



DPC: 24/30461485 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 09 October 2024

Origin: International

Latest date for receipt of comments: 02 December 2024

Project No. 2022/01943

Responsible committee: ACE/68 Space systems and operations

Interested committees:

Title: Draft BS ISO 17540 Space systems - Liquid rocket engines and test stands - Terms and definitions.

Please notify admin.start@bsigroup.com if you are aware of any keywords that might assist in clarifying or identifying the standard or of the content of this standard:

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD. THIS DRAFT IS NOT CURRENT BEYOND 02 December 2024

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <https://standardsdevelopment.bsigroup.com/>.

E-mail: admin.start@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 17540

Space systems — Liquid rocket engines and test stands — Terms and definitions

*Systèmes spatiaux — Moteurs de fusée liquides et stands d'essai
— Termes et définitions*

ICS: 01.040.49; 49.140

ISO/TC 20/SC 14

Secretariat: **ANSI**

Voting begins on:
2024-10-09

Voting terminates on:
2025-01-01

This document is circulated as received from the committee secretariat.

THIS DOCUMENT IS A DRAFT CIRCULATED FOR COMMENTS AND APPROVAL. IT IS THEREFORE SUBJECT TO CHANGE AND MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

Reference number
ISO/DIS 17540:2024(en)

Full document details: 24/30461485 DC

© ISO 2024  **Documents**
Document Sharing Hub



COPYRIGHT PROTECTED DOCUMENT

© ISO 2024

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
3.1 General	1
3.2 Major engine units	2
3.3 Engine cycle types	2
3.4 Engine types by reusability and multiple-firing capability	2
3.5 Engine types by purpose	3
3.6 Low-thrust engines by cycle types	3
3.7 Basic parameters and performance characteristics of the engine	4
3.8 Engine time characteristics, types of operating time and operating life	6
3.9 Low-thrust engine performance characteristics	7
3.10 Engine operating modes	8
3.11 Low-thrust engine operation modes	9
3.12 Combustion chamber (gas generator) components	10
3.13 Gas generator types	11
3.14 Chamber (gas generator) cycle	11
3.15 Engine nozzle types	13
3.16 Nozzle components	14
3.17 Nozzle characteristics	15
3.18 Nozzle operation modes	15
3.19 Nozzle flows	15
3.20 Turbopump: components	16
3.21 Pump characteristics	17
3.22 Turbopump performance characteristics	18
3.23 Engine control devices	18
3.24 Devices and methods to create the engine steering efforts	18
3.25 Engine cooling	19
3.26 Engine thermal protection	19
3.27 Engine test: general	20
3.28 Engine test types: thermal loads	20
3.29 Engine test types: by connection with the vehicle being moved	20
3.30 Engine test types: by test site	20
3.31 Engine test types: by organizational factor and test site	21
3.32 Engine test types: by test conditions	21
3.33 Engine test types: by accelerated data acquisition	21
3.34 Engine test types: by test purpose	21
3.35 Types of tests, specific for low-thrust engines	22
3.36 Engine test procedures	22
3.37 Engine test conditions	23
3.38 Test results	23
3.39 Engine reliability	24
3.40 Engine defects	24
3.41 Engine failure modes	24
3.42 Engine operation	25
3.43 Engine health analysis	25
3.44 Engine reliability factors	26
3.45 Engine quality control	26
3.46 Structural and functional analysis of the engine reliability	26
3.47 Test stands: general	27
3.48 Test stand types	27
3.49 Stand systems	28

3.50	Post-test processing systems.....	29
3.51	Stand systems devices and components	29
3.52	stand room.....	31
Annex A (informative) Letter Symbols.....		32

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

This second edition cancels and replaces the first edition (ISO 17540:2016), which has been technically revised.

The main changes are as follows:

- a number of terms are revised, including such terms as "rocket engine", "liquid rocket propulsion system", "high-altitude firing test", etc.
- definitions are revised in terms of redundancy and presence of general terms definitions in the document. Redundant terms are deleted.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is intended to be applied for all types of rocket engines, which use liquid propellant.

The terms used in this document address design, tests, reliability analysis and quality control of liquid rocket engines.

The terms are to be used in all types of documentation and subject-matter literature, related to standardization or use of the results of field-specific works.

Space systems — Liquid rocket engines and test stands — Terms and definitions

1 Scope

This document provides terms and definitions for design, tests, reliability analysis and quality control of liquid rocket engines. The terms are to be used in all types of documentation and subject-matter literature, related to standardization or use of the results of field-specific works.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 General

3.1.1

rocket engine

RE

reaction engine that contains within itself, or carry along with itself, all the substances necessary for its operation or for the consumption or combustion of its fuel, not requiring of any outside substance

3.1.2

liquid rocket engine

LRE

rocket engine (3.1.1), which uses liquid propellant

3.1.3

low-thrust liquid rocket engine

LTE

liquid rocket engine (3.1.2), which is used as a final-control element of the control system of spacecraft and descent vehicles for acceleration, attitude, stabilization, correction, rendezvous, mooring, docking, braking, descent, landing and other maneuvering operations of spacecraft, as well as for imparting acceleration for the purpose of creating gravity

3.1.4

liquid rocket propulsion system

liquid rocket propulsion system, consisting of *LRE* (3.1.2), propellant tanks, propellant (propellants) feeding system, thrust vector control system and engine control system

3.1.5

clustered liquid rocket propulsion system

liquid rocket propulsion system (3.1.4), consisting of *rocket engines* (3.1.2) of various applications, which are fed from common propellant tanks, but have autonomous (independent) propellant feed systems

3.1.6**pressure-fed system**

propellants feed to the *chamber* (3.2.1) and (or) *gas generator* (3.2.4) by their expulsion from propellant tanks

3.2 Major engine units**3.2.1****chamber**

engine unit (assembly) where propellant and/or exhaust gas of the gas generator is converted by chemical reactions into combustion products, which, when expelled, generate *reaction force* (3.7.9)

3.2.2**turbopump****TPU**

engine unit (component), designed to pump propellant into the *chamber* (3.2.1), *gas generator* (3.2.4) and *engine control devices* and consisting of *pumps* (3.20.1) and the driving *turbines* (3.20.5)

3.2.3**booster turbopump****BTPU**

auxiliary *turbo-pump* (3.2.2) of the engine designed to increase propellant pressure in the pipelines downstream of the engine *pumps* (3.20.1)

3.2.4**gas generator**

engine unit (component), where propellant is converted by chemical reactions into exhaust gas

3.3 Engine cycle types**3.3.1****closed cycle**

engine (3.1.2), where exhaust gas of the gas generator, after having been used to drive the *turbo-pump* (3.2.2), is fed to the *chamber* (3.2.1)

3.3.2**open-cycle engine**

engine (3.1.2), where exhaust gas of the gas generator, after having been used to drive the *turbo-pump* (3.2.2), is released into the environment

Note 1 to entry: *open-cycle engine* (3.3.2) is pump-fed or *pressure-fed* (3.1.6)

3.4 Engine types by reusability and multiple-firing capability**3.4.1****expendable engine**

engine (3.1.2), designed for a single use as intended

3.4.2**reusable engine**

engine (3.1.2), designed for multiple use as intended

3.4.3**single-start engine**

engine (3.1.2), which performs a single firing during one use as intended

3.4.4**multiple-start engine**

engine (3.1.2), which performs multiple firings during one use as intended

3.5 Engine types by purpose

3.5.1

main engine

engine ([3.1.2](#)), designed to accelerate the vehicle being moved

3.5.2

correction engine

engine ([3.1.2](#)), designed to change the velocity when correcting the trajectory of the space vehicle being moved during the coasting flight

3.5.3

control engine

engine ([3.1.2](#)), designed to control the velocity vector of the space vehicle being moved during the powered phase

3.5.4

retrorocket engine

engine ([3.1.2](#)), designed to reduce the velocity of the space vehicle being moved

3.6 Low-thrust engines by cycle types

3.6.1

catalytic LTE

LTE ([3.1.3](#)), where propellant is converted into gaseous chemical reaction products using a catalyst

3.6.2

thermo-catalytic LTE

catalytic LTE ([3.6.1](#)), where the catalyst is heated by the external heat source

3.6.3

electro-thermo-catalytic engine

thermos-catalytic LTE ([3.6.2](#)), which uses an electrical power source

3.6.4

radio-thermo-catalytic LTE

thermos-catalytic LTE ([3.6.2](#)), which uses a radioactive power source

3.6.5

thermal LTE

LTE ([3.1.3](#)), where propellant is externally heated to convert the propellant into chemical reaction gaseous products and increase their exhaust velocity

Note 1 to entry: Power is supplied to the propellant or products of chemical reactions

3.6.6

electro-thermal LTE

thermal LTE ([3.6.5](#)), which uses an electrical power source

3.6.7

radio-thermal LTE

thermal LTE ([3.6.5](#)), which uses a radioactive power source

3.6.8

electrolytic LTE

monopropellant *LTE* ([3.1.3](#)), where the electrolysis of the propellant is part of the engine cycle

3.6.9

throttleable LTE

LTE ([3.1.3](#)), which has a throttling device (throttle, [3.7.10](#))

3.7 Basic parameters and performance characteristics of the engine

3.7.1

rated engine performance

nominal engine performances, specified in the specification

3.7.2

mass flow rate (oxidizer, fuel)

mass of propellant (fuel, oxidizer) passing through a corresponding feed line or valve per unit of time

3.7.3

volume flow rate (oxidizer, fuel)

volume of propellant (fuel, oxidizer) passing through a corresponding feed line or valve per unit of time

3.7.4

prestart flow rate

propellants mass flow rate (3.7.2) during the period of time, starting from the moment the first firing command is given until the *thrust* (3.7.10) builds up to the value, equal to 5 % of the nominal thrust

3.7.5

engine (combustion chamber, gas generator) mass mixture ratio

ratio of oxidizer *mass flow rate* (3.7.2) during the firing of the engine (*chamber* (3.2.1), *gas generator* (3.2.4)) to the fuel mass flow rate

3.7.6

engine (combustion chamber, gas generator) volume mixture ratio

ratio of oxidizer *volume flow rate* (3.7.3) during the firing of the engine (*chamber* (3.2.1), *gas generator* (3.2.4)) to the fuel volume flow rate

3.7.7

chamber (gas generator) pressure

average static pressure of combustion products (exhaust gas of the gas generator) at the entry section of the combustion *chamber* (3.12.1) near the mixing unit of the chamber (*gas generator*) (3.12.2)

3.7.8

propellant combustion products exhaust velocity

exhaust velocity

exhaust flow velocity at the *nozzle* (3.12.12) exit of the engine, determined in a one-dimensional approximation

3.7.9

engine (chamber) reaction force

resultant of gas flow and fluid flow forces, acting on the inner surfaces of the engine (chamber) when combustion products are exhausted

3.7.10

engine (chamber) thrust

result of the *engine (chamber) reaction force* (3.7.9) and the ambient pressure forces acting on the engine (chamber) external surfaces, excluding external aerodynamic drag forces

3.7.11

engine (chamber) thrust impulse

time integral of *engine (chamber) thrust* (3.7.10)

3.7.12

cut-off impulse

engine thrust impulse (3.7.11) for the time interval, determining the *engine tail-off* (3.10.8)

3.7.13**engine (chamber) specific impulse**

ratio of *engine (chamber) thrust* (3.7.10) to the *propellant mass flow rate* (3.7.2) of the engine (chamber) ($I_s = R / \dot{m}$)

Note 1 to entry: Thrust *engine (chamber) specific impulse* (3.7.13) is determined in vacuum and at sea level.

Note 2 to entry: Thrust *engine (chamber) specific impulse* (3.7.13) also equals the derivative of the *thrust engine (chamber) impulse* (3.7.11) with respect to mass or volume of the usable propellant.

Note 3 to entry: for *LTE* (3.1.3) the term “specific impulse” is used for steady-state continuous mode, *single firings mode* (3.11.6) and the *steady-state impulse mode* (3.11.3).

3.7.14**engine (chamber) volume specific impulse**

ratio of the *engine (chamber) thrust* (3.7.10) to the *propellant volume flow rate* (3.7.3) of the engine (chamber) ($I_{s,V} = R / \dot{V}$)

Note 1 to entry: *engine (chamber) volume specific impulse* (3.7.14) also equals the derivative of the *engine (chamber) thrust impulse* (3.7.11) with respect to the volume of usable propellant.

3.7.15**chamber thrust coefficient**

ratio of the chamber *thrust* (3.7.10) to the product of combustion products stagnation pressure in the *nozzle throat* (3.16.8) and the area of the throat and the *nozzle flow coefficient* (3.7.21)

3.7.16**coefficient of the chamber specific impulse**

ratio of the actual *chamber specific impulse* (3.7.13) in vacuum to the ideal (design) *value* (3.7.25), defined by the same values of *mixture ratio* (3.7.5), *chamber pressure* (3.7.7) and geometrical expansion ratio of a *nozzle* (3.17.1)

3.7.17**overall coefficient of chamber thrust specific impulse**

coefficient of chamber *thrust specific impulse* (3.7.16), defined at the *mixture ratio* (3.7.5), corresponding to the maximum ideal (design) *value* (3.7.25)

3.7.18**chamber flow rate product****flow rate product**

product of the combustion pressure in a given section of the *chamber* (3.2.1) and the *nozzle throat area*, (3.16.8), referred to the *propellant mass flow rate* (3.7.2) in the chamber

Note 1 to entry: Given section of the *chamber* (3.2.1) is:

- entry section of the *combustion chamber* (3.12.2) near *mixing unit* (3.12.1), when analyzing stability of chamber characteristics during full production
- entry section of the *nozzle* (3.16.7), when analyzing multiphase *flows* (3.19.4).

3.7.19**thrust ratio**

ratio of the chamber *thrust* (3.7.10) to the product of combustion products in a given section of the *chamber* (3.2.1) and the area of the *nozzle throat* (3.16.8) ($K_{R_{ch}} = R_{ch} / P_{ch} \cdot A_{thr}$).

Note 1 to entry: Thrust ratio also equals the ratio of the *chamber-specific impulse* (3.7.13) to the *flow rate product* (3.7.18)

3.7.20**coefficient of the flow rate product**

ratio of the engine chamber actual *flow rate product* (3.7.18) to the ideal (design) (3.7.25), defined at the same values of the *mixture ratio* (3.7.5) and propellant pressure in the chamber