AD-A051 847 FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OHIO F/G 21/8.1
LIQUID-PROPELLANT ROCKET ENGINES: TERMS AND DEFINITIONS.(U)
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FOREIGN TECHNOLOGY DIVISION

LIQUID-PROPELLANT ROCKET ENGINES: TERMS AND DEFINITIONS

EDITED TRANSLATION

FTD-ID(RS)T-1911-77 28 December 1977

MICROFICHE NR: FTD-78-C-000074

LIQUID-PROPELLANT ROCKET ENGINES: TERMS AND DEFINITIONS

English pages: 43

Source: GOST 17655-72, Moscow, pp. 1-47.

Country of origin: USSR
Translated by: SCITRAN
F33657-76-D-0390
Requester: FTD/PDBP

PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$sinh^{-1}$
cos	cos	ch	cosh	arc ch	$cosh^{-1}$
tg	tan	th	tanh	arc th	$tanh^{-1}$
ctg	cot	cth	coth	arc cth	$coth^{-1}$
sec	sec	sch	sech	arc sch	$sech^{-1}$
cosec	csc	csch	csch	arc csch	$csch^{-1}$

Russian	English
rot	curl
lg	log

LIQUID-PROPELLANT ROCKET ENGINES: TERMS AND DEFINITIONS

STATE STANDARD OF USSR

GOST 17655-72

By decree of State Committee of Standards of USSR Council of Ministers of IV/27/1972 No. 873 the period of introduction has been set from VII/1/1973.

This standard sets the terms and definitions applicable in science, technology and production for the primary concepts in the area of liquid-propellant rocket engines.

The terms set by this standard are mandatory for use in documentation of all types, textbooks, instructional manuals, technical and reference literature. The use of these terms is recommended in the rest of the cases.

One standardized term has been set for each concept.

For individual standardized terms in the standard letter designations have been given for reference, as well as short forms which can be used in cases which exclude the possiblity of their varying interpretation.

In cases where the essential features of the concept are contained in the literal meaning of the term a definition is not given and a line is drawn accordingly in the "Definition" column.

The standard gives an alphabetical index of the terms it contains.

The recommended appendix 1 contains the terms and definitions referring to automatic machine aggregates of liquid-propellant rocket engines and to their characteristics.

The reference appendix 2 presents the terms and definitions for the liquid-propellant rocket engine nozzles.

[ЖРД]

The reference appendix 3 presents the terms of reliability of the LRE.

The reference appendix 4 contains schematic drawings of certain LRE aggregates.

The standardized terms have been set in semi-bold face type, their short form in light type and inadmissible synonyms in italics.[1]

Term	Definition	Letter designation
	Main Concepts	
1. Rocket engine (RE)	Jet engine which uses for its operation only substances and energy sources stored on a mobile apparatus. Note: The mobile apparatus can be flying, ground or underwater.	
2. Liquid rocket propellant (LRP)	Substance or collection of substances in liquid state which as a result of exothermic chemical reactions is capable of forming high-temperature products creating a jet force (45)* when they flow from the RE. Note: When LRP is used reactions of oxidation, breakdown and others can occur in the RE in the chambers of combustion, breakdown and others respectively and form products of combustion, breakdown and others. Below, for the sake of abbreviation, only the combustion chambers and combustion products are mentioned.	
3. Liquid-propellant rocket engines (LRE)	Rocket engine operating on liquid rocket propellant. Note: LRE generally consist of chambers (8), pipe and pump aggregates** (9), gas generators (10), automatic machine aggregates (11), devices for creating controlling forces and momentum, frames, trunk lines and auxiliary devices and aggregates.	

[1] Translator's note: Regular type, parentheses and underlining of terms respectively are used for the different face types in this translation.

*Here and further the numbers in parentheses indicate the number of the terms placed in this standard.

**In this standard "aggregate" means the finished item of a specific functional purpose to fulfill operations in the EA work (4). [ЖУ]

4. Liquid-propellant rocket engine assembly (EA)	The assembly consisting of one or several LRE, fuel tanks, supercharging aggregates of fuel tanks or pressure propellant supply (5), steering gears (134), trunk lines connecting the engines to the tanks, and auxiliary devices.
5. Pressurized propellant supply	Supply of fuel components to chamber by displacement from fuel tanks by gases whose pressure exceeds the pressure in the combustion chamber (42).
6. Pump supply of propellant 7. Products of gas generation	Products of breakdown or low-temperature combustion of components of main (211) or auxiliary (212) fuel used to drive TPA (9), supercharge fuel tanks, operate control aggregates. Note: Products of gas generation are called oxidizing if they are obtained with an excess of oxidant and are called reducing with an excess of fuel.

Main Aggregates of Liquid-Propellant Rocket Engine

8. Chamber of liquid-propellant rocket engine (Chamber LRE)	The LRE aggregate in which the fuel or products of gas generation as a result of chemical reactions are transformed into high-temperature products creating a jet force during outflow. Note: The LRE chamber consists of the chambers of combustion (75) and nozzle (85).
9. Turbopump aggregate of liquid-propellant rocket engine (TPA)	The LRE aggregate designed for pump supply of fuel to the chamber and gas generator. Note; The TPA usually consists of pumps and turbines activating them.
10. Liquid-propellant gas generator of liquid-propellant rocket engine (Gas generator)	The LRE aggregate in which the main or auxiliary fuel as a result of exothermic chemical reactions is converted into products of gas generation.
11. Automatic machine aggregates of liquid-propellant rocket engine (Automatic machine aggregates LRE)	Collection of devices installed in LRE which provide control, adjustment and servicing of LRE. Note: The devices can be mechanical, hydraulic, pneumatic, electric, pyrotechnic, etc.
12. Impulse block	Aggregate of multichamber LRE of normal orientation (34) or link-up (35), triggered for

	short time intervals and consisting of a chamber and valves turning on or off the flow of fuel components into the chamber.

Types of Liquid-Propellant Rocket Engines

13. Liquid-propellant rocket engine with pressurized propellant supply (LRE with pressurized prop. supply)	-
14. Liquid-propellant rocket engine with pump prop. supply (LRE with pump propellant supply)	-
15. Liquid-propellant rocket engine with afterburning (LRE with afterburning)	LRE with fuel supply by TPA in which the products of gas generation after their work in the gas turbine enter the chamber
16. Liquid-propellant rocket engine without afterburning (LRE without afterburning)	-
17. One-chamber liquid-propellant rocket engine (One-chamber LRE)	-
18. Multichamber liquid-propellant rocket engine (Multichamber LRE)	-
19. Block liquid-propellant rocket engine (Block LRE)	LRE consisting of several engine blocks united by a common frame. Note: 1. The engine block is understood to be the engine intended only for formation in a set of block LRE and lacking certain aggregates. 2. Engine blocks can have common systems, for example, start (69) and stop (73).

20. Liquid-propellant rocket engine of single use (LRE of single use)	-
21. Liquid-propellant rocket engine of multiple use (LRE of multiple use)	LRE designed to ensure several flights of the aircraft.
22. Liquid-propellant rocket engine of single actuation (LRE of single actuation)	-
23. Liquid-propellant rocket engine of multiple actuation (LRE of multiple actuation)	LRE actuated many times in one flight
24. One-pattern liquid-propellant rocket engine One-pattern LRE	LRE with one main pattern of operation (71)
25. Multi-pattern liquid-propellant rocket engine (Multi-pattern LRE)	LRE with several main patterns of operation
26. Rotating liquid-propellant rocket engine (Rotating LRE)	LRE which can rotate relative to the aircraft
27. Sustainer liquid-propellant rocket engine (Sustainer LRE)	LRE which ensures the acceleration of the aircraft. Note: In addition to **fulfilling** the indicated task the sustainer LRE can be used to control the flight, brake the aircraft, etc.
28. Auxiliary liquid-propellant rocket engine (Auxiliary LRE)	LRE installed on aircraft in addition to the main engine
29. Correcting liquid-propellant rocket engine (Correcting LRE)	LRE used to correct the speed of the aircraft

30. Steering liquid-propellant rocket engine (Steering LRE)	LRE creating forces and momentum used to control the position of the aircraft in the active portion of the flight. Note: The steering LRE can also perform the function of sustainer LRE and others.
31. Braking liquid-propellant rocket engine (Braking LRE)	-
32. Starting liquid-propellant rocket engine (Starting LRE)	Auxiliary LRE serving to force the take-off of the aircraft. Note: Usually discarded after the end of operation.
33. Launching liquid-propellant rocket engine (Launching LRE)	Auxiliary LRE, usually of small thrust, creating overloads to separate propellant components from gas in fuel tanks feeding the main engine.
34. Liquid-propellant rocket engine of orientation (LRE of orientation)	LRE creating forces and momentum used to control position of aircraft in passive portion of flight.
35. Liquid-propellant rocket engine of link-up (LRE of link-up)	LRE for link-up of aircrafts

Parameters and Characteristics of Liquid-Propellant Rocket Engine

36. Mass consumption of LRE oxidant (Oxidant consumption)	Mass of oxidant consumed during operation of LRE in unit of time	m_{ok}
37. Mass consumption of LRE fuel (Fuel consumption)	Mass of fuel consumed during operation of LRE in unit of time	m_r
38. Mass consumption of LRE propellant (Propellant consumption)	Mass of propellant consumed in operation of LRE in unit of time	m
39. Volume consumption of LRE propellant	Volume of propellant consumed in operation of LRE in unit of time	V

40. Mass correlation of components of propellant in LRE (chamber, gas generator) (Correlation of components)	Ratio of mass consumption of LRE oxidant (by chamber, gas generator) to corresponding mass consumption of fuel	k_m
41. Volume correlation of components of propellant in LRE (Volume correlation of components)	Ratio of volume consumption of LRE oxidant to corresponding volume consumption of fuel	k_V
42. Pressure in combustion chamber (gas generator)	Mean static pressure of combustion products in beginning of combustion chamber (gas generator)--at displacing head (76)	p_k (p_{rr})
43. Combustion temperature	Temperature for inhibiting the combustion products in the first section of the nozzle (101). Note: Here and further the index "0" is given to inhibition or braking parameters.	T_{0c}
44. Rate of outflow	Rate of stream on section of nozzle (106) determined in linear approximation.	w_a
45. Jet force	Equivalent hydro- and gas-dynamic forces which affect the inner surfaces of the rocket engine during the outflow from it of substances, and the forces of environmental pressure affecting its outer surfaces, with the exception of forces of outer aerodynamic resistance.	
46. Chamber thrust	Jet force created by the chamber	P_k
47. LRE thrust	Equivalent force of all jet forces created by LRE aggregates. Note: Consists of the chamber thrust, thrust of exhaust pipes and other elements through which outflow occurs.	P
48. Specific impulse of LRE thrust (LRE chamber) Specific impulse LRE (LRE chambers)	Ratio of LRE thrust (LRE chambers) to LRE propellant consumption (by LRE chamber) Note: 1. Specific LRE impulse (LRE chambers) is also equal to derivative from LRE thrust impulse (LRE chambers) according to the mass of consumable propellant.	I_y

	2. In a vacuum is designated on ground	$I_{y,\text{п}}$ $I_{y,\text{з}}$
49. Volume specific impulse of LRE thrust (LRE chambers) (Volume specific LRE impulse (LRE chambers))	Ratio of LRE thrust (LRE chambers) to volume consumption of LRE propellant (LRE chamber) Note: Volume specific LRE impulse (LRE chambers) also equals derivative from impulse of engine thrust (LRE chambers) according to the volume of consumable propellant.	$I_{y,l}$
50. Characteristic rate in chamber (Characteristic rate) Inad. <u>Specific impulse of pressure</u>	Product of braking pressure in minimum section of nozzle (102) for area of this section and for coefficient of nozzle consumption (57) referred to the mass consumption of propellant by the LRE chamber	c_*
51. Consumption complex Inad. <u>Specific impulse of pressure</u>	Product of pressure in certain section of combustion chamber for area of minimum section of nozzle, referred to mass consumption of propellant by LRE chamber. Note: 1. When used to analyze the stability of the characteristics of the combustion chamber during its serial production it is recommended that the consumption complex be determined according to the static pressure in the first section of the combustion chamber. 2. When used to analyze multiphase currents it is recommended that the consumption complex be determined according to the braking pressure in the first section of the nozzle; designated β_s.	β
52. Thrust coefficient	Ratio of chamber thrust to product of braking pressure in minimum section of nozzle for area of this section and coefficient of nozzle consumption Note: Thrust coefficient also equals the ratio of specific chamber impulse to characteristic rate in chamber.	k_T
53. Thrust complex	Ratio of chamber thrust to product of pressure in certain section of combustion chamber for area of minimum nozzle section.	k_p

	Note: 1. The thrust complex is also equal to the ratio of specific chamber impulse to the consumption complex. 2. When used to analyze the stability of the characteristics of the chamber during its serial production it is recommended that the thrust complex be determined according to the static pressure in the section of the combustion chamber. 3. When used to analyze multiphase currents it is recommended that the thrust complex be determined according to the braking pressure in the first section of the nozzle; designated k_{ps}	
54. Ideal value of chamber parameter	Value of chamber parameter corresponding to equilibrium linear flow of combustion products with lack of elimination of heat and friction.	
55. Coefficient of specific impulse	Ratio of actual specific chamber impulse in vacuum to ideal, computed at the same values of the correlation of components, pressure in combustion chamber and geometric degree of nozzle expansion (108)	φ_I
56. Complete coefficient of specific impulse	Ratio of actual specific chamber impulse in vacuum to ideal, computed with value of correlation of components corresponding to the maximum of ideal specific impulse, and with the same geometric degrees of expansion and pressures in the combustion chamber	$\varphi_{I\Sigma}$
57. Coefficient of nozzle consumption	Ratio of actual consumption of gas through nozzle to ideal, determined with respectively the same values of temperature and pressure of braking in the minimum nozzle section, gas constant and local index of adiabatic curve (169) as well as with a flat surface of transition from the subsonic speeds to supersonic	μ_c
58. Coefficient of combustion chamber	Ratio of actual characteristic rate in chamber to ideal, computed with the same values of correlation of components and pressure in combustion chamber	φ_k
59. Nozzle coefficient	Ratio of actual thrust coefficient in vacuum to ideal, computed with same values of correlation of components, pressure in combustion chamber and geometric degree of nozzle expansion	φ_c

60. LRE Mass		$m_{Д}$
61. Mass of primed LRE	Mass of LRE and propellant components filling its trunk lines, and aggregates during LRE operation	$m_{Д,з}$
62, Specific LRE mass	Ratio of mass of primed LRE to its greatest thrust in main pattern. Note: When there are several main patterns it is determined according to the greatest thrust.	$m_{Д,у}$
63. Relative mass of turbopump aggregate (Relative TPA mass)	Mass of TPA per unit of power producable by gas turbine	
64. LRE working time	Time from first command for start-up of LRE to first command for its stop. Note: For LRE of multiple actuation the working time is a sum of the working time of LRE corresponding to each actuation.	
65. Impulse of LRE aftereffect	Impulse of LRE thrust from first command for its stop to complete disappearance of thrust	
66. LRE high-altitude characteristic	Dependence of thrust on environmental pressure with constant pressures in combustion chamber and correlation of propellation components	
67. LRE throttle characteristic	Dependence of thrust on pressure in combustion chamber with constant correlation of propellant components and environmental pressure	

Operating Pattern of Liquid-Propellant Rocket Engine

68. LRE operating pattern	State of operating LRE determined by collection of parameters of the processes occurring in it	
69. Starting of LRE	LRE operating pattern from first command for its actuation to passage to main pattern (71)	
70. Pattern of preliminary stage of LRE	Steady-state operating pattern of LRE during start-up with thrust less than thrust in main pattern. Note: Several patterns of preliminary stages can occur.	

71. Main LRE operating pattern	LRE operating pattern which is the determining one during the fulfillment of the main task. Note: Several main patterns can occur.
72. Pattern of final stage of LRE	Steady-state LRE operating pattern before stop with thrust less than the thrust for the main pattern.
73. Stop of LRE	LRE operating pattern from first command for its shutdown to complete disappearance of thrust. Note: The pattern of the final stage is not included in the stop of LRE.
74. Emergency LRE shutdown ESE	Premature shutdown of LRE produced by breakdown of LRE, EA, stand systems or aircraft system.

Chamber (Gas Generator) of Liquid-Propellant Rocket Engine

75. LRE Combustion chamber	Section of LRE chamber in which the processes of carburetion and combustion of propellant components and (or) products of gas generation mainly occur. Note: It includes displacing head (76) and a part of the frame of the chamber (80) before the first section of the nozzle.
76. Displacing head of chamber (gas generator)	Section of chamber (gas generator) of LRE which is a device for feeding the components of propellant and (or) products of gas generation into the fire space and initially for their intermixing.
77. Displacing head end plate	Part of displacing head which separates the cavities of propellant components or products of gas generation from each other, or separates them from the fire space and the outer medium (draw. 1) Note: 1. Usually an outer, middle and inner end plate are distinguished. 2. In the LRE chambers with afterburning the gas conduit can fulfill the role of the outer end plate.
78. Gas distributing network	Element of the displacing head which provides the necessary distribution of gas consumption over the area of the displacing head and an improvement in

	stability of the working process in the combustion chamber (136)
79. Antipulsation barrier	Element of displacing head which improves the stability of the working process in the combustion chamber (gas generator)
80. Frame of chamber (gas generator)	Section of chamber (gas generator) which is a casing forming the wall of the nozzle and combustion chamber without displacing head. Note: In the designs with circulating (171) or transpirating (177) cooling it usually consists of an inner and outer wall forming the cooling channel (81) or part of it.
81. Cooling channel of chamber (gas generator)	Collection of channels in framework and displacing head of chamber (gas generator) with circulating or transpirating cooling serving for the flow of the coolant
82. Band of screens of chamber (gas generator)	Set of elements of chamber (gas generator) located in one cross section and designed to feed one of the propellant components or products of gas generation into the boundary region of the fire space to create a protective layer of liquid or gas.
83. Single zone gas generator	Gas generator in which propellant components are only fed through displacing head
84. Multizone gas generator	Gas generator in which the propellant components are fed through the displacing head and frame

Nozzle of Chamber of Liquid-Propellant Rocket Engine

85. Nozzle of LRE chamber	Section of chamber forming channel of varying section in which the heat energy of the combustion products is converted into kinetic energy of the exhaust stream
86. Axisymmetric nozzle	Nozzle show surface on the side of the stream of combustion products is axisymmetric
87. Round nozzle	Axisymmetric nozzle in which any section of the stream of combustion products perpendicular to axis of symmetry is a circle

88. Ring nozzle	Axisymmetric nozzle in which a portion or all of the sections of the current of combustion products perpendicular to axis of symmetry are are ring (drawings 7, 8, 9)
89. Contour of nozzle	The intersection line of the nozzle surface on the side of the stream of combustion products with the half plane passing through its central axis. Note: The outer and inner section of the contour are distinguished in the ring nozzles.
90. Conical section of nozzle	Section of nozzle between the first (101) and minimum sections
91. Expanding section of nozzle	Section of nozzle between minimum section and cut-off of nozzle
92. Conical nozzle	Round nozzle whose expanding section, beginning with the section near the minimum has a rectilinear contour
93. Profiled nozzle	Nozzle whose expanding section has a curvilinear contour, profiled in order to increase the nozzle efficiency.
94. Extremal contour of nozzle	Contour of profiled nozzle whose expanding section is determined with the help of variation methods
95. Nozzle contour with uniform characteristic	Contour of profiled nozzle whose expanding section provides a parallel stream in the outgoing section of the nozzle with the same amount of speed at any point of this section
96. Shortened contour of nozzle	Contour of profiled nozzle whose expanding section is the first part of the expanding section of nozzle with a contour with uniform characteristic
97. Nozzle contour with angular point	Nozzle contour with angularity. Note: Usually the angularity of the contour occurs in the critical section (103).
98. Pin-type nozzle Inad. Nozzle with outer expansion. Nozzle with covered (semi-covered) shell	Ring nozzle whose contour of the expanding section almost or completely lacks an outer section (draw. 8)

99. Plate-like nozzle Inad. Mushroom nozzle. Nozzle with inner expansion	Ring nozzle whose contour of the expanding section almost or completely lacks an inner section (draw. 9)
100. Telescopic nozzle	Nozzle with one or several extensible fittings which in the extended position are a continuation of the expanding section of the nozzle and increase its degree of expansion (108)
101. First section of nozzle	Conventional flow-passage section of chamber beyond which intensive change in the area of the flow-passage section begins. Note: 1. The parameters in this section are given the index "c". 2. For round nozzles it is a flat, perpendicular to axis of symmetry section while for ring nozzles the first section can be not flat (conical, cylindrical, etc).
102. Minimum section of nozzle	Flow-passage section of nozzle which has the minimum area. Note: 1. The parameters in this section are given the index "m" (if this section differs from the critical). 2. For round nozzles the minimum section is a flat section perpendicular to the axis of symmetry, for ring nozzles it can be not flat
103. Critical section of nozzle	Flow-passage section in which the gas speed equals the local speed of sound. Note: 1. The parameters in this section are given the index "*". 2. When there are irreversible processes in the nozzle the critical section located according to the stream below the minimum section. 3. In practice the critical and minimum sections are often identified.
104. Outgoing section of nozzle	The section, perpendicular to the central axis, passing through the end point of the nozzle contour.

Term	Definition	Symbol
	Note: 1. The parameters in this section are given the index "a". 2. By the area of the outgoing section of the ring nozzle is meant the area of the section conducted through the end point of the outer section of the ring nozzle contour (draw. 7,8,9) 3. For nozzles with oblique cut (107) it is conducted through the end point of the shortest contour	
105. Contour of outgoing nozzle opening	Closed line conducted through outgoing end points of all nozzle contours. Note: Not defined for ring nozzles.	
106. Nozzle cut	Surface of minimum area limited by contour of outgoing opening of nozzle. Note: 1. Not defined for ring nozzles. 2. For axisymmetric, not ring nozzles it coincides with the outgoing section	
107. Oblique cut of nozzle	Nozzle cut at angle to axis, distinct from straight Note: The nozzle with oblique cut is not axisymmetric, however it can consist of main, axisymmetric section and small non-axisymmetric section.	
108. Geometric degree of nozzle (Degree of nozzle expansion) Inad. <u>Expansion of nozzle</u>	Ratio of area of outgoing section of nozzle to area of its minimum section	$\bar{F}$
109. Degree of expansion of gas in nozzle	Ratio of braking pressure in first section of nozzle to static pressure in its outgoing section. Note: In terms (109-112) by "pressure" is meant the pressure determined in linear approximation.	ε
110. Rated operating pattern of nozzle	Operating pattern of nozzle in which the gas pressure in its outgoing section equals the pressure of the environment.	
111. Operating pattern of nozzle with underexpansion	Operating pattern of nozzle in which the gas pressure in its outgoing section is higher than the environmental pressure.	

112. Operating pattern of nozzle with overexpansion	Operating pattern of nozzle in which gas pressure in its outgoing section is below environmental pressure
113. Adjustable nozzle	Nozzle whose degree of expansion can by changed in the required manner during its operation
114. Altitude of nozzle	Altitude above sea level at which under standard atmospheric conditions the operating pattern of the nozzle is the rated. Note: Instead of altitude it is permitted to use the environmental pressure corresponding to it.

Turbopump Aggregate of Liquid-Propellant Rocket Engine and Other Aggregates of Propellant Supply

115. Oxidant pump	Pump for supplying oxidant to LRE aggregates
116. Fuel pump	Pump for supplying fuel to LRE aggregates
117. Booster pump aggregate	Aggregate installed in propellant trunk line before inlet to LRE pump in order to increase the pressure of the component entering this pump and which consists of a pump and drive. Note: The drive can be a hydroturbine, gas turbine, electric drive, etc.
118. Worm rotary pump	Pump with pre-actuated worm feeder
119. Jet prepump LRE	Booster-type jet pump (draw. 11).
120. Launching turbine of turbopump aggregate	Gas turbine providing start of TPA rotor during LRE launching.
121. Turbopump aggregate spring	Part of TPA designed for spring connection of coaxial shafts of of the aggregates in it and for transmission of the torque (draw. 12) Note: The spring permits relative radial and axial shift of the shaft axes without disrupting the normal TPA operation.
122. Floating sealing ring of turo-pump aggregate pump	Part separating the cavities with different pressures in the TPA pump, made in the form of a ring which is self-adjusting during the pump operation under the influence of hydrodynamic forces and a drop in pressures (draw. 13).

123. Launching nozzle	Autonomous nozzle or group of nozzles in stator of TPA turbine used to start TPA
124. Pneumoblock	One or several cylinders with supply of compressed gas equipped with valves and reducers for charging the cylinders and turning on the gas. Note: The pneumoblock is used for pressurized propellant supply, starting up the LRE (LRE aggregates), supercharging the tanks, etc.
125. Solid-propellant LAP	Aggregate generating by combustion of solid propellant grains gases which serve to displace the components of liquid propellant from the tanks or for auxiliary purposes. Note: By auxiliary purposes is meant TPA overspeeding during start-up, feeding of steering nozzles, etc.

Devices and Means for Creating Controlling Forces and Momentum in Liquid-Propellant Rocket Engine

126. LRE Steering chamber	Auxiliary immobile or rotating chamber serving to create controlling forces and momentum
127. Steering nozzle	Auxiliary rotating or immobile nozzle serving to create controlling forces and momentum
128. Rotating chamber LRE	Chamber which can rotate relative to the immobile LRE sections.
129. Rotating nozzle	Nozzle which can rotate relative to the immobile section of the chamber (drawing 14).
130. Gas vane	Profiled rotating element installed in current of products of combustion near the outgoing section of nozzle and having two working surfaces streamlined by the current (drawing 15).
131. Peripheral vane	Profiled rotating element, in neutral position is a continuation of the nozzle and has one working surface streamlined by the current of combustion products (drawing 16).
132. Controlling flap	Blade located near outgoing section of nozzle and can be moved into the stream of combustion products (drawing 17).
133. Rotating section of nozzle	Outgoing section of nozzle which can rotate relative to immobile section of nozzle (draw. 18).

134. Steering drive	Drive which changes the position of the rotating or movable devices creating controlling forces and momentum
135. Injection into nozzle	Irregular feeding into expanding section of nozzle of secondary gas stream (liquid-propellant)resulting in the development of lateral unbalanced force (draw. 19).

Working Process in Combustion Chamber (Gas Generator) of Liquid-Propellant Rocket Engine

136. Working process in combustion chamber (gas generator) LRE	Collection of physicochemical processes of conversion of propellant components or products of gas generation into products of combustion (gas generation) occurring in the combustion chamber (gas generator)
137. Carburetion in combustion chamber (gas generator)	Distribution, intake,diffusion and movement of propellant components and gas generation products
138. Diffusion of liquid components of propellant	Breakdown of stream or sheet of propellant components flowing from jet into drops
139. Boundary layer in combustion chamber (gas generator) LRE	Section of stream in combustion chamber (gas generator) adjacent to walls and differing from main part of stream in fundamental chemical composition, thermophysical characteristics and speed. Note: The division of the stream into core (140) and boundary layer is arbitrary.
140. Core of stream in combustion chamber (gas generator) LRE	Central and main section of stream in combustion chamber (gas generator) where the passage of its working process is essentially not affected by the walls of the combustion chamber (gas generator) and the boundary layer.
141. Flow intensity of chamber (gas generator)	Ratio of mass consumption of combustion products to area of cross flow section to chamber (gas generator) at displacing head
142. Relative flow intensity of combustion chamber (gas generator)	Ratio of flow intensity to pressure in chamber of combustion (gas generator)

143. Mean time of stay in combustion chamber	Ratio of mass of products in combustion chamber to mass consumption of propellant by combustion chamber
144. Relative length of combustion chamber	Ratio of sum of volumes of combustion chamber and conical section of nozzle to area of minimum section of nozzle

Stability of Working Process in Combustion Chamber (Gas Generator) of Liquid-Propellant Rocket Engine

145. High-frequency oscillations in combustion chamber (gas generator) LRE	Auto-oscillations in combustion chamber (gas generator) with frequency near to one of its own acoustic frequencies.
146. Longitudinal oscillations in combustion chamber (gas generator) LRE	High-frequency oscillations along chamber (gas generator) axis
147. Cross oscillations in combustion chamber (gas generator) LRE	High-frequency oscillations in plane perpendicular to chamber (gas generator) axis Note: Depending on the direction of the oscillating movement of the gas tangential, radial and mixed cross oscillations are distinguished.
148. Low-frequency oscillations in combustion chamber (gas generator) LRE	Auto-oscillations in combustion chamber (gas generator) with frequency considerably lower than the minimum inherent acoustic frequency.
149. Nozzle impedance	Complex amount whose modulus equals the ratio of amplitude of oscillations in pressure to the amplitude of oscillations in speed in the first section of the nozzle, and the phase--to the shift in phases between oscillations in pressure and oscillations in speed.
150. Impedance of displacing head of chamber (gas generator)	Complex amount whose modulus is equal to the amplitude of oscillations in pressure to the amplitude of oscillations in the speed at the displacing head, and phase--to the shift in phases between oscillations in pressure and oscillations in speed.
151. Light excitation of auto-oscillations in combustion chamber (gas generator) LRE	Development in combustion chamber (gas generator) of auto-oscillations from arbitrarily light disturbances.

152. Strong excitation of auto-oscillations in combustion chamber (gas generator) LRE	Development in combustion chamber (gas generator) of auto oscillations from disturbance exceeding the specific-critical value
153. Stable working process in combustion chamber (gas generator) LRE	Working process in combustion chamber (gas generator) without autooscialations
154. Unstable working process in combustion chamber (gas generator) LRE	Working process in combustion chamber (gas generator) with auto-oscillations
155. Region of stability for working process in combustion chamber (gas generator)	Region of values of parameters for operating pattern of combustion chamber (gas generator) in which working process is stable.
156. Region of instability of working process in combustion chamber (gas generator)	Region of values of parameters for operating pattern of combustion chamber (gas generator) in which working process is unstable.
157. Border of stability of working process in combustion chamber (gas generator) LRE	Collection of values of parameters for operating pattern of combustion chamber (gas generator) separating the region of stability of the working process from the region of instability.
	Processes of Flow in Nozzles
158. Equilibrium flow in nozzle	Model of flow in nozzle according to which at each point of the current there exists an energy, chemical and phase equilibrium of the combustion products. Note: 1. By energy equilibrium is meant the equilibrium distribution of atoms and molecules according to the energy states. 2. It is the limiting case in which the greatest release of energy occurs.
159. Nonequilibrium flow in nozzle	Flow in nozzle in which there is no energy, chemical or phase equilibrium or even if one of these types of equilibrium.

160. Chemically frozen flow in nozzle	Model of flow according to which the chemical composition of the combustion products moving in the nozzle does not change. Note: The energy of recombination is not released and the greatest losses occur due to the chemical nonequilibrium	
161. Multiphase flow in nozzle	Flow in nozzle of combustion products consisting of gas, liquid and solid phases. Note: Multiphase flow in the nozzle occurs with a flow of combustion products which contains particles of condensed components, for example, oxides. The parameters of condensed particles are given the index "s", for example, w_s--velocity of particles, r_s--radius of particles, etc.	
162. Velocity lag in nozzle	Difference in velocities of particles of the condensed phase and the gas environment surrounding it.	
163. Temperature lag in nozzle	Difference in temperatures of particles of condensed phase and gas environment surrounding it.	
164. Losses in specific impulse in nozzle (Losses in nozzle)	Relative losses in specific impulse in vacuum, governed by deviation of actual parameters of combustion products in nozzle from ideal. Note: $\zeta_c \approx \zeta_p + \zeta_{\text{тр}} + \zeta_{\text{н}} + \zeta_s + \zeta_{\text{пр}}$, where: ζ_p--losses due to dispersion (165); $\zeta_{\text{тр}}$--losses due to friction (166); $\zeta_{\text{н}}$--losses due to chemical nonequilibrium of flow (167); ζ_s--losses due to multiphase nature (168); $\zeta_{\text{пр}}$--other unaccounted for losses.	ζ_c
165. Losses due to dispersion in nozzle	Losses in nozzle governed by nonuniformity of parameters of current in outgoing section of nozzle	ζ_p
166. Losses in nozzle due to friction	Losses in nozzle governed by friction and encumbering of transitional sections of nozzle by boundary layer (displacement)	$\zeta_{\text{тр}}$
167. Losses in nozzle due to chemical nonequilibrium of flow	Losses in nozzle governed by chemical nonequilibrium of combustion products	$\zeta_{\text{н}}$

168. Losses in nozzle due to multi-phase nature	Losses during flow of multiphase combustion products in nozzle produced by final time of relaxation during formation, cooling and hardening of particles of the condensed phase, as well as their velocity and temperature lag from the gaseous medium.	ξ_s
169. Index of adiabatic curve	Index of degree in equation p/ρ^{x} = const (p--pressure, ρ--density), describing the flow of gaseous products of combustion in the nozzle when heat exhange with the environment is lacking	x

Cooling and Thermal Protection of Aggregates of Liquid-Propellant Rocket Engines

170. Outer LRE cooling	Removal of heat from elements in LRE construction to coolant or to surrounding space
171. Flow-type cooling	Outer cooling by coolant flowing along channels in wall
172. Autonomous cooling	Flow-type cooling in which the removable heat is not transmitted by propellant components
173. Regenerative cooling	Flow-type cooling in which the removable heat is transmitted by the propellant components
174. Radiation cooling	Outer cooling implemented by emission of heat into surrounding space
175. Inner cooling	Reduction in heat flow to elements of LRE construction by creating on their surface a protective layer of liquid or gas.
176. Screen cooling	Inner cooling implemented by creation of a protective layer of liquid or gas flowing along the wall. Note: When there is a liquid phase in the protective layer the screen is called liquid, when there is none--gas.
177. Transpirating cooling	Inner cooling implemented by injecting gas or vapor into the boundary layer through a porous or perforated wall.
178. Capacity cooling	Prevention of overheating of structural element by absorbing heat by its material without removal of mass.

179. Ablation cooling	Prevention of overheating of structural element by absorbing heat by its material with removal of mass.
180. Heat-insulating protection	Reduction of heat flow by inclusion in the construction of an aggregate of elements with high heat resistance. Note: It is implemented by using heat-insulating coverings of the walls, shields, etc. in chambers, gas generators, and other aggregates for their protection from the effect of high temperatures or to reduce the losses of heat or cold

Operation of Liquid-Propellant Rocket Engine

181. Operation of LRE	The use of LRE according to purpose or its readiness for direct use in the ~~compsition~~ composition of aircraft.
182. Thermostatic control of LRE (LRE aggregate)	Bringing the LRE (LRE aggregate) temperature to the assigned and maintaining it.
183. Thermostatic control of propellant component	Bringing the temperature of the propellant component to the assigned and maintaining it.
184. Prestart consumption of propellant component LRE	Mass of propellant component consumed by engine of first stage from first command for LRE actuation to start of movement of aircraft
185. Blowing through LRE (LRE aggregates)	Process of substitution of products of combustion, gas generation, propellant components or atmospheric air in inner LRE cavities by air, neutral or special gases.
186. LRE neutralization (LRE aggregates)	Treatment of LRE (LRE aggregate) in order to remove residue of propellant components and other substances and rendering harmless of unremoved residue.
187. Passivation of LRE cavities	Treatment of LRE cavity surfaces as a result of which the material on the surfaces is transferred into an inert state in relation to the agressive action of the components.

Testing of Liquid-Propellant Rocket Engine

188. Flight testing of LRE (FT)	Testing of LRE during flight in composition of aircraft
189. Flight and structural testing of LRE (FST)	Flight testing of rebuilt or modified LRE in order to verify the compliance of its characteristics to the specifications, in the process of which additional LRE sizing can be performed.
190. Stand testing of LRE (LRE aggregate)	Autonomous testing of LRE (LRE aggregate) on test stand.
191. Fire testing of LRE (LRE aggregate)	Stand testing of LRE (LRE aggregate) with combustion of propellant in it.
192. Cold testing of LRE (LRE aggregate)	Stand testing of LRE (LRE aggregate) without combustion of propellant in it.
193. Operating life testing of LRE (LRE aggregate)	Testing conducted in order to determine the operating life of the LRE (LRE aggregate).
194. Sizing testing of LRE (LRE aggregate)	Testing of LRE in order to finish off the construction and bring the characteristics of the LRE (LRE aggregate) to the values corresponding to the specifications.
195. Concluding sizing testing of LRE (LRE aggregate) (SCT)	Sizing testing of final structural variant of LRE (LRE aggregate) at the initial stage of which an insignificant correction in the design is possible,
196. Research testing of LRE (LRE aggregate)	Testing of LRE (LRE aggregate) in order to study the phenomena determining the parameters or the LRE characteristics (LRE aggregate)
197. Adjusting testing of LRE	Fire testing of LRE before the start or resumption of commercial production in order to verify the technology and quality of manufacture
198. Adjusting testing of LRE aggregate	Testing of LRE aggregate before start or resumption of commercial production in order to verify the technology and quality of manufacture
199. Control and technical testing LRE (CTT)	Fire testing of each LRE model during commercial production to verify the compliance of its characteristics to specifications.

200. Control and sampling testing of LRE (CST)	Fire testing of individual LRE selected from batch according to the results of which the suitability of the batch is determined.
201. Control testing of LRE aggregate	Stand testing of each model of LRE aggregate during its commercial production in order to verify the compliance of the characteristics to the specifications.
202. Control and sampling testing of LRE aggregate	Testing of individual LRE aggregate selected from batch according to the results of which the suitability of the batch is determined.
203. Interdepartmental testing of LRE (IDT)	According to GOST 16504-70
204. Special verifying testing of LRE (SVT)	Fire testing of LRE conducted in expanded relative to working range of parameters in order to verify the stability of production
205. Stand for testing LRE (LRE aggregate)	-
206. Testing complex	Complex of stands for various types of tests for LRE and its aggregates
207. Stand base	Collection of testing complexes available to enterprise (department)

Liquid Rocket Propellant

208. Component of liquid rocket propellant (Component of propellant)	Part of liquid rocket propellant, can be stored separately and fed into LRE, differs in composition. Note: 1. The propellant component can consist of one or a mixture of individual chemicals. 2. Liquid rocket propellant can be one-, two- or multi-component (three-component, etc.).
209. Liquid rocket fuel	Component of liquid rocket propellant, oxidizable during combustion
210. Liquid rocket oxidant	Component of liquid rocket propellant serving to oxidize the fuel in the process of combustion.

211. Main liquid rocket propellant	Liquid rocket propellant serving to produce all or the main percentage of thrust. Note: In the IRE usually only one propellant is used which is also employed for auxiliary purposes (feeding of aggregates of pump supply, devices for creating controlling forces and momentum, etc.).
212. Auxiliary liquid rocket propellant	Liquid rocket propellant which differs from the main and is used only for auxiliary purposes, whose products of gas generation or combustion are discarded aside from the combustion chamber of the main chamber. Note: The components of main propellant can be one or several of the components of two or multi-component auxiliary propellant. At the same time the components of auxiliary fuel are auxiliary oxidant or fuel respectively.
213. Density of liquid rocket propellant	Calculated amount equal to the ratio of the total mass of the propellant components to their volume at the assigned value of the component correlation.
214. Efficiency of rocket propellant	Relative characteristic of rocket fuel under conditions of its use in EA which are optimal for fulfilling the assigned task with the standard and available propellants as determined by the final result of employing the EA on these propellants. Note: The final results for the use of the EA are usually evaluated by the amount of changes in the net load or speeds of flight at the end of the active portion of trajectory.
215. High-boiling component of liquid rocket propellant	Component of liquid rocket propellant which has at the maximum temperature under operating conditions or storage a pressure of the saturated vapor below the permissible according to the conditions for the strength of propellant tanks. Note: High-boiling component of liquid rocket propellant can be stored in the condensed state in hermetically sealed stationary tanks and propellant tanks without taking special measures for cooling the component or recovering the condensate, essentially without losses for evaporation.
216. Low-boiling component of liquid rocket propellant	Component of liquid rocket propellant which has at the maximum temperature under operating conditions or storage a pressure of saturated vapor above the

	permissible according to the conditions for the strength of propellant tanks. Note: Low-boiling component of propellant cannot be stored in the condensed state in hermetically sealed propellant tanks without taking special measures for cooling the component or recovering the condensate.
217. Cryogenic component of liquid rocket propellant	Component of liquid rocket propellant which has a critical temperature lower than the maximum temperature under the conditions of operation or storage. Note: The cryogenic component cannot be stored in the condensed state in hermetically sealed tanks without taking special measures for cooling the component or recovering the condensate.
218. Stable component of liquid rocket propellant	Component of liquid rocket propellant which has stability of the physicochemical properties under conditions of operation or storage during the assigned time. Note: The stable component can be stored for several years.
219. Stable liquid rocket propellant	Liquid rocket propellant consisting only of stable components.
220. Thermostability of component of liquid rocket propellant	Ability of component of liquid rocket propellant to preserve its chemical composition and not to separate solid ingredients during heating under operating conditions.
221. Radiation stability of component of liquid rocket	Ability of component of liquid rocket propellant to preserve its physicochemical properties during lengthy action of electromagnetic and corpuscular radiation.
222. Hypergolic liquid rocket propellant	Liquid rocket propellant which is combustible during the contact of its components in the liquid state in the entire range of pressures and temperatures occurring during LRE operation.
223. Limited-hypergolic liquid rocket propellant	-
224. Non-hypergolic liquid rocket propellant	-

225. Coefficient of excess of oxidizing elements	Ratio of sum of products for number of gram-atoms of oxidizing elements for their highest valency to the sum of products for the number of gram-atoms of oxidizable elements in the same amount of propellant for their highest valency. Note: With $\alpha=1$ the products of combustion contain only products of compelete oxidation.	α
226. Coefficient of excess oxidant	Ratio of actual correlation of propellant components to the correlation at which only products of complete oxidation are obtained.	α_{OK}
227. Launching liquid rocket propellant	Liquid rocket propellant used only for launching LRE	
228. Standard rocket propellant	Rocket propellant to characteristics of which the corresponding characteristics of the propellant at hand are compared.	
229. Nitric acid oxidant	Liquid rocket oxidant--based on nitric acid or a mixture.	
230. Nitric tetroxide oxidant	Liquid rocket oxidant based on nitric tetroxide or a mixture.	
231. Fluorine oxidant	Liquid rocket oxidant--simple fluorine or its mixture with other substances, as well as oxidant which contains fluorine-containing compounds.	
232. Oxygen propellant	Liquid rocket propellant which contains liquid oxygen as the oxidant.	
233. Nitric acid propellant	Liquid rocket propellant which contains a nitric acid oxidant.	
234. Hydrogen peroxide propellant	Liquid rocket propellant which contains hydrogen peroxide as the oxidant.	
235. Fluorine propellant	Liquid rocket propellant which contains a fluorine oxidant. Note: It is possible to have types of liquid rocket propellant which are determined according to the types of oxidants and fuels they contain, for example: nitric acid-kerosene, nitric tetroxide-dimethylhydrazine, oxygen-hydrogen, etc.	
234. Nitrogen tetroxide propellant	Liquid rocket propellant which contains nitrogen tetroxide as the oxidant.	

237. Metal-containing propellant	Rocket propellant which contains metals or metal-containing compounds.
238. Pseudo-liquid propellant	Rocket propellant which contains powdery components which can be fluidized fed similar to the liquid component.
239. Thixotropic propellant	Rocket propellant containing one or several components in the gelatinous state which acquire fluidity under the influence of a drop in pressure.
240. Sludge-like propellant	Rocket propellant containing one or several components in the sludge-like state. Note: It is a liquid-moving mixture of substances in the liquid and solid states.
241. Suspension propellant	Rocket propellant whose component is a suspension
242. Addition to component of liquid rocket propellant	Substance added to component of liquid rocket propellant to give it the required properties
243. Inhibitor	Addition to component of propellant which inhibits undesirable chemical processes occuring during its use or storage. Note; By "undesirable" is meant processes: polymerization and oxidation of component, corrosion of metal contacting the component, etc.
244. Stabilizer of component of liquid rocket propellant	Addition to component of liquid rocket propellant to increase the stability of its physicochemical properties during storage or use.
245. Retarder of component of liquid rocket propellant	Addition to component of liquid rocket propellant which reduces the sensitivity of the component to external factors.

Alphabetical Index of Terms

Appendix 1 to GOST 17655-72 Recommended

Automatic Devices of Liquid-Propellant Rocket Engines and Their Characteristics

Term	Definition
1. Regulator	Automatically acting device which ensures the maintenance of any parameter as constant or its change according to the assigned law. Note: The regulator generally consists of a sensitive element, amplifier-converter consisting in turn of an actuating mechanism and regulating device.
2. Sensitive element of regulator	Device reacting to deviation of regulated parameter from assigned value, manufactures and transmits reaction to amplifier-converter, and if this is lacking, to the actuating device.
3. Controller of regulator	Device which introduces the assigned value of the regulated parameter.
4. Regulator of direct action	Regulator whose regulating device is adjusted directly by the sensitive element without an additional source of energy.
5. Regulator of indirect action	Regulator whose regulating device is adjusted due to an additional energy source controlled by the sensitive element.
6. Regulator of consumption	Regulator whose sensitive element reacts to the deviation in consumption of liquid or gas from the assigned amount.
7. Regulator of pressure	Regulator whose sensitive element reacts to a deviation in pressure of the liquid or gas from the assigned amount.
8. Pressure reducer	Regulator of pressure of direct action which reduces the pressure of the gas or liquid passing through it to the assigned amount.
9. Tuning characteristic of regulator	Dependence of regulated parameter on the value of the reference action (signal) or on the position of the controller.
10. Loading characteristic of regulator Inad. Efficiency characteristic	Dependence of regulated parameter on value of parameter at inlet or outlet of regulator

11. Throttle	Device designed for smooth change in hydraulic resistance by partial covering of working through sections with the help of actuating mechanism.
12. Throttle plate	Device which has constant through section installable in liquid or gas line to create local hydraulic resistance.
13. Jet	Throttle plate with small through section.
14. Valve	Device opening and closing the passage of liquid or gas in the line on which it is installed.
15. Triggering of valve	Shifting of parts opening or closing the through section of the valve from one fixed position to another.
16. Automatic valve	Valve which is triggered by forces of liquid (gas) pressure in the line on which it is installed.
17. Controlled valve	Valve which is triggered upon reception of a command signal directly not related to pressure or consumption of liquid (gas) in the line on which it is installed.
18. Valve of direct action	Valve which is triggered by energy contained in command signal.
19. Valve of indirect action	Valve which is triggered by energy not contained in command signal.
20. Valve of single triggering	Valve whose parts are not reset after triggering.
21. Valve of multiple triggering	Valve whose parts are reset after a specific cycle of triggering.
22. Pneumovalve	Valve in which the actuating mechanism is triggerd by the pressure of the controlling gas
23. Pyrotechnic valve	Valve which includes a pyrotechnic cartridge producing triggering of the valve during the feeding of an electric impulse.
24. Electric valve EV	Valve which is triggered by an electromagnet included in the composition of the valve.
25. Electropneumatic valve EPV	Valve in which the actuating mechanism is controlled by an electromagnet included in the composition of the valve, while the triggering of the valve is implemented by the pressure of the gas in the line on which it is installed.

26. Electrohydraulic valve EHV	Valve in which the actuating mechanism is controlled by an electromagnet included in the composition of the valve, while the triggering of the valve is implemented by the pressure of the liquid in the line on which it is installed.
27. Membrane valve	Valve of single triggering in which the through section is covered by a membrane before triggering.
28. Pyrotechnic membrane valve	-
29. Pneumatic membrane valve	-

Appendix 2 to GOST 17655-72 Reference

Nozzles of Liquid-Propellant Rocket Engines

Term	Definition
1. LRE nozzle	Device for feeding the components of propellant or products of gas generation into the fire space of the chamber (gas generator) Note: It is usually an element of the displacing heads.
2. One-component nozzle	Nozzle through which is fed either one component of propellant or reducing or oxidizing products of gas generation (draw. 2).
3. Two-component nozzle	Nozzle through which simultaneously are fed either two different components of propellant or oxidizing and reducing products of gas generation in combination with one of the types of gas generation products (draw. 3).
4. Jet nozzle	Nozzle from which the liquid (gas) comes out in the form of one or several streams (draw. 2).
5. Centrifugal nozzle	Nozzle at whose outlet the liquid has an axial as well as tangential component of speed (draw. 4, 5).
6. Jet-centrifugal nozzle	Nozzle combining elements of jet and centrifugal nozzles (draw. 6).

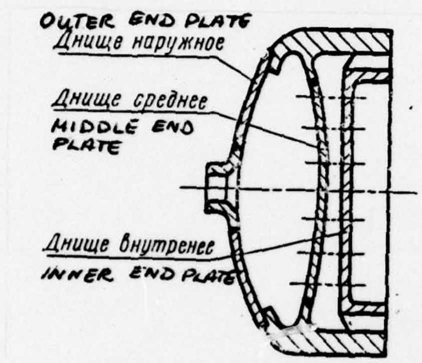
Appendix 3 to GOST 17655-72 Reference

Reliability of LRE

Term	Definition
1. Operating life of LRE (LRE aggregate)	Length of operation or number of cycles of triggering of LRE (LRE aggregate) during which LRE (LRE aggregate) maintains the assigned characteristics. Note: The length of work or the number of cycles of triggering of LRE (LRE aggregate) during control testing is not included in the LRE operating life.
2. Gamma-percent operating life of LRE	Operating life of LRE which has and exceeds on the average the conditional number (γ) of percents of items of the given type
3. Working life of LRE (LRE aggregate)	Length of work or number of cycles of triggering of LRE (LRE aggregate) in composition of aircraft

Appendix 4 to GOST 17655-72 Reference

<u>Schematic Drawings of Certain LRE Aggregates</u>



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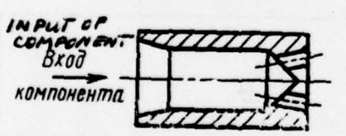

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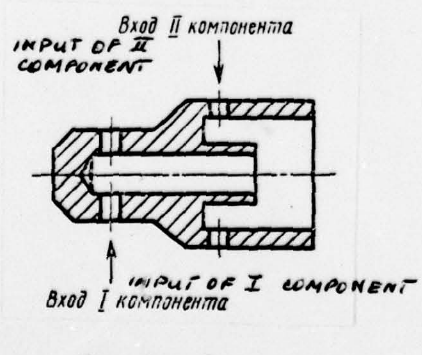

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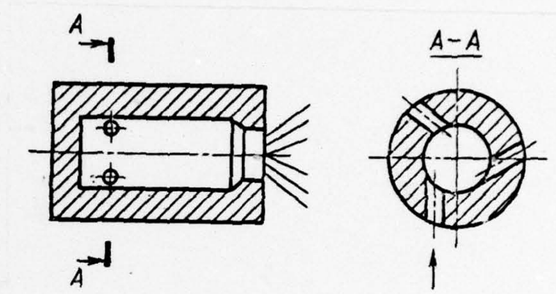

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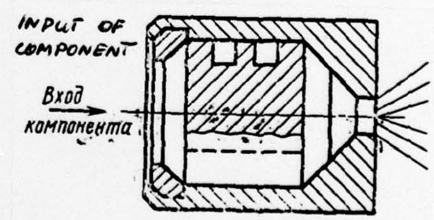

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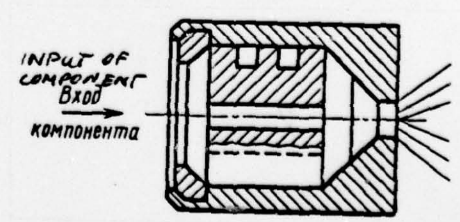

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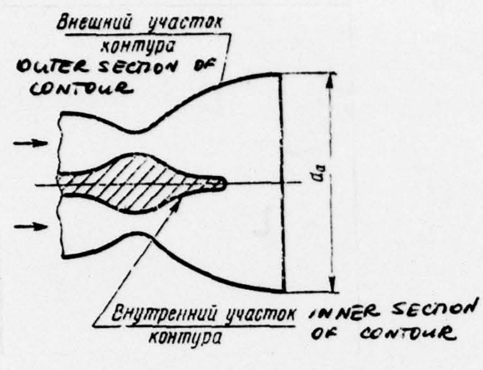

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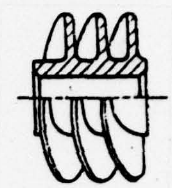

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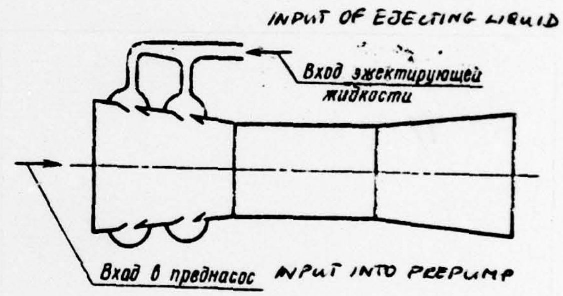

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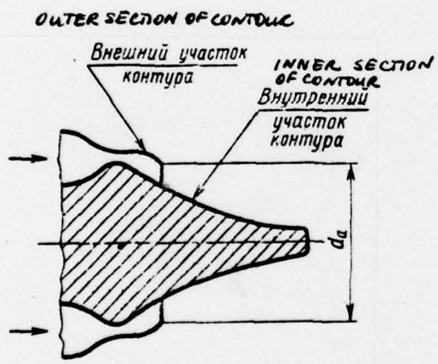

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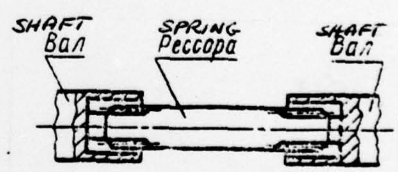

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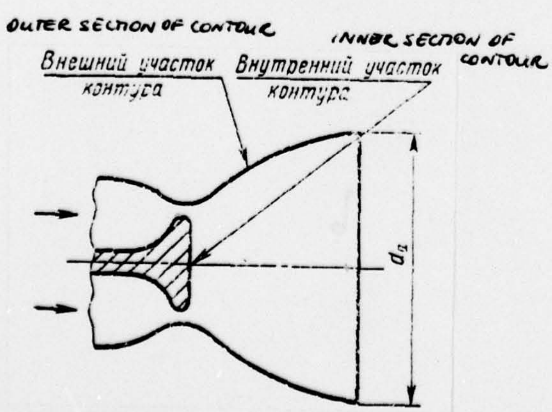

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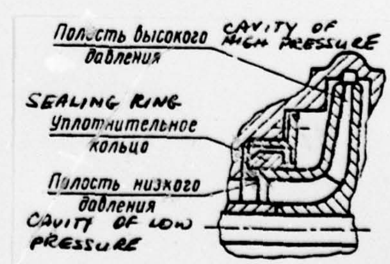

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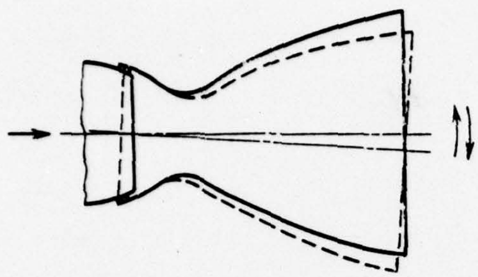

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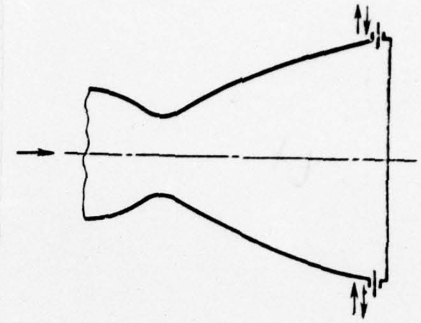

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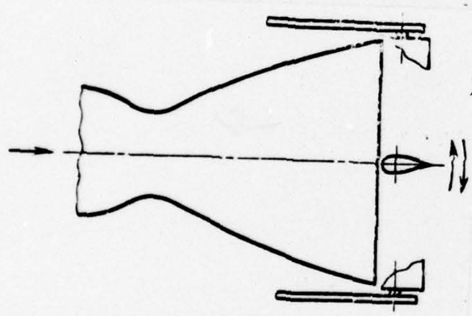

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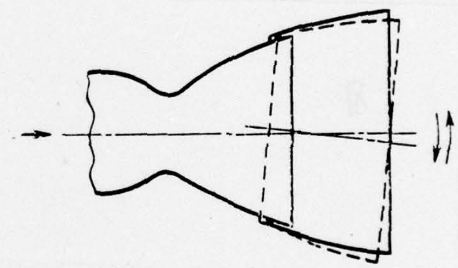

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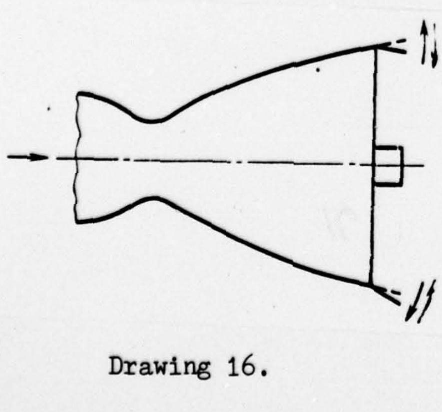

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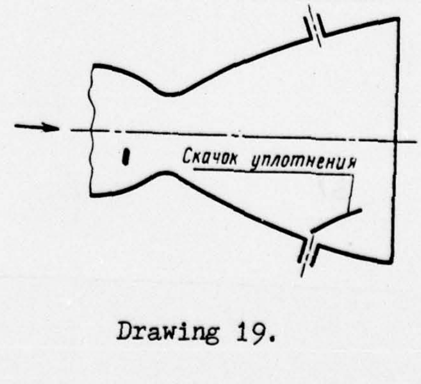

Drawing 19.

1 - SHOCK WAVE