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Space systems — Fluid characteristics, sampling and test methods —

Part 8: Kerosine propellant

Systèmes spatiaux — Caractéristiques, échantillonnage et méthodes d'essai des fluides —

Partie 8: Kérosène (carburant)

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15859-8 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

ISO 15859 consists of the following parts, under the general title *Space systems — Fluid characteristics, sampling and test methods*:

- *Part 1: Oxygen*
- *Part 2: Hydrogen*
- *Part 3: Nitrogen*
- *Part 4: Helium*
- *Part 5: Nitrogen tetroxide propellants*
- *Part 6: Monomethylhydrazine propellant*
- *Part 7: Hydrazine propellant*
- *Part 8: Kerosine propellant*
- *Part 9: Argon*
- *Part 10: Water*
- *Part 11: Ammonia*
- *Part 12: Carbon dioxide*
- *Part 13: Breathing air*

Introduction

Fluid operations at a spaceport or launch site may involve a number of operators and supplier/customer interfaces, from the fluid production plant to the delivery to the launch vehicle or spacecraft. The purpose of ISO 15859 is to establish uniform requirements for the components, sampling and test methods of fluids used in the servicing of launch vehicles, spacecraft and ground support equipment. The fluid composition limits specified are intended to define the purity and impurity limits of the fluid for loading into the launch vehicle or spacecraft. The fluid sampling and test methods are intended to be applied by any operator. The fluid sampling and test methods are acceptable methods for verification of the fluid composition limits.

Space systems — Fluid characteristics, sampling and test methods —

Part 8: Kerosine propellant

1 Scope

This part of ISO 15859 specifies limits for the composition of kerosine and establishes the sampling and test requirements applicable for the verification of the kerosine composition.

This part of ISO 15859 is applicable to kerosine propellant intended for use in fuel in propellant systems of space systems as well as in both flight hardware and ground support facilities, systems and equipment. It may be applied to influent or effluent kerosine.

This part of ISO 15859 is applicable to any sampling operation required to ensure that, when the fluid enters the launch vehicle or spacecraft, the fluid composition complies with the limits provided hereafter or with any technical specification agreed to for a particular use.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3012, *Petroleum products — Determination of thiol (mercaptan) sulfur in light and middle distillate fuels — Potentiometric method*

ISO 3014, *Petroleum products — Determination of the smoke point of kerosine*

ISO 9000, *Quality management systems — Fundamentals and vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9000 and the following apply.

3.1
particulate matter
undissolved solids retained on a filter paper with a 10-µm nominal and 40-µm absolute rating

3.2
verification test
analysis performed on the fluid in the container, or a sample thereof, which is representative of the supply, permitting the verification of fluid composition limits

4 Chemical composition and chemical and physical properties

4.1 Chemical composition

Unless otherwise provided in an applicable technical specification, the chemical composition of kerosine propellant delivered to the flight vehicle interface shall be in accordance with the limits given in Table 1 when tested in accordance with the applicable test methods.

Table 1 — Composition limits

Component		Limit
Existent gum	mg/100 ml, max.	7
Potential gum, 16 h aging	mg/100 ml, max.	14
Sulfur	Total mass fraction, %, max.	0,05
Mercaptan-sulfur	Mass fraction, %, max.	0,005[a]
Aromatics	Volume fraction, %, max.	5,0
Olefins	Volume fraction, %, max.	2,0
Particulate matter	mg/l, max	1,5

[a] The mercaptan-sulfur determination may be waived at the option of the customer if the fuel is considered "sweet."

4.2 Chemical and physical properties

The propellant shall be a clear and bright homogeneous liquid when examined visually by transmitted light. Unless otherwise provided in an applicable technical specification, the chemical and physical properties of kerosine propellant delivered to the flight vehicle interface shall be in accordance with the limits given in Table 2 when tested in accordance with the applicable test methods.

Table 2 — Chemical and physical properties

Property			Limit
Distillation	Initial boiling point		a
	Fuel evaporated, 10 %		185 °C to 210 °C
	Fuel evaporated, 50 % at °C		a
	Fuel evaporated, 90 % at °C		a
	End point, max.		274 °C
	Residue, volume fraction, %, max.		1,5
	Distillation loss, volume fraction, %, max.		1,5
Specific gravity		max.	0,815
		min.	0,801
Freezing point		°C, max.	–37,8
Thermal value: Net heat of combustion		MJ/kg, min.	43,031
Viscosity		mm^2/s at –34,4 °C, max.	16,5
Smoke point		mm, min.	25,0
Copper strip corrosion		max.	a
Water reaction			b
Flashpoint		min.	43,3 °C
Aniline point		°C	a
Copper corrosion test for 3 h at 100 °C			a

[a] To be reported; not limited.
[b] See 4.3 for requirements.

4.3 Water reaction

When tested as specified in Table 1 and Clause 7, the propellant shall separate sharply from the water layer. In addition, neither layer shall change in volume by more than 1 ml.

4.4 Additives

4.4.1 Type and amount

The additives listed in this clause may be used singly or in combination, in amounts which shall not exceed those specified. No substance of known dangerous toxicity under usual conditions of handling and use shall be added except as specified herein. The type and amount of each additive used shall be reported.

4.4.2 Antioxidants

The following active inhibitors may be added separately or in combination to the propellant in total concentration not in excess of 9 g of inhibitor (not including mass of solvent) per 375 l of fuel in order to prevent the formation of gum:

a) 2,6-ditertiarybutyl-4-methyl phenol;

b) *N*,*N*′-disecondarybutyl paraphenylenediamine;

c) 2,4-dimethyl-6-tertiarybutyl phenol;

d) 2,6-ditertiarybutyl phenol.

4.4.3 Metal deactivator

A metal deactivator, *N*,*N*′-disalicylidene-1,2-propanediamine, may be added in an amount which shall not exceed 2,1 g of active ingredient per 375 l of fuel.

4.4.4 Dye

A dye, methyl derivative of azobenzene-4-azo-2-naphthol, may be added in an amount which shall not exceed 14 g per 3 750 l of fuel.

5 Procurement

The kerosine specified in Clause 1 should be procured in accordance with an applicable national standard.

6 Fluid sampling

CAUTION — Kerosine propellant is a combustible liquid and a fire hazard. Care should be taken in the handling and storage of kerosine propellant to prevent contact with ignition sources. Harmful if swallowed and/or aspirated into the lungs. Can cause skin irritation upon prolonged or repeated contact.

6.1 Plan

In order to ensure that the fluid composition complies with the limits specified in this part of ISO 15859, a fluid sampling plan should be established by all the involved operators, from the production to the space vehicle interface, and approved by the final user. Sampling activities and test methods shall comply with all safety regulations and rules applicable to that task. This plan shall specify

— the sampling points,

— the sampling procedures,

— the sampling frequency,

— the sample size,

— the number of samples,

— the test methods, and

— the responsibilities of any involved operator.

6.2 Responsibility for sampling

Unless otherwise provided in an applicable technical specification, the kerosine delivered to the flight vehicle interface shall be sampled and verified by the supplier responsible for providing the kerosine to the flight vehicle. The supplier may use his/her or any other resources suitable for the performance of the verification tests specified herein unless otherwise directed by the customer.

6.3 Sampling points

Unless otherwise specified, sampling shall be conducted at the fluid storage site.

6.4 Sampling frequency

Sampling shall be performed annually or in accordance with a time agreed upon by the supplier and the customer.

6.5 Sample size

The quantity in a single sample container shall be sufficient to perform the analysis for the limiting characteristics. If a single sample does not contain a sufficient quantity to perform all of the analyses for the required quality verification test, additional samples shall be taken under similar conditions.

6.6 Number of samples

The number of samples shall be in accordance with one of the following:

a) one sample per storage container;

b) any number of samples agreed upon by the supplier and the customer.

6.7 Storage container

Unless otherwise provided by the applicable sampling plan, the fluid storage container shall not be refilled after the sample is taken.

6.8 Liquid samples

Liquid samples shall be a typical specimen from the liquid kerosine supply. Samples shall be obtained in accordance with one of the following.

a) By filling the sample container and storage containers at the same time, on the same manifold, and under the same conditions and with the same procedures.

b) By withdrawing a sample from the supply container through a suitable connection into the sample container. No pressure regulator shall be used between the supply and the sample containers. (Suitable purge and drain valves are permissible.) For safety reasons, the sample container and sampling system shall have a rated service pressure at least equal to the pressure in the supply container.

c) By connecting the container being sampled directly to the analytical equipment using suitable pressure regulation to prevent overpressurizing this equipment.

6.9 Rejection

When any sample of the fluid tested in accordance with Clause 7 fails to conform to the requirements specified in this part of ISO 15859, the fluid represented by the sample shall be rejected. Disposal of the rejected fluid shall be specified by the customer.

7 Test methods

7.1 General

The supplier will ensure, by standard practice, the quality level of kerosine. If required, alternate test methods are described in 7.3 to 7.19. Other test methods not listed in this part of ISO 15859 are acceptable if agreed upon between the supplier and the customer.

These tests are a single analysis or a series of analyses performed on the fluid to ensure the reliability of the storage facility to supply the required quality level. This can be verified by analysis of representative samples of the fluid from the facility at appropriate intervals as agreed upon between supplier and the customer. Tests may be performed by the supplier or by a laboratory agreed upon between the supplier and the customer.

The analytical requirements for the tests shall include the determination of all limiting characteristics of kerosine.

7.2 Parameters of analysis

The parameters for analytical techniques contained in 7.3 to 7.19 are the following:

a) calibration of gas standards containing the applicable gaseous components may be required to calibrate the analytical instruments used to determine the limiting characteristic levels of fluid;

b) if required by the customer, the accuracy of the measuring equipment used in preparing these standards shall be traceable to an established institute for standards;

c) analytical equipment shall be operated in accordance with the manufacturer's instructions.

7.3 Kerosine distillation

The kerosine shall be distilled by using a 100 ml sample under prescribed conditions that are appropriate to its nature. Systematic observations of thermometer readings and volumes of condensate are made, and from these data the results of the test are calculated and reported.