

BS ISO 17540:2016



BSI Standards Publication

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

National foreword

This British Standard is the UK implementation of ISO 17540:2016.

The UK participation in its preparation was entrusted to Technical Committee ACE/68, Space systems and operations.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2016.
Published by BSI Standards Limited 2016

ISBN 978 0 580 82528 6

ICS 49.140

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2016.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

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

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



COPYRIGHT PROTECTED DOCUMENT

© ISO 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, 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
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Terms and definitions	1
2.1 General.....	1
2.2 Engine units.....	1
2.3 Engine types by way of work process.....	2
2.4 Engine types by multiplicity of use and integration.....	2
2.5 Engine types by purpose.....	2
2.6 Low-thrust engine types by way of work process.....	3
2.7 General parameters and performance of engine.....	3
2.8 Engine time characteristics, types of operating and resources.....	6
2.9 Low-thrust engine performance.....	7
2.10 Engine operation modes.....	9
2.11 Low-thrust engine operation modes.....	10
2.12 Chamber (gas generator) components.....	10
2.13 Gas generator types.....	12
2.14 Operating process in chamber (gas generator).....	12
2.15 Nozzle types.....	14
2.16 Nozzle items.....	15
2.17 Nozzle characteristics.....	16
2.18 Nozzle operation modes.....	16
2.19 Flow in nozzle.....	16
2.20 Turbine pump components.....	17
2.21 Pump characteristics.....	18
2.22 Turbine pump general characteristics.....	18
2.23 Automation units.....	19
2.24 Devices and methods of control efforts creation in engines.....	19
2.25 Engine cooling.....	19
2.26 Engine thermal protection.....	20
2.27 Engine tests: General.....	20
2.28 Types of engine tests: Thermal loads.....	21
2.29 Types of engine tests: Associate with rocket.....	21
2.30 Types of engine tests: Test site.....	21
2.31 Types of engine tests: Organizational factor and test site.....	21
2.32 Types of engine tests: Test conditions.....	21
2.33 Types of engine tests: Accelerated data accessing.....	22
2.34 Types of engine tests: Test purposes.....	22
2.35 Types of tests specific for low-thrust engines.....	23
2.36 Test technology.....	23
2.37 Test conditions.....	23
2.38 Test results.....	24
2.39 Engine reliability.....	24
2.40 Engine defects.....	25
2.41 Engine failure modes.....	25
2.42 Engine operation.....	25
2.43 Analysis of engine technical status.....	26
2.44 Engine reliability index.....	26
2.45 Engine quality control.....	26
2.46 Structural and functional analysis of reliability.....	27
2.47 Test stands: General.....	27
2.48 Stand types.....	28
2.49 Stand systems.....	28
2.50 Post-test processing.....	29

2.51	Stand system elements.....	30
2.52	Stand compartments.....	31

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 on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

Introduction

This International Standard is intended to be applied for all types of rocket engines which use a liquid propellant.

The terms in this International Standard are specified in scope of design, testing, reliability analysis and quality control of liquid rocket engines.

The terms are intended to be required for use in all types of documentation and literature including in scope of standardization or using results of this activity.

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

1 Scope

The International Standard provides terms and definitions in scope of design, testing, reliability analysis and quality control of liquid rocket engines. The terms are required for use in all types of documentation and literature including in the scope of standardization or using the results of this activity.

2 Terms and definitions

2.1 General

2.1.1

rocket engine

RE

reaction engine producing thrust for vehicle movement with the help of substances and energy sources contained within the vehicle being moved

2.1.2

liquid rocket engine

LRE

rocket engine (2.1.1) using propellants in liquid form

2.1.3

low-thrust engine

LTE

rocket engine (2.1.1) of a thrust not more than 5 000 N

2.1.4

liquid rocket propulsion system

propulsion system including engine, propellant tanks, avionics for control sub-systems, pressure vessels and control devices for pneumatic and hydraulic control sub-systems, propellant feed system, actuators for steering sub-systems, and auxiliary equipment

2.1.5

clustered engine

liquid rocket propulsion system (2.1.4) consisting of multiple *rocket engines* (2.1.1), common propellant tanks, and autonomous (independent) propellant feed systems

2.2 Engine units

2.2.1

chamber

engine assembly where propellant and/or gas generation products, as a result of chemical reactions, are converted into products of combustion, created at the expiration of the reactive force

2.2.2

turbo-pump

TP

engine component designed to pump propellant into the *chamber* (2.2.1), gas generator sets and automatic engine

2.2.3

booster turbo-pump

BTP

turbo-pump (2.2.2) engine support designed to increase propellant pressure in the pipelines to *pump* (2.20.1)

2.2.4

gas generator

unit of engine wherein propellant, as a result of chemical reaction, is converted in gaseous products of reaction at relatively low temperature

2.2.5

automatic engine controller

engine assembly designed for automatic control, regulation or maintenance of engine

2.3 Engine types by way of work process

2.3.1

engine with afterburning

engine where gas generation products after their use are used to drive the *turbo-pump* (2.2.2) assembly

2.3.2

engine without afterburning

engine where gas generation products after their use to drive the *turbo-pump* (2.2.2) assembly are released into the environment

Note 1 to entry: Engine without afterburning have a *pump* (2.20.1) or a pressurized fuel supply.

2.3.3

single-mode engine

engine with one major mode

2.3.4

multimode engine

engine with several basic modes

2.4 Engine types by multiplicity of use and integration

2.4.1

expendable engine

engine intended for a specific purpose and used only one time

2.4.2

nonexpendable engine

engine intended for a specific purpose and used multiple times

2.4.3

single-start engine

engine started only once for a specific purpose

2.4.4

multi-start engine

restartable engine

engine started multiple times for one specific purpose

2.5 Engine types by purpose

2.5.1

main engine

engine intended to accelerate the space vehicle

2.5.2

correction engine

engine intended to correct the speed during the correction of trajectory of the space vehicle

2.5.3

control engine

engine intended to control the correction of the vector of the space vehicle in the active phase of the trajectory of motion

2.5.4

retrorocket engine

engine intended to reduce the speed of the space vehicle

2.6 Low-thrust engine types by way of work process

2.6.1

catalytic engine

LTE (2.1.3) where the transformation of propellant into gaseous chemical reaction products is performed with the help of a catalyst

2.6.2

thermo-catalytic engine

catalytic *LTE* where the catalyst is heated by the external heat source

2.6.3

electro-thermo-catalytic engine

thermo-catalytic *LTE* using an electrical source of energy

2.6.4

radio-thermo-catalytic engine

thermo-catalytic *LTE* using a radioactive source of energy

2.6.5

thermal engine

LTE (2.1.3) where the conversion of propellant in the gaseous products of chemical reactions is affected by heating the fuel from an external source of energy which increases their rate of expiration

Note 1 to entry: Energy is fed to the propellant or products of chemical reactions.

2.6.6

electro-thermal engine

thermal *LTE* using an electrical energy source

2.6.7

radio-thermal engine

thermal *LTE* using a radioactive energy source

2.6.8

electrolytic engine

one-component of the *LTE* (2.1.3) where the electrolysis of the propellant is part of operating process

2.6.9

adjustable engine

low-thrust engine (2.1.3) that has a device to change the thrust

2.7 General parameters and performance of engine

2.7.1

rated performance

set of nominal values of the engine designated in the specifications

2.7.2

mass flow rate

mass of fluid passing a specified line or gate in unit time

2.7.3

volume flow rate

volume of fluid passing a specified line or gate in unit time

2.7.4

pre-start consumption

propellant mass consumption during the time interval from the first start command until the thrust build-up to a specified value equal to 5 % of the nominal

2.7.5

mixture ratio

ratio of oxidizer *mass flow rate* ([2.7.2](#)) to the fuel mass flow rate

2.7.6

volume ratio

ratio of oxidizer *volume flow rate* ([2.7.3](#)) to the fuel volume rate

2.7.7

pressure

<in chamber> average static pressure of combustion products at the beginning of the *combustion chamber* ([2.12.1](#)) at the mixing system chamber

2.7.8

pressure

<in gas generator> average static pressure of gas generation at the beginning of the *combustion chamber* ([2.12.2](#)) at the mixing system gas generator

2.7.9

combustion temperature

<in chamber> stagnation temperature of combustion products at the exit from the *combustion chamber* ([2.12.1](#))

2.7.10

combustion temperature

<in gas generator> stagnation temperature of gas generation at the exit from the *gas generator* ([2.2.4](#))

2.7.11

exhaust velocity

velocity of exhaust stream through the *nozzle* ([2.12.16](#)) or a reaction engine, relative to the nozzle

2.7.12

engine reactive force

gas and fluid flow resultant force acting on the thrust chamber internal surfaces resulting from the combustion gases

2.7.13

engine thrust

resultant of the *engine reactive force* ([2.7.12](#)) and the environment pressure forces acting on the engine external surfaces (excluding external aerodynamic drag forces)

2.7.14

engine impulse

time integral of engine thrust

2.7.15

cut-off impulse

impulse ([2.9.5](#)) of engine thrust for the time interval defining the engine tail-off

**2.7.16
specific impulse**

ratio of engine thrust to the mass flow of propellant $\left(I_s = \frac{R}{\dot{m}} \right)$

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

Note 2 to entry: Thrust engine (chamber) specific impulse is also an equalled derivative from the thrust engine (chamber) impulse by weight or volume of propellant consumed.

Note 3 to entry: For *LTE* (2.1.3), the term “specific impulse” is used for steady-state continuous mode, single inclusions mode and the steady-state impulse mode.

**2.7.17
volume specific impulse**

ratio of engine thrust to the propellant volume flow rate $\left(I_{s,v} = \frac{R}{\dot{v}} \right)$

**2.7.18
thrust coefficient**

ratio of chamber thrust to the product of the nozzle stagnation pressure (or chamber total pressure at nozzle inlet) and the area of nozzle throat

**2.7.19
coefficient of specific impulse**

ratio of actual specific impulse to the theoretical value that is defined by the same values of *mixture ratio* (2.7.5), the nozzle stagnation pressure or chamber total pressure at nozzle inlet

**2.7.20
total coefficient of specific impulse**

coefficient of *specific impulse* (2.7.16) defined at the *mixture ratio* (2.7.5) to be the maximum ideal value

**2.7.21
consumable complex of chamber
consumable complex**

product of the combustion pressure in a given section of the *chamber* (2.2.1) to a nozzle throat area, referred to the mass flow of the propellant in chamber

Note 1 to entry: Given section of the *chamber* (2.2.1) is in analysis of camera characteristics stability during serial production [initial section of *combustion chamber* (2.12.1) at (near) *mixing system* (2.12.3)] and in analysis of multiphase flows (2.19.4) [initial section of *nozzle* (2.12.16)].

**2.7.22
thrust complex**

ratio of engine thrust chamber pressure and the product of combustion products in a given section of the *chamber* (2.2.1) for an area of minimum section of the *nozzle* (2.12.16)

Note 1 to entry: Thrust complex is also equal to the ratio of camera-specific impulse to *consumable complex* (2.7.19).

**2.7.23
coefficient of consumable complex**

ratio of the actual spending of the complex chamber rocket engine to the ideal that defined the same values of the ratio components fuel pressure in the *chamber* (2.2.1)

**2.7.24
coefficient of nozzle flow
coefficient of flow**

ratio of the actual flow of gas through the rocket engine nozzle to the theoretical value, as defined under the same temperature and total pressure in the nozzle throat, under the conditions for the gas constant and the local adiabatic exponent

2.7.25

nozzle coefficient

ratio of the actual thrust coefficient in a vacuum to the ideal that defined the same values of the *mixture ratio* (2.7.5) and combustion pressure in the *chamber* (2.2.1) and the geometric expansion ratio nozzle

2.7.26

chamber coefficient

ratio of the real characteristic velocity in the *chamber* (2.2.1) to the ideal defined by the same values of the *mixture ratio* (2.7.5) and the combustion chamber pressure

2.7.27

characteristic velocity

product of the nozzle stagnation pressure and nozzle throat area, referred to the mass consumption of propellant in chamber

2.7.28

ideal parameter value

<of chamber> parameter value of *chamber* (2.2.1), corresponding to the equilibrium flow of combustion products in the absence outlet heat and friction

2.7.29

ideal parameter value

<of gas generator> parameter value of *gas generator* (2.2.4), corresponding to the equilibrium flow of products gas generation in the absence outlet heat and friction

2.7.30

wet mass

mass of engine designed with propellants and other consumption articles filling its pipelines and aggregates

2.7.31

relative mass

ratio of the *wet mass* (2.7.30) to the maximum thrust on the main steady-state operation

2.7.32

engine altitude characteristic

dependence of the thrust rocket engine on the environment pressure at constant values of the ratio of the propellant components and the pressure in the *chamber* (2.2.1)

2.7.33

engine throttle characteristic

dependence of the engine thrust from the chamber pressure at constant values of the *mixture ratio* (2.7.5) of propellants and the ambient pressure

2.8 Engine time characteristics, types of operating and resources

2.8.1

period of propellant flow

time interval from the moment of complete opening of the solenoid valve until it is completely closed

2.8.2

designed operating life

period of time during which the engine is expected to operate within its specified design parameters

2.8.3

engine operating time

operation duration and/or operation cycle number of the engine

2.8.4

engine verification time

mean time engine specified in the request for the proposal

2.8.5

engine specified resource

engine operating time (2.8.3) specified in the request for the proposal

2.8.6

engine working resource

total running time of engine during a specified period of service, used as directed

2.8.7

engine single working resource

work resource of engines, or part thereof, during one cycle operation

2.8.8

engine designated resource

total operating time after the expiry of which the use of the engine should be stopped

2.8.9

LTE total designated resource

operation duration assigned for continuous and pulse modes

Note 1 to entry: In addition to total designated resource, for *LTE* (2.1.3), it is also determined designated resource according to the following:

- number of *inclusions* (2.9.8);
- duration at impulse mode;
- duration at continuous mode;
- total propellant consumption for catalytic LTE.

2.9 Low-thrust engine performance

2.9.1

full thruster impulse

thruster impulse of *LTE* (2.1.3) at which the mean integrated value of thrust, or chamber pressure, is more or equal to 0,9 of the steady-state value of the thrust, or chamber pressure, for the firing

2.9.2

part-thrust impulse

thruster impulse of *LTE* (2.1.3) at which the average integral value of thrust, or *pressure* (2.7.7) in the *chamber* (2.2.1), is less than 0,9 the steady-thrust, or pressure in the chamber, at a switch

2.9.3

unit impulse

thruster impulse of *LTE* (2.1.3) or one firing (*on-time* (2.9.10)) in the pulse or single firing operation mode

2.9.4

total impulse

thruster impulse of *LTE* (2.1.3) over the operating duration

2.9.5

impulse

forceful impact of *LTE* (2.1.3) characterized by changes in traction or *pressure* (2.7.7) in the *chamber* (2.2.1) at the time of a switch

2.9.6

rated thrust

designed thrust level in a steady-state condition mode under nominal working conditions

2.9.7

conditional rated thrust

rated thrust of *LTE* (2.1.3) in a vacuum at an initial temperature of 288 K where structures and the geometric expansion ratio of the nozzle is equal to 50

2.9.8

inclusion

on-time

time interval from the moment of voltage being applied to the thruster electric valve up to the moment of reenergizing the *LTE* (2.1.3)

2.9.9

aftereffect

thruster electric valve reenergizing up to the moment when the thrust of the chamber pressure fall to a value equal to 0,1 of the thrust of the chamber pressure in the steady-state continuous operation mode

2.9.10

off-time

pause between inclusions

time interval from the moment of the thruster electric valve reenergizing up to the moment of the next voltage being applied

2.9.11

cycle period

on-time (2.9.8) and *off-time* (2.9.10) sum

2.9.12

inclusion frequency

reciprocal of *cycle period* (2.9.11)

2.9.13

cycle period to on-time ratio

duty cycle

reciprocal of duty cycle

2.9.14

coefficient of fill cycle operation

inclusion relation of *LTE* (2.1.3) to switching cycles

2.9.15

thrust build-up time

time interval from the ignition signal to the moment when the thrust or chamber pressure reaches a value of 90 % of the steady-state thrust or the chamber pressure

2.9.16

thrust delay

time interval from the cut-off signal until the thrust or chamber pressure decreases to 10 % of steady-state thrust or chamber pressure

2.9.17

propellant expansion delay

interval time from the start entry of the second component of propellant cell *LTE* (2.1.3) until the *pressure* (2.7.7) in the *chamber* (2.2.1) reaches a value equal to the pressure in the absence of fuel decomposition

2.9.18

propellant ignition delay

time interval from the moment the second propellant enters the *chamber* (2.2.1) up to ignition

2.9.19

average mass flow of propellant

ratio of the mass flow of propellant (fuel, oxidizer) *LTE* (2.1.3) for one *inclusion* (2.9.8) to the next

2.10 Engine operation modes

2.10.1

engine operation

engine operating for thrust creating or changing its value and/or for providing the operation conditions of the vehicle components in accordance with the engine requirements

2.10.2

engine operation mode

set of the engine parameter values defined by the processes occurring in the engine

2.10.3

engine main mode

mode engine is in when a major problem is carried

2.10.4

engine firing

engine operation (2.10.1) from the firing command up to when the specified mode is reached

2.10.5

engine steady-state mode

engine operation mode (2.10.2) where the mean thrust and mixture ratio values remain constant

2.10.6

engine unsteady mode

engine operating mode where the average thrust or the ratio of propellant components varies in time

2.10.7

engine preview mode

setting of the engine thrust with less traction on the main mode

Note 1 to entry: Advance regime is part of the launching engine.

2.10.8

engine cut-off

engine operation (2.10.1) from the cut-off command up to when the thrust disappears

2.10.9

engine final mode

setting of the engine before stopping with a thrust with less traction on the main mode

2.10.10

break between engine inclusions

time interval from the engine stop multiple power-up to the first team for the subsequent *inclusion* (2.9.8)

2.10.11

engine emergency cut-off

engine cut-off caused by a failure of the engine, the propulsion system, the test stand systems or the vehicle systems

2.11 Low-thrust engine operation modes

2.11.1

continuous operation mode

LTE operation mode of one firing with the specific impulse value constant in time

2.11.2

pulse mode

LTE operation mode of many firing (*on-times* (2.9.8)) where the *specific impulse* (2.7.16) depends on each firing (*on-time*)

Note 1 to entry: Minimum duration of the pulses is limited by the time taken for the thruster valves to open and close, since this limits the repeatability of the process.

2.11.3

steady-state pulse mode

LTE pulse mode where the pulse shape is stabilized with a constant value of the on-time frequency

2.11.4

operation mode with connected pulses

LTE pulse mode where, during the *off-time* (2.9.10), the thrust or the chamber pressure falls to a value higher than 0,1 of the thrust or the chamber pressure of the steady-state continuous mode

2.11.5

cyclic mode

LTE mode consisting of repeating combinations of continuous and *pulsed modes* (2.11.2) or combinations of *inclusion* (2.9.8) and repetitive pauses of varying lengths

2.11.6

separate firing mode

isolated firing mode

LTE operation mode where the engine returns to the initial state during the *off-time* (2.9.10)

2.12 Chamber (gas generator) components

2.12.1

combustion chamber

<for chamber> part of the *chamber* (2.2.1) between the internal bottom of the *mixing system* (2.12.3) and the initial section of the *nozzle* (2.12.16), which is intended for *mixture generation* (2.14.3) and propellant combustion

2.12.2

combustion chamber

<for gas generator> part of the *gas generator* (2.2.4) intended for *mixture generation* (2.14.4) and propellant components transformation into gas generation products

2.12.3

mixing system

<for chamber> part of the *chamber* (2.2.1) representing the device for propellant components and/or gas generation products input into the *combustion chamber* (2.12.1) and their initial mixing

2.12.4

mixing system

<for gas generator> part of the *gas generator* (2.2.4) representing the device for propellant components input into the *combustion chamber* (2.12.2) and their initial mixing

2.12.5

mixing system bottom

<for chamber> item of the engine chamber mixing system, dividing cavities of propellant components or gas generation products among themselves, or separating them from fire space and the external environment

2.12.6

mixing system bottom

<for gas generator> item of the gas generator mixing system, dividing cavities of propellant components among themselves, or separating them from fire space and external environment

Note 1 to entry: Distinguish the external, average and internal bottoms.

Note 2 to entry: External bottom function in the engine chamber, with reburning, can perform gas passage.

2.12.7

injector

device for propellant components or gas generation products that input into the *combustion chamber* (2.12.1) of *chamber* (2.2.1) and/or *gas generator* (2.2.4)

2.12.8

jet injector

engine injector whereby liquid or gas escapes in the form of one or several streams

2.12.9

centrifugal injector

engine injector whereby liquid or gas escape in the form of a veil generated as result of liquid or gas rotating in a vortex chamber

2.12.10

gas-distributing grid

item of the *chamber* (2.2.1) or gas generator mixing system (2.12.3) that provides gas distribution in areas of the *mixing system* (2.12.3) and increases the operating process stability in the chamber or *gas generator* (2.2.4)

2.12.11

anti-pulsating partition

partition established in the *combustion chamber* (2.12.1) of the engine chamber or *gas generator* (2.2.4) for cross-section fluctuations suppression

2.12.12

chamber gas generator case

wall of engine chamber (gas generator) without *mixing system* (2.12.4)

2.12.13

gas generator chamber cooling tract

set of channels in the case and chamber (gas generator) mixing system with *one-through* (2.25.2) (direct-flow) or *transpiration cooling* (2.25.7)

2.12.14

veil belt zone

<for chamber> item of engine chamber intended for one of the propellant components or gas generation products to input into the wall area of the fire space for the creation of a liquid or gas protective layer

2.12.15

veil belt zone

<for gas generator> item of the engine *gas generator* (2.2.4) intended for one of the propellant components to input into the wall area of fire space for the creation of a liquid or gas protective layer

2.12.16

nozzle

part of the engine that converts the thermal energy of the combustion gases into the kinetic energy of the exhaust plume

Note 1 to entry: The engine nozzle may be stationary and rotational, relative to the stationary parts of the *chamber* (2.2.1), and also have a rotational section for performance control.

2.13 Gas generator types

2.13.1

one-zone gas generator

gas generator (2.2.4) where all phases of the operating process are provided with items of the mixture generation constructional units placed on the internal bottom of the *mixing system* (2.12.4)

2.13.2

multizone gas generator

gas generator (2.2.4) where some phases of the operating process are provided with items of the mixture generation constructional units placed on the internal bottom of *mixing system* (2.12.4)

2.14 Operating process in chamber (gas generator)

2.14.1

operating process

<in chamber> set of processes in the *combustion chamber* (2.12.1) of an engine chamber for the transformation of propellant components and/or gas generation products to combustion products

2.14.2

operating process

<in gas generator> set of processes in the *combustion chamber* (2.12.2) of an engine gas generator for the transformation of propellant components to gas generation products

2.14.3

mixture generation

<in chamber> dispersion and mixing of propellant components or gas generation products

2.14.4

mixture generation

<in gas generator> dispersion and mixing of propellant components

2.14.5

wall layer in chamber

<gas generator> part of the propellant flow in a *chamber* (2.2.1) (gas generator) that adjoins to the combustion chamber walls but different in terms of the chemical composition, thermophysical characteristics and speed

2.14.6

propellant flow core

central part of propellant flow and/or gas generation products in the *chamber* (2.2.1) or *gas generator* (2.2.4) where combustion chamber walls and wall layer do not influence the operating process

2.14.7

flow rate tension

<in chamber> ratio of combustion products mass flow to the area of the chamber cross-section at the *mixing system* (2.12.3)

2.14.8

flow rate tension

<in gas generator> ratio of gas generation products mass flow to the area of the gas generator cross-section at the *mixing system* (2.12.4)

2.14.9

relative flow rate tension of chamber

<gas generator> ratio of *flow rate tension* (2.14.7) to the *pressure* (2.7.8) in the *chamber* (2.2.1) (gas generator)

2.14.10

average time of propellant being

time interval defined by ratio of product weight in the *combustion chamber* (2.12.1) to the propellant mass flow by the *chamber* (2.2.1)

2.14.11

high-frequency oscillation

pressure oscillation in the *combustion chamber* (2.12.1) with frequencies that are equal to or exceeding the minimum natural acoustic frequency

2.14.12

high-frequency self-oscillation

pressure self-oscillation in the *combustion chamber* (2.12.1) with a frequency that is similar to one of the natural acoustic frequencies

2.14.13

longitudinal oscillation

pressure high-frequency self-oscillation in *combustion chamber* (2.12.1) along combustion chamber axis

2.14.14

transverse oscillation

pressure high-frequency self-oscillation in *combustion chamber* (2.12.1) in a plane that is perpendicular to the combustion chamber axis

Note 1 to entry: Distinguish the tangential, radial and mixed cross-section oscillations depending on the oscillatory motion direction.

2.14.15

low-frequency oscillation

pressure oscillation in the *chamber* (2.2.1) (gas generator) with frequencies that are smaller than the minimum natural acoustic frequency

2.14.16

nozzle impedance

complex value in which the module is the ratio of pressure oscillations amplitude to the speed in the nozzle's initial section and the phase is the displacement between *pressure* (2.7.7) and speed oscillations

2.14.17

mixing system impedance

complex value in which the module is the ratio of pressure oscillations amplitude to the speed at the chamber (gas generator) mixing system and the phase is the displacement between *pressure* (2.7.8) and speed oscillations

2.14.18

soft excitation of self-oscillation

appearance of pressure self-oscillation in the *combustion chamber* (2.12.1) from small disturbances

2.14.19

hard excitation of self-oscillation

appearance of pressure self-oscillation in the *combustion chamber* (2.12.1) from disturbances that exceed critical value

2.14.20

stable operating process

operating process in the chamber (gas generator) without pressure self-oscillations

2.14.21

unstable operating process

operating process in the chamber (gas generator) with pressure self-oscillations

2.14.22

frequencies identification

identification of pressure oscillation frequencies in the *chamber* ([2.2.1](#)) (gas generator) corresponding to maximum of amplitude spectrum with natural frequencies

2.14.23

stability range of operating process

values range (area) of the chamber (gas generator) operating mode parameters that provide a stable process

2.14.24

stability boundary of operating process

set of chamber (gas generator) operating mode parameter values that divide the operating process stability and instability ranges (areas)

2.15 Nozzle types

2.15.1

axisymmetric nozzle

engine nozzle in which the surface, from the side where combustion products flow, is symmetric relative to its axis

2.15.2

round nozzle

axisymmetric nozzle ([2.15.1](#)) in which any combustion products flow section perpendicular to symmetry axis is a circle

2.15.3

conical nozzle

round nozzle ([2.15.2](#)) in which the expanding part from the similar to the nominal section has a rectilinear contour

2.15.4

shaped nozzle

engine nozzle in which the expanding part has a curvilinear contour shaped for increasing nozzle efficiency

2.15.5

ring nozzle

axisymmetric nozzle ([2.15.1](#)) in which some or all perpendicular symmetry axes of the combustion products flow section are rings

2.15.6

pin nozzle

nozzle with external expansion

ring nozzle ([2.15.5](#)) in which the external zone is almost or completely absent at the expanding part contour

2.15.7

disk nozzle

nozzle with internal expansion

ring nozzle ([2.15.5](#)) in which the internal zone is almost or completely absent at the expanding part contour

2.15.8

sliding nozzle

extending nozzle

nozzle (2.12.16) with one or several sliding attachments which are nozzle expanding part continuation in extended position

2.15.9

nozzle with oblique cut

nozzle (2.12.16) whose cut is inclined to nozzle axis, different from right angle

Note 1 to entry: A nozzle with an oblique cut consists of a major axisymmetric part and small non-axisymmetric part.

2.15.10

adjustable nozzle

nozzle (2.12.16) whose expansion ratio can be changed in the process of operation

2.16 Nozzle items

2.16.1

nozzle contour

intercepting line of the nozzle surface with the plane passing through central axis

2.16.2

extremal nozzle contour

shaped *nozzle contour* (2.16.1) whose expanding part is determined by various methods

2.16.3

nozzle contour with uniform characteristic

shaped *nozzle contour* (2.16.1) whose expanding part provides parallel flow at the *nozzle exit section* (2.16.10) with constant speed at any point of the section

2.16.4

shorter contour nozzle

shaped *nozzle contour* (2.16.1) whose extending part represents the initial site of the nozzle contour extending part with uniform characteristic

2.16.5

nozzle contour with corner point

nozzle contour (2.16.1) that has a break (turn)

2.16.6

nozzle exit section contour

closed line drawn through exit endpoints of all *nozzle contours* (2.16.1)

2.16.7

nozzle inlet section

engine chamber flow section behind where the sharp reduction of flow section area begins

2.16.8

nozzle throat section

nozzle flow section with minimum area

2.16.9

nozzle critical section

nozzle flow section where combustion product speed is equal to the local sound speed

2.16.10

nozzle exit section

end of *nozzle* (2.12.16) of the divergent, bell-shaped part of a rocket exhaust nozzle that converts the thermal energy of the combustion gases to the kinetic energy of the exhaust plume and controls the expansion of the plume

Note 1 to entry: The nozzle exit section is perpendicular to the central axis and passes through endpoint of the *nozzle contour* (2.16.1).

Note 2 to entry: The exit section for a *ring nozzle* (2.15.5) is passed through endpoints of nozzle contour external site, while the exit section for a nozzle with an end cut is through the endpoint of the shortest contour.

2.16.11

nozzle tapering part

part of the *nozzle* (2.12.16) between the *nozzle inlet section* (2.16.7) and the *nozzle throat section* (2.16.8)

2.16.12

nozzle growing part

part of the *nozzle* (2.12.16) between the *nozzle throat section* (2.16.8) and the *nozzle exit section* (2.16.10)

2.17 Nozzle characteristics

2.17.1

geometric expansion ratio of nozzle

ratio of the nozzle exit section area to the minimum section area

2.17.2

gas expansion ratio in nozzle

ratio of the combustion product total pressure in the initial section to the static pressure at the exit section

2.18 Nozzle operation modes

2.18.1

rated operation mode

nozzle operating mode when gas pressure at the exit section is equal to the environment pressure

2.18.2

under-expansion

nozzle operating mode when gas pressure at the exit section is higher than the environment pressure

2.18.3

over-expansion

nozzle operating mode when gas pressure at the exit section is lower than the environment pressure

2.18.4

nozzle altitude

height above sea level where nozzle operating mode is rated in standard atmospheric conditions

Note 1 to entry: Instead of height above sea level, the height may be the applicable environment pressure corresponding to it.

2.19 Flow in nozzle

2.19.1

equilibrium flow

flow in the *nozzle* (2.12.16) characterized by power, chemical and phase balance of the combustion products

2.19.2

non-equilibrium flow

flow in the *nozzle* (2.12.16) where there are no complied power, chemical and phase balance of combustion products or no presence of at least one of these kinds of balances

2.19.3

frozen flow

flow in the *nozzle* (2.12.16) characterized by constancy of combustion product chemical composition

2.19.4

multiphase flow

flow in the *nozzle* (2.12.16) characterized by the availability of gaseous, liquid and solid phases of combustion products

2.19.5

speed lag

speed difference of the condensed phase particle and the gaseous environment in a *nozzle* (2.12.16)

2.19.6

thermal lag

temperature difference of the condensed phase particle and the gaseous environment in a *nozzle* (2.12.16)

2.19.7

loss of specific impulse

deflection of real values from the ideal of the combustion product parameters in a *nozzle* (2.12.16)

2.20 Turbine pump components

2.20.1

pump

engine unit for an oxidizer or a fuel supply

2.20.2

pump auger

pump runner, with vanes, performed on helical surface

2.20.3

turbine

gas turbine intended for the pump drive of a turbine pump

2.20.4

booster turbine

gas or hydraulic turbine intended for pump drive of booster turbine pump

2.20.5

launch turbine

turbine (2.20.3) providing turbine pump rotor spin-up at engine launch

2.20.6

launch nozzle

nozzle (2.12.16) or group of nozzles in the turbine rotor providing turbine pump rotor spin-up at engine launch

2.20.7

axial unloading automat of turbine pump

booster turbine pump

device that unloads the turbine pump (booster turbine pump) bearings from axial forces by rotor automatic equilibration

2.21 Pump characteristics

2.21.1

head

mechanical energy per unit mass flow

2.21.2

pump head

mechanical energy imparted to the fluid by the *pump* ([2.20.1](#))

2.21.3

pump cavitation stall

sharp reduction of *pump head* ([2.21.2](#)) due to cavitation and stalling

2.21.4

pump stalling pressure

total pressure at the inlet of *pump* ([2.20.1](#)) which may cause cavitation stall

2.21.5

net positive suction head

NPSH

head ([2.21.1](#)) corresponding to the difference between the pump inlet pressure and the vapour pressure and the density of fluid and the gravitational acceleration

2.21.6

rated conditions of pump operation

set of conditions defined by standard value of the temperature, inlet pressure, flow rate, density of propellant and pump rotating speed that are specified in the design

2.21.7

pump cavitation characteristic

dependence of *pump head* ([2.21.2](#)) on the pressure input in the *pump* ([2.20.1](#)) at rated conditions

2.21.8

pump throttling cavitation characteristic

characteristic of pump stalling cavitation static suction head corresponding to the propellant flow rate

2.21.9

pump pressure characteristic

characteristic of total pressure corresponding to the flow rate at rated conditions

2.21.10

pump capacity characteristic

characteristic of pump capacity on the flow rate through the *pump* ([2.20.1](#)) at rated conditions

2.21.11

pump efficiency characteristic

characteristic of pump efficiency on flow rate through the *pump* ([2.20.1](#)) at rated conditions

2.22 Turbine pump general characteristics

2.22.1

specific weight of turbine pump

turbine pump weight per unit capacity that is increased by the *turbine* ([2.20.3](#))

2.22.2

efficiency of turbine pump

ratio of the sum of pump available capacities to the sum of turbine adiabatic capacities

2.22.3

efficiency of booster turbine pump

ratio of the sum of pump available capacities to the gas turbine adiabatic capacity or hydraulic turbine theoretical capacity

2.23 Automation units

2.23.1

solenoid electrical valve

engine valve whose sluice activates by the electromagnet part of the valve

2.23.2

single-component solenoid

solenoid (2.23.1) having an oxidizer or a propellant cavity

2.23.3

two-component solenoid

solenoid (2.23.1) having an oxidizer and a propellant cavity

2.23.4

hydraulic solenoid electrical hydraulic valve

valve whose sluice is activated by the electromagnet and hydraulic drive parts of the valve

2.23.5

indicator of pressure in chamber

device that is activated when the engine chamber pressure reaches a specified value

2.24 Devices and methods of control efforts creation in engines

2.24.1

control chamber

auxiliary chamber used for control efforts creation

2.24.2

control nozzle

auxiliary nozzle used for control efforts creation

2.24.3

jet vane

profiled rotary element mounted on the combustion product flow near the nozzle exit and have two working surfaces streamlined by the flow

2.24.4

control actuator

engine actuator that controls the position of devices creating control efforts

2.24.5

injection in nozzle

entering into the nozzle, the expanding part of the additional gas (liquid) flow leading to the emergence of an unbalanced lateral force

2.25 Engine cooling

2.25.1

external cooling

heat removal from engine design elements to cooler or environment

2.25.2

one-through cooling

engine external cooling performed by a cooler flowing through a cooling channel in the wall of the chamber (2.2.1) and *gas generator* (2.2.4)

2.25.3

autonomous cooling

engine one-through cooling where removed heat is not transmitted to propellant components

2.25.4

regenerative cooling

engine one-through cooling where removed heat is transmitted to fuel components

2.25.5

radiation cooling

engine external cooling performed by heat emission to the environment

2.25.6

film cooling

reduction of heat flow, directed towards engine design elements, by creating a protective liquid or gas layer to their surface

2.25.7

transpiration cooling

engine internal cooling performed by injection into a gas or steam boundary layer through porous or perforated wall

2.25.8

capacitive cooling

prevention of engine design element overheating through heat absorption by a material without its mass entrapment

2.25.9

ablation cooling

prevention of engine design element overheating through heat absorption by a material with its mass entrapment

2.26 Engine thermal protection

2.26.1

thermal protection

set of measures implemented in the engine and rocket design that provides an acceptable thermal state

2.26.2

engine thermal state

engine condition characterized by a set of temperatures at its various points

2.26.3

LTE thermal bridge

LTE thermal protection item used as device with a thermal resistance and also used for a change of heat flow directed towards LTE construction

2.27 Engine tests: General

2.27.1

engine test

test for engine technical conditions assessment or its research processes

2.27.2

engine experimental-design developing

experimental-design development that includes investigation tests of the engine and its component prototypes, design and technological documentation updating by test results, and *completing development tests* (2.34.3) and interagency tests of prototypes made of updated documentation

2.28 Types of engine tests: Thermal loads

2.28.1

firing test

engine test (2.27.1) with fuel combustion or decomposition

2.28.2

cold test

engine test (2.27.1) without fuel combustion or decomposition

2.29 Types of engine tests: Associate with rocket

2.29.1

integrated test

on-line test

engine test (2.27.1) in a propulsion system or rocket

2.29.2

independent test

off-line test

engine test (2.27.1) outside a propulsion system

2.30 Types of engine tests: Test site

2.30.1

ground test

engine firing test in an earthly environment

2.30.2

flight test

engine test (2.27.1) in a rocket in real operating conditions

2.31 Types of engine tests: Organizational factor and test site

2.31.1

flight-design test

developed or modernized engine test in a rocket in a real environment for the purpose of updating design and technological documentation

2.32 Types of engine tests: Test conditions

2.32.1

altitude test

engine firing test at high-altitude conditions

2.32.2

vacuum test

engine firing test in a vacuum chamber at a *pressure* (2.7.7) below 1 Pa

2.33 Types of engine tests: Accelerated data accessing

2.33.1

forced test

engine accelerated test based on the intensification of processes that cause failures or defects

2.33.2

limit test

engine test ([2.27.1](#)) to the limiting state

2.34 Types of engine tests: Test purposes

2.34.1

research test

engine test ([2.27.1](#)) for the purpose of a parameter value area to determine where the engine is in working condition

2.34.2

development test

engine research test for the purpose of accessing data necessary for creating the final design

2.34.3

completing development test

engine development test of the final design for the purpose of confirming its performance to technical specification requirements and providing for acceptance test possibility

2.34.4

acceptance test

engine check test at acceptance inspection after which a decision is made about engine availability for delivery to operation

2.34.5

qualification test

engine firing test before start or renewal of a serial production for the purpose of confirming manufacturer availability to produce engines in compliance with the design documentation requirements

2.34.6

model test

produced engines check tests for the purpose of assessing the effectiveness and appropriateness of changes made in the product design or manufacturing process

2.34.7

technological test

check test of each sample engine for the purpose of checking the manufacture technological process

Note 1 to entry: The technological test may be firing or cold, with or without reassembly.

2.34.8

random test

check test of one engine selected from those made within a set time of production

Note 1 to entry: A random test may be acceptance or periodic (periodic confirmation, special periodic).

2.34.9

periodic confirmation test

engine periodic test for the purpose of making a decision perform an acceptance the inspection of each sample made within a set time of production

2.34.10

special periodic test

engine periodic test for the purpose of a quality conformity assessment of the engines manufactured for delivery to operation at a level reached during development finishing

2.35 Types of tests specific for low-thrust engines

2.35.1

thermal test

thermocatalytic or thermal LTE test without fuel delivery, with heat supply from an external source

2.35.2

thermal-vacuum test

LTE vacuum test at a specified temperature of fuel components and design elements

2.36 Test technology

2.36.1

test cyclogram

graphical representation and/or numerical description of the engine test condition changes program

2.36.2

engine adjustment

installation of engine regulatory elements for the purpose of a specified operating mode support

2.36.3

engine thermostating

reduction of the engine (fuel components) temperature to a specified value and its maintenance in that range for a set time interval

Note 1 to entry: The engine thermostating may be performed in combination with the fuel component thermostatic or separately.

2.36.4

engine blow

removal of combustion products, gas generation products, atmospheric air and engine internal cavity fuel by gas with excess pressure

2.36.5

engine neutralization

engine processing for the remaining fuel removal and/or clearance of unremoved remaining fuel

2.36.6

engine cavity passivation

engine cavity surface processing which results in the formation of a material film that does not act on fuel components and is inert to their aggressive action to engine cavities

2.36.7

engine fault detection

engine dismantling and technical condition research after test for the purpose of defect detection

2.37 Test conditions

2.37.1

test conditions

set of engine operating modes, external influencing factors and operating time during the test

2.37.2

operating test conditions

engine test conditions are equal to the specified by design documentation for the intended use in operation

2.37.3

guarantee test conditions

expanded engine test condition (as compared to the *operating test conditions* ([2.37.2](#)))

Note 1 to entry: When a fault is identified during the test, there are actions to be taken to determine its causes, removal of the fault or confirming the impossibility of it appearing in operating conditions.

2.37.4

standard test conditions

engine test conditions where parameter values are implemented at random during initial nominal stand and *engine adjustment* ([2.36.2](#))

2.37.5

special test conditions

engine test conditions which are provided by stand special adjustment and/or *engine adjustment* ([2.36.2](#)) and/or special requirements to exposure factors

2.37.6

high-altitude test conditions

engine test conditions providing complete gas expansion in the *nozzle* ([2.12.16](#))

2.38 Test results

2.38.1

conclusive test result

test result on the basis of which conclusions can be drawn about engine technical condition, suitable for its reliability or quality analysis

2.38.2

inconclusive test result

test result on the basis of which conclusions cannot be drawn about engine technical condition, suitable for its reliability or quality analysis

Note 1 to entry: The same test result depending on the objectives specified at reliability analysis and quality control may be regarded as conclusive and inconclusive.

2.39 Engine reliability

2.39.1

engine reliability

engine property to maintain an *operable state* ([2.39.2](#)) under determined operational conditions

2.39.2

operable state

engine state when it can develop thrust of a specified value and direction, fulfil specified requirements for provision of a specific thrust impulse, fuel component ratio and rocket component operating conditions

Note 1 to entry: The specified customer requirements are provided in the process of development and delivery into operation.

2.39.3

non-operable state

engine state when it is not able to fulfil at least one of the requirements providing in an *operable state* ([2.39.2](#))

2.39.4

technical state qualification

identification of the type of engine operation condition

2.40 Engine defects

2.40.1

structural defect

engine defect caused by imperfect design documentation or set design rules and/or standards breach

Note 1 to entry: The design documentation is imperfect in the case where all its performance requirements' during engine manufacturing do not provide the engine operable state in operation.

2.40.2

manufacturing defect

engine defect caused by non-performance of the design documentation, non-fulfilment or non-performance of technological documentation requirements during its manufacturing and/or maintenance

2.40.3

operating defect

engine defect caused by a specified operating conditions breach

2.40.4

test defect

non-conformity of engine testing conditions to the design documentation requirements

2.41 Engine failure modes

2.41.1

engine failure

event based on the breach of engine operable state or its *non-operable state* ([2.39.3](#)) detection during test or operation

2.41.2

engine structural failure

engine failure ([2.41.1](#)) based on *structural defect* ([2.40.1](#))

2.41.3

engine manufacturing failure

engine failure ([2.41.1](#)) based on *manufacturing defect* ([2.40.2](#))

2.41.4

engine operating failure

engine failure ([2.41.1](#)) based on *operating defect* ([2.40.3](#))

2.42 Engine operation

2.42.1

engine operating conditions

set of conditions specified by the design documentation for engine operating

2.42.2

operation cycle

in-service live

operating periodically of a recurrent part from its beginning to the end of engine intended use or to the end of it or its return after intended use for the purpose of maintenance

2.42.3

failure-free operation

operating when the engine keeps its *operable state* ([2.39.2](#)) during its storing, transportation and intended use

Note 1 to entry: Failure-free operation of reusable engines includes the recovery of an engine operable state during period of time between its flights not exceeding the specified time.

2.43 Analysis of engine technical status

2.43.1

capacity for work parameter

engine parameter used for its reliability analysis for the purpose of identifying which one of its properties definition provides its *operable state* ([2.39.2](#))

2.43.2

critical value of capacity for work parameter

engine capacity for work parameter value, at which when exceeded the engine will be at a *non-operable state* ([2.39.3](#))

2.43.3

reserve of capacity for work parameter

difference between the capacity for work parameter value and its critical value during *engine test* ([2.27.1](#)) or operation

2.43.4

operational reserve of capacity for work parameter

reserve of capacity for work parameter ([2.43.3](#)) at operating conditions

2.43.5

guarantee reserve of capacity for work parameter

reserve of capacity for work parameter ([2.43.3](#)) at guarantee conditions

2.44 Engine reliability index

2.44.1

probability of failure-free work

probability of an engine operable state during work at operating conditions

2.44.2

probability of failure-free operation

probability of an engine operable state when operated at all operational stages at specified operating conditions

2.45 Engine quality control

2.45.1

preliminary acceptance testing

quality control of each engine specimen before acceptance testing

2.45.2

between-flights control

turnaround control

control of a reusable engine before regular intended use

2.45.3

control plan

plan that includes control type and structure, testing engine number, test periodicity and conditions, and decision rules

2.45.4

manufacturing period

calendar time of engine manufacturing, after it resumes manufacturing quality assurance, makes decision about manufacturing perfection and updating the control plan, determining the possibility of when the next manufacturing period begins, and issuing the reporting document

Note 1 to entry: The manufacturing period can also be determined by the number of engines produced.

2.45.5

disruption of production

calendar time from the production of the last engine specimen to the renewal of engine production according to the manufacturer plan

2.46 Structural and functional analysis of reliability

2.46.1

structural-functional analysis of reliability

quantitative reliability analysis based on engine consideration as the assembly of statistically independent *structural-functional elements* ([2.46.2](#))

2.46.2

structural-functional element

engine component which is nominally equipped by one of the properties necessary for its operable state provision

2.46.3

engine structural-functional scheme

engine configuration represented as *structural-functional elements* ([2.46.2](#))

2.46.4

coefficient of test conditions forcing

ratio of engine failure possibility at forcing tests to its failure possibility at normal test

2.46.5

engine final design

engine design suffices the design documentation requirements until the moment of reliability analysis implementation

2.47 Test stands: General

2.47.1

engine test stand

technical construction designed for the test

2.47.2

engine test complex

integration of *engine test stand* ([2.47.1](#)) and constructions needed to perform incoming control and post-launch activities

Note 1 to entry: The test complex may include a number of stands integrated by common constructions for input control and post-launch activity.

2.47.3

stand base

totality of stand complexes available in an enterprise or department

2.47.4

test equipment

stand equipment designed to provide engine test conditions

2.47.5

stand system

stand unit designed to carry out one or more specification tasks involved in stand development and engine testing

2.47.6

system component

stand system unit that performs the specified functions and is the lowest level of assembly

2.47.7

work station

place for a single test operator in a stand fire module where the engine to be tested is mounted

2.47.8

accessory equipment

aggregate of mechanisms and devices that provide stand operation such as transportation, loading, unloading, engine mounting and removal

2.48 Stand types

2.48.1

vertical test stand

engine test stand ([2.47.1](#)) with the engine mounted in a datum position so that its gas dynamic axis has vertical or close to vertical direction

Note 1 to entry: The vertical stand engine thruster can be mounted with the *nozzle* ([2.12.16](#)) up or down.

2.48.2

horizontal test stand

engine test stand ([2.47.1](#)) with the engine or its unit mounted so that its gas dynamic axis has a horizontal or close to horizontal direction

2.48.3

single-seated test stand

engine test stand ([2.47.1](#)) that has a single *work station* ([2.47.7](#))

2.48.4

multi-seated test stand

engine test stand ([2.47.1](#)) with a number of *work stations* ([2.47.7](#)) that enable the testing of two or more engines or their units in a specified sequence

2.49 Stand systems

2.49.1

fuel feed system

stand system ([2.47.5](#)) intended for engine propellant delivery when carrying out tests

2.49.2

compressed gas feed system

gas supply system

stand system ([2.47.5](#)) intended for the engine and stand facilities compressed gas supply

2.49.3

fuel gas saturation system

stand system ([2.47.5](#)) intended for the propellant component gas saturation

2.49.4

control sequence procedure

test procedure intended for the sequential control of the engine and stand system actuator devices

2.49.5

television control equipment

stand system (2.47.5) intended for the engine or its unit television observation when preparing for a test and while testing and during post-launch operation

2.49.6

information measuring system

stand system (2.47.5) intended to obtain, digitize and deliver information about certain mode parameters to the consumer

2.49.7

neutralization system

stand system (2.47.5) that prevents the arbitrary emission of toxic gas discharges into the atmosphere and neutralizes them under special conditions

2.49.8

ventilation system

stand facility that provides controllable air exchange in stand rooms

2.49.9

accumulated hazard materials

detection system

stand system (2.47.5) intended for environment composition control with appropriate audible and luminous signal warnings when the quantity of hazard materials exceed permissible limits

2.49.10

alarm system

stand system (2.47.5) intended to provide luminous and audible signal warnings during hazardous stand activities

2.49.11

fire protection system

stand system (2.47.5) designed for extinguishing fires in a compartments and spaces stand

2.49.12

noise protection system

stand system (2.47.5) that prevents the spread of noise from the running *rocket engine* (2.1.1)

2.49.13

electric power supply system

stand system (2.47.5) designed for the stand to supply devices with electric power

2.49.14

water supply system

stand system (2.47.5) designed for cold water (process and drinking) and hot water supply

2.49.15

vacuum system

stand system (2.47.5) that provides below atmospheric pressure in the cavities of the bench systems and *rocket engines* (2.1.1)

2.49.16

thermostatic control system

stand system (2.47.5) that controls the temperature of the engine and propellant components

2.50 Post-test processing

2.50.1

neutralization system of industrial waste water

system intended for the neutralization of water contaminated by propellant components

2.50.2

system of post-test processing engine

system intended for the decontamination of propellant components residuals and combustion products

2.51 Stand system elements

2.51.1

stand tank

fuel components feed stand system element which is a vessel for propellant components storage

Note 1 to entry: The time period required for the test is specified in the technical documentation.

2.51.2

main stand tank

stand tank ([2.51.1](#)) used for propellant components storage required for the test based on its operating conditions

2.51.3

starting stand tank

propellant stand tank

stand tank ([2.51.1](#)) used for propellant components storage required for *engine test* ([2.27.1](#)) and its operating conditions

2.51.4

stand tank drain post-test

tank drain

stand tank ([2.51.1](#)) used for draining the propellant component which stayed after testing in the main or launch stand tanks and propellant components pipelines

2.51.5

stand tank of dumping

emergency drain

stand tank ([2.51.1](#)) used to receive propellant component from the main and/or starting tanks and *pipeline* ([2.51.6](#)) in case of accident

2.51.6

stand pipeline

pipeline

stand system pipeline for propellant components connecting the elements of the stand

2.51.7

main pipeline

stand pipeline ([2.51.6](#)) connected directly to the engine

2.51.8

primary pipeline

stand pipeline ([2.51.6](#)) from the *stand tank* ([2.51.1](#))

2.51.9

pipeline filling

propellant flow from propellant storage to the main and/or starter tanks

2.51.10

flow-measuring meter

element of the stand in the *pipeline* ([2.51.6](#)) that establishes a means of measuring the flow of the propellant supplied through this pipeline

2.51.11

gas dynamic tube

stand element intended for creating negative pressure at the *nozzle* ([2.12.16](#))

2.51.12

gas protecting device

stand facility intended for neutralizing toxic propellant components ejected from the engine during launch and stop regime and also at its post-launch treatment on the stand

2.51.13

afterburner

stand device for the removal of toxic and explosive propellants through afterburning

2.51.14

pressure chamber

stand unit designed to simulate operating pressure in an engine or unit

2.51.15

thermal pressure chamber

pressure chamber (2.51.14) where the temperature can be changed and/or maintained to the preset temperature

2.51.16

thrust measuring unit

stand device for measuring the force developed by an engine when tested

2.51.17

stand armour plate

stand device which protects the *stand system* (2.47.5) and equipment elements from damage in case of emergency event

2.51.18

gas vent tube

stand device used for closed gas jet outlet of combustion products in a required direction

2.51.19

flame deflector

gas deflector

part of a hot firing test stand to deflect the exhaust gas stream to a safer direction

2.52 Stand compartments

2.52.1

firing compartment

stand building designed to house the engine and conduct fire tests of an engine or clusters of engines

Note 1 to entry: The firing compartment is an explosion-proof room, providing protection for personnel and related facilities in case of an emergency.

2.52.2

technical compartment

stand compartment intended for technical equipment

2.52.3

gas distribution compartment

stand compartment used for gas distribution devices/panels

2.52.4

fuel compartment

stand compartment used for fuel storage tanks and other elements of the fuel supply system

2.52.5

oxidizer compartment

stand compartment used for the oxidizer storage tanks and other elements of the oxidizer supply system

2.52.6

temperature control propellant compartment

stand building designed to accommodate the water tanks and other elements of the *water supply system* ([2.49.14](#)) for testing of the engine, its components and/or stand devices

2.52.7

water compartment

stand building designed to accommodate the transforming and switching equipment information-measuring complex

2.52.8

switching and measurement signal transformation compartment

bench building designed to place the transforming and switching equipment of the information-measuring complex

2.52.9

control system switching equipment compartment

bench building designed to placing switching equipment of control system

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards-based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit, or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than 1 device provided that it is accessible by the sole named user only and that only 1 copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than 1 copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright & Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email subscriptions@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services

Tel: +44 345 086 9001

Email (orders): orders@bsigroup.com

Email (enquiries): cservices@bsigroup.com

Subscriptions

Tel: +44 345 086 9001

Email: subscriptions@bsigroup.com

Knowledge Centre

Tel: +44 20 8996 7004

Email: knowledgecentre@bsigroup.com

Copyright & Licensing

Tel: +44 20 8996 7070

Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK