

## A18 Alternate Fuel Approval Requirements

A18.1 For an alternate fuel to be approved for Sequence VI tests, the fuel supplier shall demonstrate, through chemical analyses and engine testing, that the fuel provides the same performance to the currently approved fuel. The supplier shall provide a Certificate of Analysis documenting that the fuel meets the current Sequence VI fuel specification, as well as conducting a prove-out program.

A18.2 *Prove-out Program*—Complete the prove-out program using the Sequence VIE test, which is to be performed on one test stand, using a minimum of two engines and a single reference oil, 1010-1 (or subsequent approved reblends). Testing shall utilize the first four runs of the engines’ life and shall be alternated between the currently approved fuel and the alternate fuel candidate, as shown in Table A18.1.

**Table A18.1 Testing Order**

Engine	Break-in Fuel	Run #1	Run #2	Run #3	Run #4
Engines 1, 3,...	Current Fuel	Current Fuel	Alternate Fuel	Current Fuel	Alternate Fuel
Engines 2, 4,...	Alternate Fuel	Alternate Fuel	Current Fuel	Alternate	Current Fuel

A18.3 At the completion of each engine after Engine #2, construct two Analysis of Variance (ANOVA) models using the engine hour corrected results. The response variables shall be  $FEI1Y_i$  and  $FEI2Y_i$ , which are the standardized results. Here  $Y_i$  is defined as:

$$Y_i = (R - M)/S \tag{A18.1}$$

where:

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

$R$  = actual reference oil test result expressed as %  $FEI$ ,

$M$  = reference oil target mean expressed as %  $FEI$ , and

$S$  = reference oil target standard deviation, expressed as %  $FEI$ .

Include in the ANOVA model factors “Engine”, with levels Engine1, Engine2, ..., EngineN, and “Fuel”, with two levels (current and alternate) . For the proposed fuel to be qualified, the following shall be true of the ANOVA model results for both the  $FEI1Y_i$  model and the  $FEI2Y_i$  model:

A18.3.1 The absolute difference in the least squares mean for the current fuel and the least squares mean for the alternate fuel is less than 0.75.

A18.3.2 When forming a 95 % confidence interval on the least squares mean difference between fuels, the upper and lower limits of both confidence intervals are both less than 2.5 in absolute value.

A18.4 If the criteria in both A18.3.1 and A18.3.2 are not satisfied for both  $FEI1$  and  $FEI2$ , then conduct an additional four tests on another engine, followed by another ANOVA model. Continue this process until both criteria have been satisfied for both parameters.

A18.4.1 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 in A18.3.1 or 18.3.2 or both, they may petition the surveillance panel for acceptance.

A18.5 *Implementation of a new fuel* - Each laboratory can choose which approved fuel to use for individual stands, provided all candidate testing is conducted on the same fuel used to calibrate the stand. When switching from one supplier to another, a full Certificate of Analysis shall be conducted on a sample consisting of no more than 10% of the current batch from the current supplier taken from the purchasing laboratory’s tank and at least 90% of the new batch from the new supplier. The Certificate of Analysis for

this blended sample shall meet the current Sequence VI fuel specifications. Once approved, a laboratory shall use this Certificate of Analysis only for a storage tank that consists of that same blend of current and new fuel.



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