



## Test Monitoring Center

@ Carnegie Mellon University  
6555 Penn Avenue, Pittsburgh, PA 15206, USA

<http://astmtmc.cmu.edu>  
412-365-1000

ISB Information Letter 21-2  
Sequence No. 16  
June 21, 2021

***ASTM consensus has not been obtained on this information letter. An appropriate ASTM ballot will be issued in order to achieve such consensus.***

TO: Cummins Mailing List

SUBJECT: Alternate Fuel Supplier Approval Procedure

During the April 19, 2021 Surveillance Panel teleconference the panel voted to add a new procedure for the approval of new fuel suppliers as well as the steps necessary to introduce fuels supplied by approved suppliers. The fuel specification is unchanged.

The attached changes to Test Method D7484-21 are effective with the release of this information letter.

Ryan Denton  
Corporate Chemical Technology Manager  
Cummins Inc.

Frank M. Farber  
Director  
ASTM Test Monitoring Center

Attachment

c: [http://www.astmtmc.cmu.edu/ftp/docs/diesel/cummins/procedure\\_and\\_ils/ISB/il21-2\\_ISB.pdf](http://www.astmtmc.cmu.edu/ftp/docs/diesel/cummins/procedure_and_ils/ISB/il21-2_ISB.pdf)

Distribution: Email

**(Revises Test Method D7484-21 as amended by IL21-1)**

*Revise section 7.2:*

7.2 *Test Fuel*—Approximately 8000 L of PC-10, ultra-low sulfur, diesel fuel from an approved supplier are required to complete the test. The TMC maintains a list of approved fuel suppliers. The fuel<sup>6+17</sup> shall have the properties and tolerances shown in the “PC-10 Fuel Specification” section of the “TMC-monitored Test Fuel Specifications” document maintained by the TMC.<sup>8,17</sup>

*Remove footnote 17 and renumber remaining footnotes*

<sup>17</sup>The sole source of supply of the PC-10 test fuel known to the committee at this time is Chevron Phillips Chemical Company LP, 10001 Six Pines Drive, Suite 4036B, The Woodlands, TX 77387-4910. www.cpcchem.com.

*Add the following as Annex A9*

A9.1 Fuel Requirements - The Cummins ISB Test shall use a fuel meeting the PC-10 specification located on the TMC website<sup>17</sup>, and that has been approved for use through the process defined by the Cummins Surveillance Panel for acceptance.

A9.1.1 For a fuel to be approved for the ISB test, the fuel supplier shall demonstrate, through chemical analyses and engine testing, that the fuel provides the same performance as a currently approved fuel. The supplier shall provide a Certificate of Analysis documenting that the fuel meets the current PC-10 fuel specification, as well as conducting a prove-out program. The fuel supplier shall conduct a full COA analysis for each batch produced.

A9.1.2 An individual laboratory may not bring a new fuel supplier into use, even following the criteria noted in the approval process, without the notification and acceptance by the Surveillance Panel.

**A9.2 Prove-Out Program**

A9.2.1 The prove-out program is to be run entirely on a single test stand in a single test laboratory. The chosen test stand must have a history of at least two (2) successful calibration tests in the last three (3) years, the first LTMS appearance for the stand being over one year prior to the start of the prove-out program, and shall not have had a current lapse in calibration of greater than one calibration period.

A9.2.2 The alternate fuel tests shall be conducted immediately following the calibration test on the same engine block and batch of hardware with no additional testing in between. New injectors shall be utilized for the calibration test and those same injectors shall be used for the subsequent alternate fuel tests.

A9.2.3 The program will be run using reference oil 831-4 or subsequent oil re-blends.

A9.2.4 The alternate fuel will be evaluated based on Average Camshaft Wear ( $\mu\text{m}$ ) and average Tappet Mass Loss (mg).

A9.2.5 The alternate fuel tests may be conducted on any test stand which meets the requirements stated in A9.2.1. The chosen test stand shall conduct a test on oil 831-4 (or subsequent re-blend) using a currently approved fuel. The test shall meet all LTMS calibration acceptance criteria and be considered operationally valid.

A9.2.6 Based on the results of the test, determine the new stand-level exponentially weighted moving average, or  $Z_i$  value, for each of the two evaluated parameters.  $Z_i$  is as defined in the LTMS document. The  $Z_i$  value calculated for each parameter immediately after the calibration test will be referred to as  $Z_{cal}$  in the subsequent sections. Also calculate the average injection timing in stage A, average engine load in both stages, and average tailpipe temperature in both stages. An example calculation of the weighted average (WA) for injection timing can be seen below in Table A9.1 and Equation A9.1.

| Timing Change Hours | Timing (Deg) |
|---------------------|--------------|
| 0                   | E            |
| A                   | F            |
| B                   | G            |
| C                   | H            |
| D                   | I            |

Table A9.1 Timing Change

$$WA = (A * E) + [(B - A) * F] + \dots + [(100 - D) * I] 100 \quad (A9.1)$$

Where:

WA = Injection Timing Weighted Average

A9.2.7 The same stand shall immediately conduct two (2) tests on oil 831-4 using the proposed alternate fuel.

A9.2.8 For each test, calculate the difference between the standardized test result  $Y_i$  and the previously determined  $Z_{cal}$  value for each parameter. This difference is the prediction error, or  $E_i$  value.

$$E_i = Y_i - Z_{CAL} \quad (A9.2)$$

Note that because of the use of  $Z_{cal}$  instead of  $Z(i-1)$ , this is slightly different than the definition of  $E_i$  in the LTMS document.  $Y_i$  is defined as in the LTMS document:

$$Y_i = \frac{R_i - M}{S} \quad (A9.3)$$

Where:

$Y_i$  = standardized test result at test order  $i$

$R_i$  = actual reference oil test result at test order  $i$

$M$  = reference oil target mean from LTMS

$S$  = reference oil target standard deviation from LTMS

A9.2.9 Similar to the calibration test, calculate the average injection timing in stage A, average engine load in both stages, and average tailpipe temperature in both stages.

### A9.3 Fuel Acceptance Criteria

A9.3.1 The results of the prove-out testing must meet the following criteria:

A9.3.1.1 For Average Camshaft Wear and average Tappet Mass Loss the calculated  $E_i$  values will be within +/- 1.734 for both tests.

A9.3.1.2 Both tests shall be operationally valid.

A9.3.1.3 The average injection timing for all tests shall be in a range of 0.3 Deg.

A9.3.1.4 The average torque in stage A for all tests shall be within a range of 20.0 Nm.

A9.3.1.5 The average torque in stage B for all tests shall be within a range of 10.0 Nm.

A9.3.1.6 The average tailpipe temperature in stage A for all tests shall be within a range of 20.0 C.

A9.3.1.7 The average tailpipe temperature in stage B for all tests shall be within a range of 15.0 C.

A9.3.2 The Surveillance Panel will approve the fuel for use following confirmation of these results. If the supplier believes the fuel is providing equivalent performance to the current approved fuel without meeting the criteria listed above, they may petition the surveillance panel to conduct an additional review. At this point, the actions taken by the Surveillance Panel to accept or reject the fuel will vary depending on the results and judgement of the panel members.

A9.3.3 An approved test fuel database is maintained on the TMC website. Once a supplier is approved by the surveillance panel the supplier shall upload fuel batch data to that database.

A9.3.4 The fuel prove-out runs on the alternate fuel will count against the calibration interval and the stand can return to the existing calibration period on the previously approved fuel after flushing the fuel lines to the standards of this document.

#### **A9.4 Fuel Line Flushing**

A9.4.1 Fuel shall be flushed through all lines connecting the supply tank to the test cell. Due to variation in line volumes from laboratory/stand combinations, a set volume is not defined here. Enough fuel should be flushed to ensure that the entire line volume has been changed over to the new fuel.

*A9.5 Introduction of a Surveillance Panel Approved Fuel* - A laboratory may utilize any fuel that has been approved by the Surveillance Panel for use with the ISB which has previously conducted a full "Prove-Out Program" and been approved for use at the Surveillance Panel.

A9.5.1 A new fuel for a stand is one that has never previously completed an acceptable calibration test in that stand. Notify the Test Monitoring Center when a calibration oil is requested that a new fuel supplier will be utilized.

A9.5.2 The first stand to run a fuel in a laboratory must meet level 2 Ei criteria as defined in the LTMS document. In the case that a level 2 Ei alarm is exceeded, a second test may be run, and the stand considered calibrated as long as normal referencing criteria are met.

A9.5.3 Once a particular stand in a laboratory has successfully calibrated with the new fuel, stand severity adjustments will be recalculated and applied to all candidate tests in that stand until the next calibration test.

A9.5.4 For a laboratory with multiple stands, each stand is treated as a separate entity. A fuel that has been approved for use by the panel and has successfully calibrated in one stand in a laboratory is not automatically approved for candidate tests in any other laboratory/stand combinations within the laboratory. A transition of fuel shall occur at a reference test. The intent is to not alternate fuels within a reference interval for candidate tests.

*A9.6 Transition Between Approved Fuels* - Transitioning between two fuels that have previously been approved for use in a particular stand can occur with no additional requirements outside of those listed in the LTMS for the calibration of an existing stand.

*A9.7 Fuel Supply Tanks* - The fuel tank located at a laboratory and supplying fuel to the test stand shall be addressed in one of two ways prior to being loaded with a new fuel source.

A9.7.1 If the tank was previously filled with an unapproved fuel for the ISB test, the tank should be fully drained and cleaned.

A9.7.2 If an approved fuel was in the tank, the overall capacity of the tank must be below 5% of its capacity prior to refilling with enough volume to complete an ISB test (approximately 8,000 liters) or up to its maximum safe capacity.

A9.7.3 Fuel shall be flushed through all lines connecting the supply tank to the test cell. Due to variation in line volumes from laboratory/stand combinations, a set volume is not defined here. Enough fuel shall be flushed to ensure that the entire line volume has been changed over to the new fuel.