | ~~0.2~~  | ~~2.80~~  | ~~3.00~~  | ~~--~~  | ~~--~~  |

|  |  |  |
| --- | --- | --- |
|   | EWMA Chart  | Laboratory Prediction Error  |
|   | Severity  | Severity  |
| Chart Level  | Limit Type  | Lambda  | Alarm  | Limit Type  | Limit  |
| Lab  | Level 1  | 0.3  | 0.000  | Level 1  | ±1.351  |
| Level 2  | ±1.800  | Level 2  | ±1.734  |
|   |   | Level 3  | +2.066  |
| Industry  | Level 1  | 0.2  | +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 Shewhart test stand chart limit for severity~~

* ~~Conduct an additional calibration test.~~

 ~~The following industry issues are handled by the TMC and do not require individual laboratory action.~~

Exceed Lab chart of Prediction Error (ei)

 Level 3:

~~Immediately~~ Conduct one additional reference test in the stand that triggered the alarm. Do not update the control charts until ~~the~~ a follow up reference test is completed and the Excessive Influence (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, 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.

 Level 1:

The Level 1 limit applies to the first test on the second or subsequent stand in a lab. The stand can calibrate with one test if the Level 1 limits are not exceeded. Otherwise, ~~immediately~~ conduct another reference test in the stand.

Exceed Lab EWMA of Standardized Test Result (Zi)

 Level 2:

Immediately 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:

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 Lab SA as follows and confirm the calculation with the TMC:

 Average Cam Shaft Wear: SA = (-Zi) x (8.7)

Average Tappet Weight Loss: SA = (-Zi) x (14.8)

* Exceed Industry EWMA of Standardized Test Result (Zi)

Level 2:

* ~~TMC to notify test developer, surveillance panel chairman, and ACC Monitoring Agency. Meeting of TMC, test developer, and surveillance panel required to determine course of action~~
* TMC informs the surveillance panel that the limit has been exceeded. The surveillance panel then investigates and pursues resolution of the alarm.

 Level 1:

* ~~TMC to notify test developer, surveillance panel chairman, and ACC Monitoring Agency. Coordination of TMC, test developer, and surveillance panel chairman required to discuss potential problem~~
* The TMC investigates whether severity adjustments are adequately addressing the trend, investigates the possible causes, and communicates as appropriate with industry.