Number: CTSO-2C704
Date of approval: May 27, 2022
Approval 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.

Civil Aviation Engine Lubricating Oil

1. Purpose

This China Civil Aviation Technical Standard Order (CTSO) is for manufacturers applying for civil aviation engine lubricating oil CTSO authorization (CTSOA). This CTSO prescribes the minimum performance standards that civil aviation engine lubricating oil 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 civil aviation engine lubricating oil (hereinafter referred to as aviation lubricating oil) approved under this CTSO shall require a new authorization in accordance with CCAR-21.

Aviation lubricating oil includes civil aviation turbine engine lubricating oils (hereinafter referred to as turbine lubricating oil) and civil aviation piston engine oils containing ashless dispersant additives

(hereinafter referred to as piston lubricating oil).

3. Requirements

3.1 Turbine lubricating oil

a. Composition

Turbine lubricating oil shall be based on polyol ester base-stock chemistry, the viscosity grade shall be 5 centistoke. Organic compounds containing barium and titanium are prohibited. If a tricresyl phosphate (TCP) additive is used, the TCP additive shall contain less than 0.20% by weight in total of mono, di and tri-ortho cresyl isomers of TCP.

All chemical ingredients contained in piston lubricating oil marked by this CTSO must comply with all environmental, toxicological and safety requirements of national laws and regulations. Safety data sheet for chemical products or other appropriate documents shall be established.

b. Performance

(1) Type tests

Type tests include physical, chemical, stability, deposition, tribological properties tests as well as other additional tests shall be conducted according to the requirements of this CTSO, the test results shall meet the requirements of Annex 1.

(i) Physical properties: viscosity (-40°C, 40°C and 100°C), viscosity stability, pour point, open cup flash point, evaporation, foaming tendency and shear stability.

(ii) Chemical properties: total acid number, sediment/ash, oil compatibility, elastomer compatibility and trace metals.

(iii) Stability properties: oxidation and corrosion stability(175°C, 204°C, 218°C), thermal stability and corrosivity.

(iv) Deposition properties: dynamic coking, high temperature bearing deposition, vapor phase coking.

(v) Tribological properties: high speed gear load carrying capability.

(vi) Additional tests: acid assay, viscosity-temperature curve (-55°C, -20°C, 0°C, 70°C, 150°C, 200°C and 250°C), viscosity index, pressure-viscosity coefficient, density-temperature curve (-55°C, -20°C, 0°C, 15°C, 40°C, 70°C, 100°C, 150°C, 200°C and 250°C), heat capacity-temperature curve (-55°C, -20°C, 0°C, 15°C, 40°C, 100°C, 150°C, 200°C and 250°C), thermal conductivity-temperature curve (40°C, 100°C, 150°C, 200°C and 250°C), electrical conductivity, hydrolytic stability, oxidative stability, elastomer compatibility (1800h), high temperature tube deposition, ALTE mild wear, ALTE severe wear, thermal aging (150°C, 180°C and 225°C), particulate generation, WAM load carrying capability and elastomer compatibility (days to failure).

(2) Quality control tests

The quality control tests shall be conducted on each batch of turbine lubricating oil after type tests accomplished, including viscosity (-40°C and 40°C), pour point, open cup flash point, foaming tendency, total acid

number, sediment/ash, trace metals, oxidation and corrosion stability(204°C), thermal stability and corrosivity, dynamic coking, vapor phase coking. The test results shall meet the requirements of Annex 2.

c. Testing laboratory

All tests shall be conducted in testing 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.

3.2 Piston lubricating oil

a. Composition

All chemical ingredients contained in piston lubricating oil marked by this CTSO must comply with all environmental, toxicological and safety requirements of national laws and regulations. Safety data sheet for chemical products or other appropriate documents shall be established.

b. Performance

(1) Type tests

Type tests include physical and chemical, storage stability, single cylinder and full-size engine test shall be conducted according to the requirements of this CTSO. The test results shall meet the requirements

of Annex 3.

(i) Physical and chemical properties: viscosity (40°C and 100°C), viscosity index, open cup flash point, closed cup flash point, pour point, sulfur, low temperature pumping viscosity, low temperature cold crank simulator viscosity, high temperature high shear viscosity, acid number, density, specific gravity, ash content, trace sediment, copper strip corrosion, foaming tendency, oil compatibility, elastomer compatibility and trace metal content.

(ii) Storage stability: Fourteen-day storage test shall store the piston lubricating oil at 5±1°C and -18±1°C by daily transferring from one cold box to another for fourteen days and then checked for additive separation, deposits and unevenness in fluid texture. Six-month storage test shall store the piston lubricating oil away from light at 25±3°C for six months and then checked for flocculent, waxy or cloudy insolubles.

(iii) Single-cylinder engine test shall be conducted at least 40 hours in accordance with 3.8.1 of SAE J1899. A comparison of connecting rod bearing halves mass, viscosity and acid number, bearing halves and piston skirts (thrust and non-thrust) sides photos shall be reported.

(iv) Full-size engine test shall be conducted in accordance with SAE J1899 appendix B, including engine break in run, oil consumption run, pretest calibration run, 150-hour endurance test, post-test calibration run, sample analysis, engine disassembly and inspection. And the wear of

crankshaft main journal, connecting rod journal, crankshaft main bearing, connecting rod bearing, piston pin, piston ring, intake and exhaust valve stem and other critical engine parts, carbonaceous deposits and coking degree on the oil wetted parts, changes of viscosity, total acid number and trace metal content of the oil shall be reported.

(2) Quality control tests

The quality control tests shall be conducted on each batch of piston lubricating oil after type tests accomplished, including viscosity (40°C and 100°C), viscosity index, open cup flash point, pour point, sulfur, low temperature cold crank simulator viscosity, acid number, density, specific gravity, ash content, trace sediment, copper strip corrosion, foaming tendency and trace metal content. The test results shall meet the requirements of Annex 4.

c. Testing laboratory

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

d. Deviations

For using alternative or equivalent means of compliance to the minimum performance standards requirement in this CTSO, the applicant must show that the product maintains an equivalent level of safety. Apply for a deviation under the provision of 21.368(一) in CCAR-21R4.

4. Marking

a. The certificate of analysis and other applicable documents of aviation lubricating oil shall mark at least the following information.

(1) Brand and grade;

(2) CTSO and CTSOA number;

(3) Manufacturer designation and address;

(4) Manufacture date, quantity, batch number and expiry date;

b. Annex 3 and Annex 6 are examples of the certificate of analysis for turbine and piston lubricating oil respectively.

5. Documents requirements

The applicant shall submit the responsible documents as follows:

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

b. Description of feedstock;

c. Description of manufacturing process;

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

e. Other documents required by CAAC.

6. Application Note

After CTSOA authorization, the applicant shall obtain aircraft installation approval. If product standards have already listed in the type certificate data sheets (TCDS), supplemental type certificate (STC) or other design approval documents, the aviation lubricating oil 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. ASTM standards are available from:

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

d. DEF STAN standards are available from:

Defence Procurement Agency, An Executive Agency of The Ministry of Defence. UK Defence Standardization, Kentigern House, 65 Brown Street.

e. SAE standards are available from:

Society of Automotive Engineers, Inc. 400 Commonwealth Drive, WARRENDALE, PA 15096-001, USA.

Annex 1

Civil Aviation Turbine Engine Lubricating Oils Type Test Requirements

Property		Limits		Test Method
		SPC	HPC	
Physical Properties				
Viscosity, mm^2/s	100℃	4.9~5.4		GB/T 265 ASTM D445
	40℃	≥23.0		
	-40℃	≤13000		
Viscosity Stability，72h，-40℃，change%		≤6		GJB 1264.4 ASTM D2532
Pour Point，℃		≤-54		GB/T 3535 ASTM D97
Open Cup Flash Point，℃		≥246		GB/T 3536 ASTM D92
Evaporation，6.5h，204℃，wt change%		≤10		GB/T 7325 ASTM D972
Foaming Tendency Aerated 5min，Vol. after 1min	24℃	≤25/0		GB/T 12579 ASTM D892
	93.5℃	≤25/0		
	93.5℃/24℃	≤25/0		
Shear Stability [a]，40℃，viscosity change%		≤4		NB/SH/T 0505 ASTM D2603
Chemical Properties				
Total Acid Number，mg KOH/g		≤1.0		NB/SH/T 0946 SAE ARP5088
Sediment/Ash，mg/L	Sediment	Sediment≤10		GJB 1264.5 FED-STD-791, Method3010
	Ash	Ash≤1 Sediment≤1.0 ash content shall be waived		
	Dissolved Water	No dissolved water		
Oil Compatibility [b, c]	Sediment, mg/L	≤10		GJB 562 FED-STD-791, Method3403 Def Stan 05-50(Part 61) Method 24
	Turbidity	None		
Elastomer Compatibility，72h，swell%	Fluorocarbon, 204℃	5-25		SH/T 0436 FED-STD-791, Method 3604

Elastomer Compatibility, 24/120h, wt %	Fluorocarbon，200℃	≤10/15	≤11/15	SH/T 0436 Def Stan 05-50(Part 61) Method 22
	LCS Fluorocarbon, 200℃	≤10/20	≤12/20	
	Nitrile, 130℃	≤19.5/22	≤19/19.5	
	Silicone, 175℃	≤16.5/16.0	≤14.5/14.5	
	Perfluoroelastomer 200℃	—	≤2/2	
Trace Metals, mg/L	Al	≤2		GB/T 17476 ASTM D5185 ASTM D6595
	Fe	≤2		
	Cr	≤2		
	Ag	≤1		
	Cu	≤1		
	Sn	≤4		
	Mg	≤2		
	Ni	≤2		
	Ti	≤2		
	Si	≤10		
	Pb	≤2		
	Mo	≤3		
	Zn	≤2		
Stability Properties				
Oxidation and Corrosion Stability[d] 72h, 175℃	Viscosity Change, %	-5~15	0~10	GJB 563 FED-STD-791, Method 5308 ASTM D4636 proc 2
	TAN Change mgKOH/g	≤2.0	≤1.0	
	Sediment mg/100mL	≤50	≤25	
	Metal Wt. Change mg/cm^2 Steel Silver Aluminum Magnesium Copper	 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.4~0.4	 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.4~0.4	

Oxidation and Corrosion Stability[d] 72h, 204℃	Viscosity Change, %	-5~25	0~22.5	GJB 563 FED-STD-791, Method 5308 ASTM D4636 proc 2
	TAN Change mgKOH/g	≤3.0	≤2.0	
	Sediment mg/100mL	≤50	≤25	
	Metal Wt. Change mg/cm^2 Steel Silver Aluminum Magnesium Copper	 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.4~0.4	 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.4~0.4	
Oxidation and Corrosion Stability[d] 72h, 218℃	Viscosity Change, %	≤120	≤60	GJB 563 FED-STD-791, Method 5308 ASTM D4636 proc 2
	TAN Change mgKOH/g	≤15	≤10	
	Sediment mg/100mL	≤50	≤25	
	Metal Wt. Change mg/cm^2 Steel Silver Aluminum Titanium(2 pieces)	 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.2~0.2	 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.2~0.2	
Thermal Stability and Corrosivity 96h, 274℃	Viscosity Change, %	-5.0~5.0		GJB 1264.1 FED-STD-791, Method 3411
	TAN Change mgKOH/g	≤6.0		
	Metal Wt. Change mg/cm^2	-4.0~4.0		
Deposition Properties				
Dynamic Coking, 375℃, Deposit, mg	20h	≤4.0	≤0.4	GJB 1263A Annex C SAE ARP5996
	40h	—	≤0.6	
High Temperature Bearing Deposit [e]	Deposit Rating	≤80	≤40	FED-STD-791, Method 3410 or Alternative Method
	Filter Deposits, g	≤3.0	≤1.5	
	Oil Consumption，mL	≤2000	≤4000	
	40℃ Viscosity %	-5~30	0~35	
	TAN, mgKOH/g	≤2.0	≤2.0	
Vapor Phase Coking[f], 371 ℃ , Tube Deposit, mg		Report		GJB 1263A Annex D SAE ARP5921

Tribological Properties			
High Speed Gear Load Carrying Capability[g], 74℃		Comparative analysis with similar commercial oils	FED-STD-791, Method 6508 or Alternative Method
Additional Tests			
Acid Assay, mole%		Report	GJB 1264.2 FED-STD-791, Method 3500
Viscosity-Temperature Curve	-55℃	Report	GB/T 265 ASTM D445
	-20℃		
	0℃		
	70℃		
	150℃		
	200℃		
	250℃		
Viscosity Index	RoomTemp.~175℃	Report	GB/T 1995 ASTM D2270
Pressure-Viscosity Coefficient	40℃	Report	SAE ARP6157
	70℃		
	100℃		
	130℃		
	150℃		
Density-Temperature Curve, kg/m^3	-55℃	Report	GB/T 1884 ASTM D4052
	-20℃		
	0℃		
	15℃		
	40℃		
	70℃		
	100℃		
	150℃		
	200℃		
	250℃		
Heat Capacity-Temperature Curve	-55℃	Report	NB/SH/T 0632 ASTM E1269
	-20℃		

J/kg·℃	0℃			
	15℃			
	40℃			
	100℃			
	150℃			
	200℃			
	250℃			
Thermal Conductivity-Temperature Curve, W/m·K	40℃	Report		ASTM D2717
	100℃			
	150℃			
	200℃			
	250℃			
Electrical Conductivity, μS/cm	20℃	Report		ASTM D2624
	80℃			
Hydrolytic Stability	90℃	Report		Def Stan 05-50(Part 61) Method 6
Oxidative Stability				
Temperature Parameters, 192h	E Temp. ℃	≥185	≥190	Def Stan 05-50(Part 61) Method 9
	A Temp.℃	≥190	≥190	
	V Temp.℃	≥185	≥190	
	B Temp.℃	≥190	≥205	
	Z Temp.℃	≥190	≥210	
Effective Life, 200℃	Volat. Loss, h	≥90	—	
	Acidity loss, h	≥100	—	
	Viscosity loss, h	≥60	—	
	Insolu. Increase. ,h	≥225	—	
Effective Life, 250℃	Volat. Loss, h	≥3	≥4.9	
	Acidity loss, h	≥0.5	≥1.4	
	Viscosity loss, h	≥1.0	≥1.9	
	Insolu. Increase. ,h	≥20	≥22	
Elastomer Compatibility[h] 1800h, swell %	100℃	≤20	≤20	SH/T 0436 Safran Method
	120℃	≤20	≤20	
	140℃	No	No	

		shrinkage	shrinkage	
	160℃	No shrinkage	No shrinkage	
High Temperature Tube Deposition, 15h, 163℃	Tube Deposit, mg	Report		SAE ARP8462
	Tube Deposit Rating			
	Viscosity Change%			
	TAN Increase, mg KOH/g			
	Filter Deposits, mg			
ALTE Mild Wear, 20kg Ball load, mm		Report		SAE ARP6255
ALTE Severe Wear, Ball load, 1.5mm WSD, kg		Report		
Thermal Aging[i]				SAE ARP6299
Anti-Oxidant Content, %	150℃	Report	≥50	
	180℃	Report	≥15	
Density Change, %	150℃	Report	≤0.5	
	180℃	Report	≤1.0	
40℃ Viscosity Change, %	150℃	≤10	≤5	
	180℃	≤25	≤15	
100℃ Viscosity Change, %	150℃	≤8	≤4	
	180℃	≤15	≤10	
Acidity Change, mgKOH/g	150℃	≤8	≤2	
	180℃	≤15	≤5	
Flash Point Change, ℃	150℃	≤70	≤25	
	180℃	≤85	≤50	
Thermal Aging, 72h, 225℃	Acidity Change mgKOH/g	—	≤20	SAE ARP6299
	Flash Point Change, ℃	—	≤100	
Particulate Generation (862kPa, 329.5℃, 18h), mg		≤120		SAE ARP6223
WAM Load Carrying Capability, Load Stage		Report		SAE ARP6156
Elastomer Compatibility,	Fluorocarbon 200℃	Report		SH/T 0436

Embrittlement, Days to Failure	LCS Fluorocarbon 200℃	Report	Def Stan 05-50(Part 61) Method 22
	Nitrile, 130℃	Report	
	Silicone, 175℃	Report	
	Perfluoroelastomer 200℃	Report	
Other Requirements			

Note：

[a] When test according to NB/SH/T 0505 and ASTM D2603, shall calibrate the instrument to achieve 11.5% ± 0.5% viscosity loss to a 30 mL sample of ASTM Reference Fluid A when irradiated for 5 minutes. Using the same power setting, irradiate a 30 mL sample of the turbine lubricant for 30 minutes;

[b] When test according to GJB 562 and FED-STD-791 Method 3403, upon completion of the 168 hour oven period, the test flasks shall be stored in the dark at room temperature 24 °C ± 5 °C (75 °F ± 10 °F) for 21 days before visual inspection for turbidity;

[c] The reference oil shall be selected among the oils already be approved to use in civil aviation markets;

[d] When test according to GJB 563, FED-STD-791 Method 5308 and ASTM D4636 proc 2, the test time, temperature and test metal square shall conform to the requirements of this table, and the condenser water temperature shall be maintained at 18°C ± 2.5°C;

[e] Test duration is 100 hours for SPC oils and 200 hours for HPC oils;

[f] Except for tube deposit determination, the 40°C viscosity change% and TAN change between before and after test shall be also reported;

[h] The term, “no shrinkage”, shall be taken as meaning no reduction in the % swell of the test pieces as the test progresses;

[i] Tests are terminated at 504 hours for SPC oils and 672 hours for HPC oils and each of the degradation parameters determined. Each of the degradation parameters shall also be determined and reported after test durations of 168 and 336 hours for a 504 hour test, and 168, 336, and 504 hours for a 672 hour test by sub-sampling during the test from the reaction vessel in accordance with the method.

Annex 2

Civil Aviation Turbine Engine Lubricating Oils Quality Control Test Requirements

Property		Limits		Test Method
		SPC	HPC	
Viscosity, mm^2/s	40℃	≥23.0		GB/T 265 ASTM D445
	-40℃	≤13000		
Pour Point, ℃		≤-54		GB/T 3535 ASTM D97
Open Cup Flash Point, ℃		≥246		GB/T 3536 ASTM D92
Evaporation, 6.5h, 204℃, wt change%		≤10		GB/T 7325 ASTM D972
Foaming Tendency Aerated 5min，Vol. after 1min	24℃	≤25/0		GB/T 12579 ASTM D892
	93.5℃	≤25/0		
	93.5℃/24℃	≤25/0		
Total Acid Number, mg KOH/g		≤1.0		NB/SH/T 0946 SAE ARP5088
Sediment/Ash, mg/L	Sediment	Sediment≤10		GJB 1264.5 FED-STD-791, Method3010
	Ash	Ash≤1 Sediment≤1.0 ash content shall be waived		
	Dissolved Water	No dissolved water		
Trace Metals, mg/L	Al	≤2		GB/T 17476 ASTM D5185 ASTM D6595
	Fe	≤2		
	Cr	≤2		
	Ag	≤1		
	Cu	≤1		
	Sn	≤4		
	Mg	≤2		
	Ni	≤2		
	Ti	≤2		

	Si	≤10		
	Pb	≤2		
	Mo	≤3		
	Zn	≤2		
Oxidation and Corrosion Stability[a] 72h, 204℃	Viscosity Change, %	-5~25	0~22.5	GJB 563 FED-STD-791, Method 5308 ASTM D4636 proc 2
	TAN Change mgKOH/g	≤3.0	≤2.0	
	Sediment mg/100mL	≤50	≤25	
	Metal Wt. Change mg/cm^2 Steel Silver Aluminum Magnesium Copper	 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.4~0.4	 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.4~0.4	
Thermal Stability and Corrosivity 96h, 274℃	Viscosity Change, %	-5.0~5.0		GJB 1264.1 FED-STD-791, Method 3411
	TAN Change mgKOH/g	≤6.0		
	Metal Wt. Change mg/cm^2	-4.0~4.0		
Dynamic Coking, 375℃, Deposit, mg	20h	≤4.0	≤0.4	GJB 1263A Annex C SAE ARP5996
	40h	—	≤0.6	
Vapor Phase Coking[b], 371℃, Tube Deposit, mg		Report		GJB 1263A Annex D SAE ARP5921

Note：

[a] When test according to GJB 563, FED-STD-791 Method 5308 and ASTM D4636 proc 2, the test time, temperature and test metal square shall conform to the requirements of this table, and the condenser water temperature shall be maintained at 18°C ± 2.5°C;

b. Except for tube deposit determination, the 40°C viscosity change% and TAN change between before and after test shall be also reported.

Annex 3

Civil Aviation Turbine Engine Lubricating Oil Certificate of Analysis

(Example)

Brand: **CTOSA number:** **Manufacturer designation:** **Product quantity:** **Manufacture date:**		**Grade:** **CTSO: CTSO-2C704** **Manufacturer address:** **Batch number:** **Expiry date:**			
Property		**Limits**		**Results**	**Test Method**
		SPC	**HPC**		
Viscosity, mm^2/s	40℃	⩾23.0			GB/T 265 ASTM D445
	-40℃	⩽13000			
Pour Point, ℃		⩽-54			GB/T 3535 ASTM D97
Open Cup Flash Point, ℃		⩾246			GB/T 3536 ASTM D92
Evaporation, 6.5h, 204℃, wt change%		⩽10			GB/T 7325 ASTM D972
Foaming Tendency Aerated 5min, Vol. after 1min	24℃	⩽25/0			GB/T 12579 ASTM D892
	93.5℃	⩽25/0			
	93.5℃/24℃	⩽25/0			
Total Acid Number, mg KOH/g		⩽1.0			NB/SH/T 0946 SAE ARP5088
Sediment/Ash, mg/L	Sediment	Sediment⩽10			GJB 1264.5 FED-STD-791, Method3010
	Ash	Ash⩽1 Sediment⩽1.0 ash content shall be waived			
	Dissolved Water	No dissolved water			
Trace Metals, mg/L	Al	⩽2			GB/T 17476 ASTM D5185 ASTM D6595
	Fe	⩽2			
	Cr	⩽2			
	Ag	⩽1			
	Cu	⩽1			

	Sn	≤4			
	Mg	≤2			
	Ni	≤2			
	Ti	≤2			
	Si	≤10			
	Pb	≤2			
	Mo	≤3			
	Zn	≤2			
Oxidation and Corrosion Stability[a] 72h, 204℃	Viscosity Change, %	-5~25	0~22.5		GJB 563 FED-STD-791, Method 5308 ASTM D4636 proc 2
	TAN Change mgKOH/g	≤3.0	≤2.0		
	Sediment mg/100mL	≤50	≤25		
	Metal Wt. Change mg/cm^2 Steel Silver Aluminum Magnesium Copper	 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.4~0.4	 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.2~0.2 -0.4~0.4		
Thermal Stability and Corrosivity 96h, 274℃	Viscosity Change, %	-5.0~5.0			GJB 1264.1 FED-STD-791, Method 3411
	TAN Change mgKOH/g	≤6.0			
	Metal Wt. Change mg/cm^2	-4.0~4.0			
Dynamic Coking, 375℃, Deposit, mg	20h	≤4.0	≤0.4		GJB 1263A Annex C SAE ARP5996
	40h	—	≤0.6		
Vapor Phase Coking[b], 371℃, Tube Deposit, mg		Report			GJB 1263A Annex D SAE ARP5921

Conclusion:	**Tested by:** **Reviewed by:**	**Approved by:**

Annex 4

Civil Aviation Piston Engine Oils Containing Ashless Dispersant Additives

Type Test Requirements

Property		Multigrade Oil	Viscosity Grade				Test Method
			30	40	50	60	
Viscosity, mm^2/s	100℃	a	9.3~12.5	12.5~16.3	16.3~21.9	21.9~26.1	GB/T 265 ASTM D445
	40℃	Report	Report	Report	Report	Report	
Viscosity Index		≥100	≥100	≥100	≥95	≥95	GB/T 1995 GB/T 2541 ASTM D2270
Open Cup Flash Point, ℃		≥220	≥220	≥225	≥243	≥243	GB/T 3536 ASTM D92
Closed Cup Flash Point, ℃		Report	Report	Report	Report	Report	GB/T 261 ASTM D93
Pour Point, ℃		—	≤-24	≤-22	≤-18	≤-18	GB/T 3535 ASTM D97 ASTM D5949 ASTM D5950 ASTM D5985
Sulfur, wt%		≤0.6	≤0.6	≤0.8	≤1.0	≤1.2	GB/T 17476 SH/T 0689 ASTM D129 ASTM D1552 ASTM D2622 ASTM D4951 ASTM D5185
Low Temperature Pumping Viscosity, mPa•s		a	—	—	—	—	GB/T 9171 ASTM D4684
Low Temperature Cold Crank Simulator Viscosity, mPa•s		a	—	—	—	—	GB/T 6538 ASTM D5293
High Temperature High Shear Viscosity, 150℃, mPa•s		a	2.9	3.7	3.7	3.7	SH/T 0618 ASTM D4683 ASTM D4741 ASTM D5481
Acid Number [b], mgKOH/g		≤1.0					GB/T 7304 ASTM D664
Density, 15℃, g/mL		Report					SH/T 0604 ASTM D4052
Specific Gravity, 60℉, °API		Report					SH/T 0604 ASTM D1298 ASTM D4052
Ash Content, wt%		≤0.011					GB/T 508 ASTM D482
Trace Sediment, mL/100mL		≤0.005					ASTM D2273
Copper Strip Corrosion [c], 3h	100℃	≤1					GB/T 5096 ASTM D 130
	204℃	≤3					
Foaming Tendency Aerated 5min,	24℃	≤50/0					GB/T 12579 ASTM D 892
	93.5℃	≤50/0					

Vol. after 10min, mL	93.5℃/24℃	≤50/0	
Oil Compatibility[d]		pass	GJB 562 ASTM D6922
Elastomer Compatibility[e],72h, swell%	Nitrile , 70℃	-5~10	SH/T 0436 FED-STD-791, Method 3604
	Fluoroelastomer 150℃	-5~5	
	Fluorosilicone 150℃	-5~5	
	Silicone 121℃	0~20	
Trace Metal Content, mg/L	Al	≤7	GB/T 17476 ASTM D5185
	Fe	≤5	
	Cr	≤5	
	Ag	≤2	
	Cu	≤3	
	Sn	≤10	
	Mg	≤3	
	Ni	≤3	
	Ti	≤2	
	Si	≤25	
	Pb	≤5	
	Mo	≤4	
	Zn	≤10	
Storage Stability	Fourteen-day storage test -18℃ and 5℃	No additive separation, deposits and flow unevenness	SAE J1899 第4.5.1条
	Six-month storage test 25℃, away from light	No flocculent, waxy or cloudy insolubles	
Single-Cylinder Engine Test	40h, 135℃	Mass loss of connecting rod bearing halves, viscosity (40℃ and 100℃) and acid number change before and after the test, photos of bearing halves and piston skirts (thrust and non-thrust) sides	SAE J1899 第3.8.1条
Full Size Engine Test	Engine break in	No abnormal wear of crankshaft main journal, connecting rod journal, crankshaft main bearing, connecting rod bearing, piston pin, piston ring, intake and exhaust valve stem and other critical engine parts, and no abnormal phenomenon of carbonaceous deposits and coking degree on the oil wetted parts, and changes of viscosity, TAN and trace metal content of the oil.	SAE J1899 附录B
	Oil consumption		
	Pretest calibration		
	150-hour endurance test		
	post-test calibration run		

Note:

[a] Oil shall meet the viscosity requirements of GB/T 14906 or SAE J 300 for the designated grade；

[b] Titrate to a pH 11 end point；

[c] Test temperature shall satisfy the requirements of this table when use GB/T 5096 or ASTM D130；

[d] The reference oil shall be selected among the oils already be approved to use in civil aviation markets;

[e] Test procedures shall be conducted according to SH/T 0436, FED-STD-791 Method3604, and the test temperature shall conform to the requirements of this table.

Annex 5

Civil Aviation Piston Engine Oils Containing Ashless Dispersant Additives

Quality Control Test Requirements

Property		Multigrade Oil	Viscosity Grade				Test Method
			30	40	50	60	
Viscosity, mm^2/s	100℃	a	9.3~12.5	12.5~16.3	16.3~21.9	21.9~26.1	GB/T 265 ASTM D445
	40℃	Report	Report	Report	Report	Report	
Viscosity Index		≥100	≥100	≥100	≥95	≥95	GB/T 1995 GB/T 2541 ASTM D2270
Open Cup Flash Point, ℃		≥220	≥220	≥225	≥243	≥243	GB/T 3536 ASTM D92
Pour Point, ℃		—	≤-24	≤-22	≤-18	≤-18	GB/T 3535 ASTM D97 ASTM D5949 ASTM D5950 ASTM D5985
Sulfur, wt%		≤0.6	≤0.6	≤0.8	≤1.0	≤1.2	GB/T 17476 SH/T 0689 ASTM D129 ASTM D1552 ASTM D2622 ASTM D4951 ASTM D5185
Low Temperature Cold Crank Simulator Viscosity, mPa•s		a	—	—	—	—	GB/T 6538 ASTM D5293
Acid Number [b], mgKOH/g		≤1.0					GB/T 7304 ASTM D664
Density, 15℃, g/mL		Report					SH/T 0604 ASTM D4052
Specific Gravity, 60℉, °API		Report					SH/T 0604 ASTM D1298 ASTM D4052
Ash Content, wt%		≤0.011					GB/T 508 ASTM D482
Trace Sediment, mL/100mL		≤0.005					ASTM D2273
Copper Strip Corrosion [c], 3h	100℃	≤1					GB/T 5096 ASTM D 130
	204℃	≤3					
Foaming Tendency Aerated 5min, Vol. after 10min, mL	24℃	≤50/0					GB/T 12579 ASTM D 892
	93.5℃	≤50/0					
	93.5℃/24℃	≤50/0					
Trace Metal Content, mg/L	Al	≤7					GB/T 17476 ASTM D5185
	Fe	≤5					
	Cr	≤5					
	Ag	≤2					
	Cu	≤3					
	Sn	≤10					
	Mg	≤3					

	Ni	≤3	
	Ti	≤2	
	Si	≤25	
	Pb	≤5	
	Mo	≤4	
	Zn	≤10	

Note:

[a] Oil shall meet the viscosity requirements of GB/T 14906 or SAE J 300 for the designated grade;

[b] The sulfur content shall be within ±0.15% mass of the qualification value;

[c] Titrate to a pH 11 end point;

[d] Test temperature shall satisfy the requirements of this table when use GB/T 5096 or ASTM D130.

Annex 6

Civil Aviation Piston Engine Oils Containing Ashless Dispersant Additives

Certificate of Analysis (Example)

Brand:	**Grade:**
CTOSA number:	**CTSO: CTSO-2C704**
Manufacturer designation:	**Manufacturer address:**
Product quantity:	**Batch number:**
Manufacture date:	**Expiry date:**

Property **Multigrade oil**			**Viscosity Grade**				**Results**	**Method**
			30	40	50	60		
Viscosity, mm^2/s	100℃	a	9.3~12.5	12.5~16.3	16.3~21.9	21.9~26.1		GB/T 265 ASTM D445
	40℃	Report	Report	Report	Report	Report		
Viscosity Index		≥100	≥100	≥100	≥95	≥95		GB/T 1995 GB/T 2541 ASTM D2270
Open Cup Flash Point, ℃		≥220	≥220	≥225	≥243	≥243		GB/T 3536 ASTM D92
Pour Point, ℃		—	≤-24	≤-22	≤-18	≤-18		GB/T 3535 ASTM D97 ASTM D5949 ASTM D5950 ASTM D5985
Sulfur, wt%		≤0.6	≤0.6	≤0.8	≤1.0	≤1.2		GB/T 17476 SH/T 0689 ASTM D129 ASTM D1552 ASTM D2622 ASTM D4951 ASTM D5185
Low Temperature Cold Crank Simulator Viscosity, mPa•s		a	—	—	—	—		GB/T 6538 ASTM D5293
Acid Number [b], mgKOH/g		≤1.0						GB/T 7304 ASTM D664
Density, 15℃, g/mL		Report						SH/T 0604 ASTM D4052
Specific Gravity, 60℉, °API		Report						SH/T 0604 ASTM D1298 ASTM D4052
Ash Content, wt%		≤0.011						GB/T 508 ASTM D482
Trace Sediment, mL/100mL		≤0.005						ASTM D2273
Copper Strip Corrosion [c], 3h	100℃	≤1						GB/T 5096 ASTM D 130
	204℃	≤3						
Foaming Tendency Aerated 5min, Vol. after 10min, mL	24℃	≤50/0						GB/T 12579 ASTM D 892
	93.5℃	≤50/0						
	93.5℃/24℃	≤50/0						
Trace Metal	Al	≤7						GB/T 17476

Content, mg/L	Fe	⩽5		ASTM D5185
	Cr	⩽5		
	Ag	⩽2		
	Cu	⩽3		
	Sn	⩽10		
	Mg	⩽3		
	Ni	⩽3		
	Ti	⩽2		
	Si	⩽25		
	Pb	⩽5		
	Mo	⩽4		
	Zn	⩽10		

Conclusion:	**Tested by:** **Reviewed by:**	**Approved by:**

(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.)