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**BUREAU OF INDIAN STANDARDS**

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*Draft* **AMENDMENT NO. 5**
**TO**
**IS 1571 : 2018 AVIATION TURBINE FUELS, KEROSENE TYPE, JET A-1 - SPECIFICATION**
*(Tenth Revision)*

| | |
|---|---|
| Petroleum and their Related Products of Synthesis or Biological Origin Sectional Committee, PCD 3 | Last date for Comments **24 October 2024** |

(*Foreword, para* 7, *line* 6) – Substitute 'jet fuel' *for* 'et fuel'.

(*Foreword, para* 7) – Insert the follow new paragraph *after* paragraph 7:

Annex F contains provision for co-processing of feedstock, other than petroleum crude, along with petroleum crude in refineries for production of semi-synthetic kerosene. Such co-processing is acceptable for jet fuel manufacture as shown by Research Report D02-2052, which is a supporting document to ASTM D1655-2023.

(*Page* 2, *Clause* 3.2, *Para* 2) – Delete.

(*Page* 14, *Annex* F) – Substitute the following *for* the existing:

## ANNEX F

(*Foreword*)

## CO-PROCESSING OF RENEWABLE FEEDSTOCK ALONG WITH PETROLEUM CRUDE IN REFINERY

### F-1 BACKGROUND

ASTM D-1655 first introduced the provision for jet fuel containing synthesized hydrocarbons. However, these synthesized hydrocarbons were usually generated from petroleum, oil sand, or shale derived feedstocks in the refinery and exhibited properties substantially similar to conventionally refined kerosene. The jet fuel requirements prescribed in this specification in Table 1 are for batch-to-batch quality control tests, upon satisfying which, the jet fuel can be considered fit-for-purpose. The jet fuels, derived from co-processing of renewable feedstock along with petroleum crude in refinery, will be a blend of conventional kerosene and synthetic hydrocarbons and this semi-synthetic kerosene shall comply with the requirements prescribed in IS 17081.

## F-2 CO-PROCESSING OF RENEWAL FEEDSTOCK WITH PETROLEUM CRUDE

**F-2.1** For co-processing of approved feedstocks along with petroleum crude, the approved feedstocks are:
a) mono-, di-, and triglycerides, free fatty acids and fatty acid esters;
b) hydrocarbons derived from synthesis gas via the Fischer-Tropsch (FT) process using iron or cobalt catalyst; and
c) hydrocarbons from hydroprocessed mono-, di-, and triglycerides, free fatty acids and fatty acid esters.

Only one feedstock may be used for co-processing for the production of a single aviation turbine fuel batch.

Note - Refer to DEFSTAN 91-091 Issue 17 Annex F.5 for a discussion of bio-based carbon content and identification of the applicable test method.

**F-2.2** Co-hydroprocessing of mono-, di-, and triglycerides, free fatty acids and fatty acid esters shall include hydrocracking or hydrotreating and fractionation. Processing may also include other conventional fuel manufacturing processes. The process stream from hydrocracking or hydrotreating unit containing synthesized kerosene, where process streams are used for jet fuel production, shall not exceed 5 percent by volume in the jet fuel with the balance (≥ 95 percent by volume) being fuel from conventional sources. The final jet fuel batch is limited to 5 percent by volume of co-hydroprocessed synthesized kerosene derived from co-hydroprocessed mono-, di-, and triglycerides, free fatty acids and fatty acid esters.

**F-2.3** Co-hydroprocessing of FT derived hydrocarbons shall include hydrocracking or hydrotreating and fractionation. Processing may also include other conventional fuel manufacturing processes. The process stream from hydrocracking or hydrotreating unit containing synthesized kerosene, where process streams are used for jet fuel production, shall not exceed 5 percent by volume in the jet fuel with the balance (≥ 95 percent by volume) being fuel from conventional sources. The final jet fuel batch is limited to 5 percent by volume of co-hydroprocessed synthesized kerosene derived from FT derived hydrocarbons.

**F-2.4** Co-processing of hydrocarbons from hydroprocessed mono-, di-, and triglycerides, free fatty acids and fatty acid esters shall include fractionation. Processing may also include other conventional fuel manufacturing processes. The feedstock shall be free of additives, except for the optional addition of an antioxidant of the type and concentration specified in **3.2.1**.

Antioxidant should be added to the feedstock and in such a way to ensure adequate mixing if significant exposure to air is expected. The process stream from the final fractionation unit containing synthesized kerosene, where process streams are used for jet production, shall not exceed 24 percent by volume with the balance (≥ 76 percent by volume) being fuel from conventional sources. The final jet fuel batch is limited to 10 percent by volume of co-processed

synthesized kerosene derived from hydroprocessed mono-, di-, and triglycerides, free fatty acids or fatty acid esters.

**F-2.5** For semi-synthetic kerosene manufactured through co-processing mono-, di- and triglycerides, free fatty acids and fatty acid esters; FT hydrocarbons; or hydrocarbons from hydroprocessed mono-, di-, and triglycerides, free fatty acids and fatty acid esters, the additional requirements as given in **F-2.5.1** to **F-2.5.3** and Table F-1 shall apply.

**F-2.5.1** An initial Management of Change (MOC) study shall be undertaken and documented for sites manufacturing semi-synthetic kerosene by co-processing of feedstock. Changes that impact the conversion process shall require an updated MOC. Specific changes that may have to be managed during initial and subsequent ongoing commercial operations include, but are not limited to, feedstock (e.g. selection, composition, pre-treatment), and hydroprocessing severity (e.g. hydrogen partial pressure, residence time, temperature, catalyst, conversion capability). Each MOC shall ensure that the cumulative processing severity is evaluated to be sufficient to convert mono-, di-, and triglycerides, free fatty acids and fatty acid esters, FT hydrocarbons or hydrocarbons from hydroprocessed mono-, di-, and triglycerides, free fatty acids and fatty acid esters to synthetic kerosene when added to any jet fuel batch.

**F-2.5.2** For semi-synthetic kerosene manufactured by co-hydroprocessed mono-, di- and triglycerides, free fatty acids and fatty acid esters or co-processed hydrocarbons from hydroprocessed mono-, di-, and triglycerides, free fatty acids and fatty acid esters the extent of conversion shall be assessed by IP 583/ASTM D7797. In addition to compliance to requirements prescribed in Table 1 and Table F-1 for the finished product, the preferred methodology for assessing conversion is comparison of ASTM D7797/IP 583 results between process unit rundown jet fuel samples prior to and during co-processing.

**F-2.5.3** The Certificate of Quality (CoQ) shall include statement to reflect that the batch may contain up to the maximum permitted co-processed synthesized kerosene as indicated. There is no requirement to list the percent volume as part of the reporting requirements as a synthetic blend component has not been added to the fuel and the percentage introduced by co-processing is not required to be determined on a batch basis.

**Table F-1 Additional Requirements of Aviation Turbine Fuels Containing Co-processed Synthesized Kerosene[(1,2)]**

(*Clause* F-2.5)

| Sl. No. | Characteristic | Requirement | Method of Test |
|---|---|---|---|
| i. | Thermal Stability | | IS 1448 (Part 97) / IP 323 / ASTM D3241[4] |
| | Test temperature for 2.5 h, ℃, *Min* | 280 | |
| | Tube Rating (any one of the following requirements shall be met) | | |
| | Annex B VTR | Less than 3<br>No Peacock (P) or Abnormal (A) | |

| | | | |
|---|---|---|---|
| | Annex C ITR or Annex D ETR, average over an area of 2.5 $mm^2$, nm, *Max* | 85 | |
| | Pressure differential, mm, *Max* | 25 | |
| ii. | Fluidity | | |
| | Freezing point, ℃, *Max* | -47 | IP 435 / ASTM D5972[4] / IP 529 / ASTM D7153 / ASTM D7154 |
| | Viscosity at -40 ℃[5], $mm^2/s$, *Max* | 12 | IS 1448 (Part 25) / IP 71 Section 1[(4,6)] / ASTM D445[6] / ASTM D7042[7] / ASTM D7945 |
| iii. | Aromatics (any one of the following requirements shall be met)[8,9] | | |
| | Aromatics, percent v/v, *Min* | 8 | IP 156[(4,10)] / ASTM D1319[10] / ASTM D8267 / ASTM D8305[11] / IS 3025 (Part 23) |
| | Aromatics, percent v/v, *Min* | 8.4 | IP 436 / ASTM D6379 |
| iv. | Volatility | | |
| | Distillation[8] | | IP 123[(4,12)] / ASTM D86[12] / IP 406 / ASTM D2887[13] / ASTM D7345[14] |
| | T50 – T10, ℃, *Min* | 15 | |
| | T90 – T10, ℃, *Min* | 40 | |
| v. | Lubricity, mm, *Max* | 0.85 | ASTM D5001 |
| vi. | Process control – Unconverted fatty acid esters and fatty acids, mg/kg, *Max* | 15 | IP 583 / ASTM D7797[15] |

NOTES:

1. Applies at the point of manufacture only.
2. Applies for the finished batch of jet fuel as opposed to the product of the manufacturing location co-processing unit which is used to blend the finished batch of jet fuel.
3. An JFTOT test temperature of 280 °C has been selected to help ensure that reactive compounds introduced through co-hydroprocessing of fatty acid esters and fatty acids are limited. Research is ongoing on the actual requirement for a more restrictive thermal stability limit. Metal Deactivator (MDA), may not be used to meet this requirement.
4. Referee method to be used in case of dispute.
5. The kinematic viscosity specification of 12.0 $mm^2/s$ at -40 °C maximum mitigates the potential risk of increased viscosity due to n-paraffin enrichment. Compared to conventional hydrocarbons, a co-processed esters and fatty acids stream may contain a higher concentration of n-paraffins. Research is ongoing on how n-paraffin enrichment from co-processed esters and fatty acids impacts low temperature viscosity. The results of that research will be used to confirm the necessity of and possible need for adjusting this requirement.

6. IP 71 Section 1 or ASTM D445 allows measuring the viscosity at minus 40 °C, however, the precision values were determined down to minus 20 °C. A revision to Test Method IP 71 and ASTM D445 to specify measurement precision at -40 °C is in process.
7. The temperature scanning procedure shall be used.
8. Applies only to co-processing hydrocarbons from hydroprocessed esters and fatty acids.
9. Minimum aromatics contents are based on current experience with semi-synthetic fuels and those levels were established from what is typical for refined jet fuel. Research is ongoing on the actual need for aromatics.
10. Due to technical issues, dyes with lot numbers 3000000975 through to 3000000982 are unacceptable for use and shall not be used in conjunction with these test methods. The lot number of the dye shall be reported on the test certificate**.**
11. Results from test method ASTM D8305 shall be bias-corrected using the bias-correction equation for total aromatics in Section 13 (Precision and Bias) of test method ASTM D8305.
12. In methods IP 123 and ASTM D86 all fuels certified to this Standards shall be classed as group 4, with a condenser temperature of zero to 4 °C.
13. IP 406 and ASTM D2887 results shall be converted to estimated IP 123 or ASTM D86 results by application of the correlation in Annex G of IP 406 or Appendix X4 on Correlation for Jet and Diesel Fuel in test method ASTM D2887.
14. Results from test method ASTM D7345 shall be corrected for relative bias as described in the method.
15. Applies to co-processing esters and fatty acids or hydrocarbons from hydroprocessed esters and fatty acids. The ability of IP 583/ASTM D7797 to identify carbonyl containing compounds in addition to FAMEs is acknowledged. The reported value may be corrected for a local sample-specific bias related to trace carbonyl species inherent in aviation turbine fuel derived from conventional sources Corrected values shall be identified as such.