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Approved by: Yang Zhenmei

China Civil Aviation Technical Standard Order

This China Civil Aviation Technical Standard Order (CTSO) is issued according to Part 37 of the China Civil Aviation Regulations (CCAR-37). Each CTSO is a criterion which the concerned aeronautical materials, parts or appliances used on civil aircraft must comply with when it is presented for airworthiness certification.

Antioxidant, Static Dissipator Additive, Anti-wear Additive and Icing Inhibitor of Civil Aviation Fuel

1. Purpose

This China Civil Aviation Technical Standard Order (CTSO) is for manufacturers applying for CTSO Authorization(CTSOA) of antioxidant, static dissipator additive, anti-wear additive and icing inhibitor of civil aviation fuel. This CTSO prescribes the minimum performance standards that additive must first meet for approval and identification with the applicable CTSO marking.

2. Applicability

This CTSO is applicable for new applications since CTSO goes into effect. Major design changes to the antioxidant, static dissipator additive, anti-wear additive and icing inhibitor of civil aviation fuel approved under this CTSO shall require a new authorization in accordance with CCAR-21.

3. Requirements

a. Performance requirements

(1) Antioxidant

(i) 2,6-ditertiary-butyl-4-methyl phenol

It shall meet the requirements of *501 Antioxidant* (SH/T 0015). Detailed technical requirements list in table 1.

Table 1 Technical Requirements for 2,6-ditertiary-butyl-4-methyl phenol

Property		Limits		Test Method
		Premium Product	Qualified Product	
Appearance		White crystal	White crystal	Visual
Initial melting point, ℃		69.0~70.0	68.5~70.0	GB/T 617
Free cresol, mass%	Max	0.015	0.03	SH/T 0015 Annex A
Ash content, mass%	Max	0.01	0.03	GB/T 508
Water, mass%	Max	0.05	0.08	GB/T 606[a)]
Flash point (closed cup), °C		Report	—	GB/T 261

a) For the determination of water, titrate 3~4 mL of solution A to the end point with solution B, no record, promptly add 1 g of sample (weighed to the nearest 0.01 g) and agitate to make the sample dissolve, titrate it with solution B to the end point.

(ii) New antioxidant

New antioxidant which not list in GB 6537-2018 shall specify chemical composition, content, physical and chemical properties limits.

New antioxidant and 2,6-ditertiary-butyl-4 methyl phenol shall be added to blank No. 3 jet fuel (see Table 2) respectively to compare the hydroperoxide number, acid value and insoluble gums according to the requirements of A2.4.5.1 of ASTM D4054-20c. The ability of the new

antioxidant to reduce the fuel oxidation rate shall not be less than 2,6-ditertiary-butyl-4-methyl phenol, see Table 2 for details.

Table 2 Antioxidant Performance Evaluation Criteria

Property	Criteria	Test Method
Hydroperoxide number, mg/kg	(Test Sample[a)]-Blank Sample[b)]) ≤ (Control Sample[c)]-Blank Sample)	ASTM D3703
Acid value, mg KOH/g		ASTM D3242 GB/T 12574
Insoluble gums, mg/100 mL		ASTM D5304
a) Test sample: Blank sample + new antioxidant; b) Blank sample: The blank of No. 3 jet fuel could be either the one with no additive and the microseparometer not less than 98, or the one subject to clay-filtering with the conductivity less than 5 pS/m and the microseparometer not less than 98. c) Control sample: Blank sample + 2,6-ditertiary-butyl-4-methyl phenol.		

(2) Static dissipator additive

(i) T1502 and Stadis 450

T1502 shall meet the requirements of *T1502 Static Dissipator Additive Specification* (YLB 21). Detailed technical requirements list in table 3. Stadis 450 has been included in GB 6537, ASTM D1655, Def Stan 91-091 and other current Chinese and international aviation jet fuel standards as well as aircraft and engine Type Certificate Data Sheets, its design and manufacture are not essential to obtain approval. For storage，transportation and into-plane fuel services, it shall meet the requirements of *Airworthiness Management for Civil Aviation fuel/Oil Suppliers and Laboratories* (CCAR-55).

Table 3 Technical Requirements for T1502 Static Dissipator Additive

Property		Limits	Test Method
Appearance		Clear amble liquid	Visual
Density(20°C), kg/m^3		880-910	GB/T 1884
Ash content, mass%	Max	0.10	GB/T 508
Infrared spectroscopy		In line with the infrared spectrum in YLB 21	YLB 21 Annex A
Accelerated storage test		Pass	YLB 21 Annex B
Microseparometer[a)]	Min	80	SH/T 0616
Electrical conductivity (20℃), pS/m	Min	200	GB/T 6539

a) Condition: The microseparometer of jet fuel distillate shall be over 95. Electrical conductivity shall be 200 pS/m ~ 350 pS/m after T1502 static dissipator additive added.
b) Condition: 1 L jet fuel distillate contains 2 mg of T1502 static dissipator additive.

(ii) New static dissipator additive

New static dissipator additive which not list in GB 6537-2018 shall specify chemical composition, content, physical and chemical properties limits.

The concentration shall not be over 3 mg/L when the electrical conductivity reaches 150 pS/m (20 ℃) by adding the new static dissipator additive to a blank No. 3 jet fuel; when the cumulative concentration of the new static dissipator additive reaches 3 mg/L, the microseparometer shall not be less than 70. Blank No. 3 jet fuel could be either the fuel with no additive(except antioxidant) and the microseparometer not less than 98, or the fuel subjected to clay-filtering with the conductivity less than 5 pS/m and the microseparometer not less than 98.

According to ASTM D4054-20c Section A2.4.5.3, improving and retaining electrical conducting performance of new static dissipator additive shall not be less than T1502 or Stadis 450, static dissipation ability shall be greater than charging ability.

(3) Anti-wear additive

(i) T1602

It shall meet the requirements of *T1602 Antiwear Additive for Jet Fuels* (SH/T 0766). Detailed technical requirements list in table 4.

Table 4 Technical Requirements for T1602 Anti-wear Additive

Property		Limits	Test Method
Naphthenic acid content, mass%	Min	85	SH/T 0092
Pure acid value, mg KOH/g	Min	220	SH/T 0092
Water, vol %	Max	1.0	GB/T 260
Iron-cobalt colorimetric, number	Max	14	GB/T 1722
Distillation range,			GB/T 6536
Initial boiling point	Min	160	
90% recovered	Max	335	
Density (20°C), kg/m^3		Report	GB/T 1884 and GB/T 1885
Efficiency index	Min	240	SH/T 0766 Annex A

(ii) New anti-wear additive

New anti-wear additive which not list in GB 6537-2018 shall specify chemical composition, content, physical and chemical properties limits.

According to ASTM D5001 or SH/T 0687, use iso-paraffin that has a boiling range of 225℃~254℃ to determine the minimum effective concentration, i.e. the minimum dose at which the wear scar diameter is

smaller than or the same as 0.65 mm. The minimum effective concentration shall not be over 20 mg/L. Other performances of the new anti-wear additive shall be verified in accordance with ASTM D4054-20c section A2.4.5.4.

(4) Icing inhibitor

(i) Diethylene glycol monomethyl ether

It shall meet the requirements of *Standard Specification for Fuel System Icing Inhibitors* (ASTM D4171). Detailed technical requirements list in table 5.

(ii) New icing inhibitor

New icing inhibitor which not list in GB 6537-2018 shall specify chemical composition, content, physical and chemical properties limits.

The new icing inhibitor shall be able to reduce the freezing point of fuel and improve the low temperature fluidity of fuel. The reduction of fuel freezing point ability shall not be less than diethylene glycol monomethyl ether.

b. Other requirements

All the chemical components and final products of the additive shall comply with the national laws and regulations on environmental protection, toxicology and safety.

Besides the improvement of specific fuel performance, the additive shall meet some of requirements in ASTM D4054, including fuel

specification, chemical composition, physical and chemical properties, electrical properties, ground operation performance, safety performance, compatibility with other approved additives and metallic/non-metallic materials of aircraft engine. New additive shall also be subject to rig test, engine test and flight test.

Table 5 Technical Requirements for Icing Inhibitor Diethylene Glycol Monomethyl Ether

Property		Limits	Test Method
Acid number, mg KOH/g	Max	0.09	ASTM D1613
Color, platinum-cobalt	Max	10	ASTM D1209
Purity, mass%	Min	99.0	ASTM D4171 Annex A1
pH of 25% solution in water(25±2℃)		5.5~7.5	ASTM E70[a)]
Relative density, 20℃/20℃		1.020~1.025	SH/T 0604 and ASTM D4052
Water, mass%			ASTM D1364
Point of manufacture	Max	0.10	
Point of use	Max	0.8	
Flash point, °C	Min	85	GB/T 261, GB/T 21929, ASTM D93, ASTM D56 and ASTM D3828
Antioxidant, mg/kg		50~150	b)

a) Pipette 25 mL of the inhibitor into a 100 mL volumetric flask and filled with freshly boiled and cooled distilled water having a pH of 6.5 to 7.5. Measure the pH value with a pH meter calibrated in accordance with Test Method E70.0.

b) The antioxidant shall be approved by CAAC.

c. Testing laboratory

All tests shall be conducted in laboratories approved by CAAC or under the supervision of CAAC.

d. Deviations

For using alternate or equivalent means of compliance to the criteria

in this CTSO, the applicant must show that the product maintains an equivalent level of safety. The applicant must apply for a deviation under the provision of section 21.368(一) in CCAR-21.

4. Marking

The quality certificate and other applicable documents of additive shall mark at least the following information:

a. Product designation/grade and standards;

b. CTSO and CTSOA number;

c. Manufacturer designation and address;

d. Manufacture date, quantity and batch number.

5. Documents Requirements

The applicant shall submit the responsible documents as follows：

a. Documents for CTSOA application according to CCAR-21;

b. Related standards or specifications;

c. Description of feedstock;

d. Documents of production process and technology;

e. Safety data sheet for chemical products (SDS);

f. Other documents required by CAAC.

6. Application Note

After obtaining CTSOA, the applicant shall obtain aircraft installation approval. If additive grade has already listed in the type certificate data

sheets (TCDS), supplemental type certificate (STC) or other design approval documents, civil aviation jet fuel is not essential for installation approval.

7. Referenced Documents

a. GB standards are available from:

Standard Press of China, No. 16, North Sanlihe Street, Fuxingmenwai, Beijing. Tel: 010-68523946.

b. SH standards are available from:

China Petrochemical Press Co., Ltd., No. 58, Andingmenwai Street, Dongcheng District, Beijing. Tel: 010-84271850.

c. YLB standards are available from:

AVIC China Aero-polytechnology Establishment, No. 7, Jingshun Road, Chaoyang District, Beijing. Tel: 010-84387036.

d. ASTM standards are available from:

ASTM, 100 Barr Harbor Drive, West Conshohocken PA 19428-2959.

(The English version is for reference only. In case of any discrepancy or ambiguity of meaning between this English translation and the Chinese version, the latter shall prevail.)