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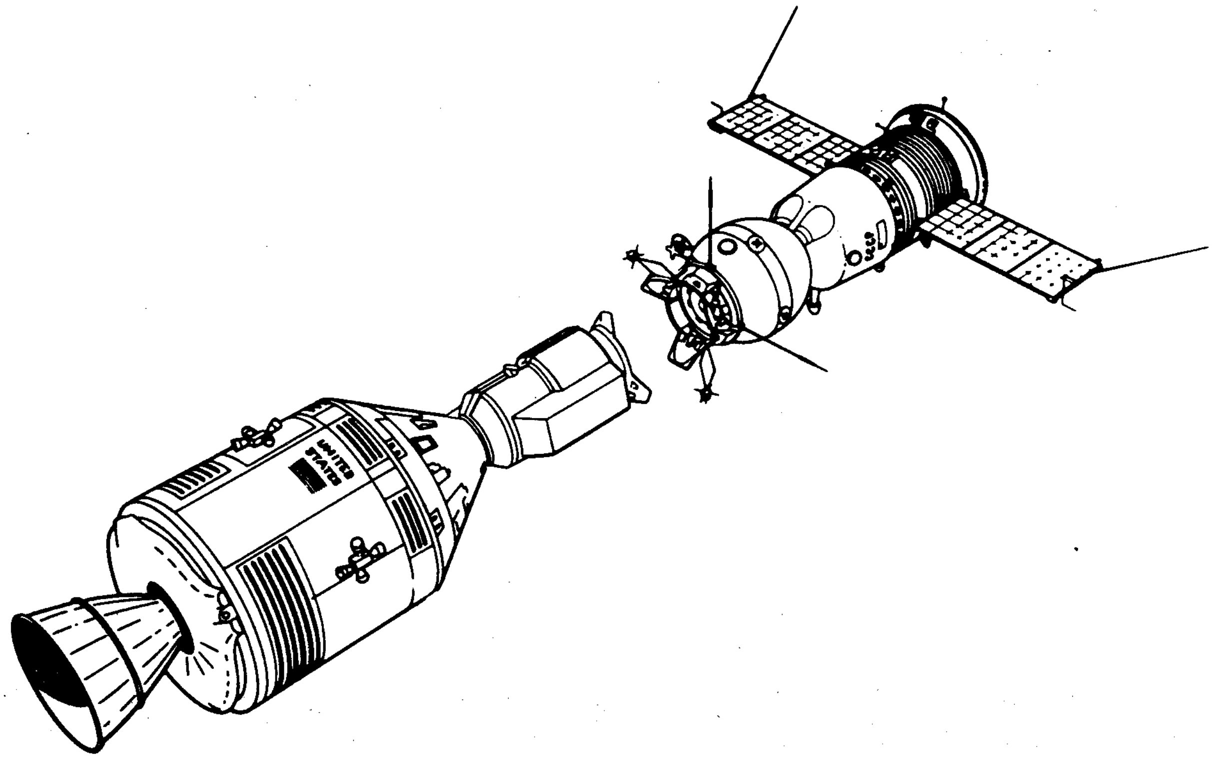
APOLLO SOYUZ TEST PROJECT



DESIGN CHARACTERISTICS

FOR SOYUZ AND APOLLO

USA - USSR

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1.0 INTRODUCTION

This document provides general design characteristics of the Soyuz and Apollo spacecrafts for reference during development of compatible rendezvous and docking systems necessary for the test flight. References are made to ASTP and IED documents that contain detailed interacting and compatibility requirements which take precedence.

2.0 ABBREVIATIONS

Apollo Soyuz Test Project	ASTP	ЭПАС
Soyuz Spacecraft	Soyuz	Союз
Apollo Spacecraft	Apollo	Аполлон
Launch Vehicle	LV	РН
Soyuz Orbital Compartment (module)	OM	ОМ
The Soyuz Descent Vehicle	DV	СА
Instrument-Assembly Module	IAM	ПАО
Apollo Command Module	CM	КМ
Apollo Service Module	SM	СЛМ
Apollo Command and Service Module	CSM	КСМ
Docking Module	DM	СМ
Apollo Spacecraft with the Docking Module	CSM/DM	КСМ/СМ
Androgynous Peripheral Docking System	APDS	АПАС
Attitude and Motion Control System Soyuz	AMCS	СОУД
Guidance and Navigation System	GNS	-СНН
Stabilization and Control System	SCS	-ССУ
Descent Power System	DPS	СУС
Rendezvous and Corrective Power System	RCPS	СКДУ

Approaching and Orientation Engines	AOE	ДПО
Orientation Engines	OE	ДО
Service Propulsion System	SPS	МДУ
Reaction Control System	RCS	РСУ
Life Support System	LSS	СОЖ
Launch Escape System	LES	САС
Electric Power System	EPS	СЭП
Cable System	CS	БКС
Radiotelemetry System	RTS	РТС
Radio Guidance System	RGS	СРН
Temperature Control System	TCS	СТР
Compartments Pressurization System	PS	СНО
Command and Signal Radio Line	CSRL	КРЛ
Crew Optical Alignment System	COAS	ОСРВ

3.0 SOYUZ DESIGN CHARACTERISTICS

3.1 SOYUZ GENERAL CONFIGURATION

3.1.1 Soyuz spacecraft general view is shown on Figure 3-1. The spacecraft coordination systems are defined in IED 50401.

3.1.2 The arrangement of orientation and control systems sensors and optical instruments of the spacecraft is included in the ASTP 10000 document.

3.1.3 The arrangement of orientation onboard lights and light pulsing beacon is included in the ASTP 10000 document. The requirements for the development and the mounting are given in IED 50301.

3.1.4 The arrangement of spacecraft docking targets is given in the ASTP 10000 document. The requirements for development and tolerances for mounting of docking targets are included in IED 50201 document. The check technique of the docking targets position is given in the IED 50202 document. The construction schemes of the main and additional (ABC) targets are shown in Figures 3-15 and 3-27.

The docking target ABC is used as a source of additional information about the angles and relative spacecraft orientation during docking. This target is a tridimensional device mounted on Soyuz spacecraft and can be viewed through Apollo sighting device.

3.1.5 The arrangement of spacecraft radio system antennas is given in ASTP 10000 document. The construction scheme of compatible VHF-radio station antennas are shown in Figures 3-16 and 3-17.

3.1.6 The spacecraft engines arrangement is given in IED 50401.

3.1.7 The identification marks scheme on the spacecraft are shown on sheet 11.

3.1.8 The Soyuz docking tunnel equipment is shown in Figure 3-30.

3.2 SOYUZ HABITABLE MODULES ARRANGEMENT

3.2.1 The orbital module arrangement (OM)

3.2.1.1 The orbital module interior is shown in Figure 3-2, 3-25, and 3-26.

3.2.1.2 The Apollo radio station mounting in the orbital module is shown in Figure 3-3.

3.2.1.3 The arrangement of TV and movie cameras and lamps in the orbital module is shown in Figure 3-4.

3.2.1.4 The scheme of the hatch cover is shown in Figure 3-5. Hatch details are defined in IED 50723.

3.2.1.5 The scheme of the crew-with-guests allocation in the orbital module is shown in Figure 3-6.

3.2.1.6 The general view of orbital module control panel and display console systems are shown in Figure 3-7 and 3-8. Detail LSS controls are defined in IED 50723.

3.2.1.7 The general view of orbital module J-box is shown in Figure 3-9.

3.2.1.8 The equipment to be transfered from Apollo to Soyuz and from Soyuz to Apollo is identified in IED's 50720 and 50721 respectively. The Soyuz transfer equipment container is used for stowage and transportation of the following TV and photographic equipment during cosmonaut transfer to Apollo:

- TV camera TK-6
- TV camera bracket
- still camera FK-6
- film rolls for still camera FK-6

The container design and equipment layout is given in Figure 3-31. The container location in OM is shown in Figure 3-28.

3.2.2 The descent vehicle (DV) arrangement.

3.2.2.1 The descent vehicle interior is shown in Figure 3-10 and 3-32.

3.2.2.2 The general view of the cosmonauts' instrument panel of DV is shown in Figure 3-11.

3.2.2.3 The general view of command signal devices in DV is defined in ASTP 20202.

3.2.2.4 The general view of the DV compatible VHF-radio-stations control panel is shown in Figure 3-12.

3.2.2.5 The arrangement of TV-camera and lamps in the descent vehicle, including Apollo TV camera installation on bracket, is shown in Figure 3-13.

3.2.2.6 The scheme of the identification marks in DV is shown in Figure 3-14.

3.2.2.7 Description and overall dimensions of the baffle used in "Artificial solar eclipse" experiment are given in USSR WG 1- 107 and USSR WG3-032 documents.

3.3 THE MAIN INERTIAL-MASS-AND-STIFFNESS PERFORMANCE OF THE SOYUZ

3.3.1 The Mass of the Spacecraft and its Modules

The nominal mass values of the spacecraft at the time of docking are 683 $kgm^{-1}\ sec^2$ including:

- orbital module 127 $kgm^{-1}\ sec^2$;
- descent vehicle 286 $kgm^{-1}\ sec^2$;
- instrument assembly module 270 $kgm^{-1}\ sec^2$.

3.3.2 The Soyuz central and centrifugal moments of inertia up to the docking is given in IED 50401.

3.3.3 The Soyuz center of mass position at the time of docking is contained in IED 50401.

3.3.4 The spacecraft mass distributed along its length, the moment of inertia distributed along the linear axis, as well as the flexural, torsional shear and longitudinal stiffness distributed along the spacecraft length are given in IED 50401. Mass and stiffness characteristics of the solar panels is also included in IED 50401.

3.4 FLIGHT CERTIFICATION TEST LEVELS OF THE SOYUZ COMPATIBLE AND INTERACTING EQUIPMENT TAKING INTO ACCOUNT FLIGHT AND GROUND HANDLING CONDITIONS.

3.4.1 Dynamic Conditions:

3.4.1.1 Acceleration (constant)

- in the direction of X-axis 6g duration 600 sec.
- in the direction of Y, Z axes ± 3g duration 600 sec.

3.4.1.2 Random vibrations (spectral density of vibro-accelerations):

	[f]	[s(f)]
- in frequency range	20-100 HZ	0.035-0.07 g^2/HZ
- in frequency range	100-400 HZ	0.07 g^2/HZ
- in frequency range	400-2000 HZ	0.07-0.05 g^2/HZ

s(f) variation in the ranges shown is linear. Test duration in each of the 3 axes, X, Y, Z, is 300 seconds. For the Apollo VHF/AM transceiver and range tone transfer assembly, taking into account its mounting provisions, the modes of sinusoidal and random vibration presented in IED 50101 are acceptable.

3.4.1.3 Shock loads:

- acceleration $\pm$ 40g;
- impulse duration within the limits of 1-3 m. sec;
- semi-sinusoidal or sawtooth impulse shape;
- 6 shocks in each direction X, Y, Z (3 shocks in two opposite directions along the axis).

3.4.1.4 Acoustic Effects

- The maximum total level of acoustic noise is up to 135 DB inside the orbital and instrument assembly modules.
- The levels of sound pressure inside the orbital and instrument assembly modules in 1/3-Octave frequency band, $L_{1/3}$ (f) are presented in the table below.

1/3 Octave Band Central Frequency	Sound Pressure Levels within 1/3 octave band, dB re 2.10^{-5} N/m^2
40	122
50	123
63	124
80	126
100	126
125	126
160	126
200	126
250	124
315	122
400	120
500	118
630	116
800	114
1000	112
1250	110
1600	108
2000	106
2500	104
3150	102
4000	100

Total 135 db

NOTE: Outside the orbital module the level of sound pressure is 6 DB higher. The duration of acoustic effect is 60 seconds.

3.4.2 Environmental conditions: (During Testing)

3.4.2.1 Gas atmosphere: (In Habitable Modules)

- composition - 21-40% O_2, 57-78% N_2, to 3% CO_2, to 2%H_2, 0.5% He
  pressure range 450-970 mmHg
- temperature range 10-30C
- relative humidity 20-90% at the temperature from 10°C to 25°C and 20-80% at the temperature from 25°C to 30°C.

3.4.2.2 Pressurization during the ground tests (in the compartments) with the helium-air mixture to 1.7 KG/cm^2. He will be to 30% in the volume, during 24 hours. Pressure variation rate - to $10\ \frac{\text{mmHg}}{\text{sec.}}$

3.4.2.3 Vacuuming during the ground tests (in the compartments) - to 10^{-4} mmHg during 24 hours. Pressure variation rate - to $10\ \frac{\text{mmHg}}{\text{sec.}}$

3.5 LIGHTING OF HABITABLE MODULES OF THE SOYUZ

3.5.1 List and location of lamps of the lighting system.

The following lamps are installed in the DV:

- two working illumination lamps (WIL)
- four special lighting lamps (SLL)

The following lamps are installed in the OM:

- two working illumination lamps (WIL)

- five special lighting lamps (SLL)
- special lighting transferable lamp (STLL)
- transferable lighting unit (TLU)

The layout for the lamps in the special lighting and working illumination systems in the DV and the OM are presented in Figure 3-13 and 3-4. The working illumination lamps in the DV and OM are stationary and their location will not be changed.

The lamps of the special lighting system in the DV are stationary and are installed on brackets. The location of the special lighting lamps will be determined more precisely during lighting simulation in the mockup stage with the Soyuz photography and television equipment.

The lamps of the special lighting system in the OM are installed by means of a "C"-clamp on the handrail.

It is possible to change the position of these lamps on the handrail within the limits of the connecting cable and to rotate them in two perpendicular planes from 50 to 100°, depending on specfic lamp location.

The direction of the lamps will be determined more precisely during lighting simulation in the mockup with the Soyuz photography and television equipment.

The special lighting transferable lamp and transferable lighting unit are placed in the OM. They are provided for additional illumination during filming and television coverage, if required.

3.5.2 Characteristics of the Working and Special Lighting

3.5.2.1 Working Illumination

The dimensional outline of the working illumination lamp is shown in Figure 3-18. The lamp contains removable light unit (A) and a power assembly (B). The light unit has a transparent light-diffusing, unbreakable case in which a white, U-shaped luminescent lamp is contained.

The power assembly changes the dc voltage of the onboard circuity to 20 KHz ac.

The working illumination lamps have a continuous adjustment of brightness. Each lamp has an axial rating of 50-60 candlepower. The light distribution curves in the longitudinal and vertical planes of the lamp are shown in Figure 3-19. The spectral characteristics of the lamp are shown in Figure 3-20. The color temperature of the lamp is not less than $3900^{\circ}K$.
The coordinates of chromacity are:

$x = 0.412$;

$y = 0.397$.

The working illumination system according to the data from the preliminary light simulation in the mockup, creates an average of 107 lux illumination level in the DV; and in the OM of 85 lux at the maximum brightness level of the lamps.

3.5.2.2 Special Lighting

The dimensional outline of the Special Lighting lamp is shown in Figure 3-21 a light reflector (A) and a light source (B) are installed in the body of the lamp. The lamp has a protective grille (C) over the front which is connected to the lamp through a threaded joint.

A halogen incandescent lamp with a rated power of 27 volts is used as the light source. Each lamp has an axial candlepower rating of 160-200 C.P.

The light distribution curves for the lamp are shown in Figure 3-22. The spectral characteristics of the lamp are shown in Figure 3-23. The color temperature of the lamp is 3000-3200°K. The coordinates of chromacity are:

$$x = 0.424;$$
$$y = 0.400.$$

The configuration of the lamp permits the installation of a removable, light-reflecting screen or of a correcting filter at a distance of about 4-8 cm. from the lamp instead of the protective grille.

The Special Illumination transferable lamp is shown in Figure 3-24. The technical light characteristics of the transferable lamp correspond exactly with the characteristics of the Special Lighting lamps, in the DV and OM. The transferable lamp has a cable of 4-5 meters in length.

3.5.2.3 Based on results of Soyuz mockup equipment compatibility tests and checkouts, a transferable lighting unit (TLU), consisting of 3 working illumination lamps, was added to Soyuz spacecraft equipment. The stowage place of TLU is container No. 11. General view of TLU is shown in Figure 3-29.

3.5.3 Lighting System Control

Working Illumination in the DV is controlled from Command Signal assemblies. The lamps may be switched on and off individually.

Regulation of the illumination brightness is performed from the instrument panel.

Working Illumination in the OM is controlled from the OM panel and from the DV command signal assemblies.

The two lamps of the Working Illumination System may be turned on or off on the OM panel.

One lamp (WIL-1) of the Working Illumination System may be turned on or off from the Command Signal Assemblies of the DV.

The control of the brightness of illumination in the OM is performed from the OM panel.

The cluster of Special Lighting lamps in the DV, SIL-VI, SIL-VII, SIL-VIII is turned on simultaneously with the activation of the TV cameras, and may also be turned on and off without activation of the TV camera from the Command Signal Assemblies.

The fourth Special Illumination (SIL-IX) lamp is controlled by a separate toggle switch installed over the instrument panel.

The Special Illumination lamps in the OM have been divided into two groups:

- Group I with three lamps, SIL I, SIL II, SIL III.
- Group II with two lamps SIL IV, SIL V. It is possible to turn on and off the lamps in Groups I and II from the OM panel. Lamps SIL-I through SIL-V are also automatically switched on when the TV cameras are activated.

The STLL or TLU, after connection with a cable to the adapter plug of the OM circuit, may be switched on and off by a toggle switch on the OM panel and by a switch on the lamp itself.

4.0 APOLLO SPACECRAFT DESIGN CHARACTERISTICS

4.1 APOLLO GENERAL CONFIGURATION

4.1.1 The Apollo CSM/DM general view is shown in Figures 4-1 and 4-2. The spacecraft coordinate systems are defined in IED 50401.

4.1.2 The requirements and arrangement of the flashing light beacon, the orientation lights, and the docking floodlight are contained in IED 50301.

4.1.3 The requirements, description, location, and installation tolerances for the docking target mounted on the docking module are contained in IED 50201. The location is also shown in Figures 4-1 and 4-2.

4.1.4 The requirements for the Apollo VHF antenna assembly are given in IED 50101 together with data on location and performance.

4.1.5 The arrangement of the service module reaction control system of the attitude control engines is shown in IED 50401, together with their performance characteristics.

4.2 APOLLO HABITABLE MODULES ARRANGEMENT

4.2.1 Command Module (CM)

4.2.1.1 The command module general view is shown in Figures 4-3 and 4-4.

4.2.1.2 The command module interior is shown in Figures 4-5 through 4-9.

4.2.1.3 The provisions for mounting TV cameras and 16 mm movie cameras in the command module are shown in Figure 4-10. The command module interior floodlight provisions are shown in Figure 4-11.

4.2.1.4 The location of the command module side hatch is shown in Figures 4-3. and 4-8. Side hatch details are shown in Figure 4-12. The location of the command module forward tunnel hatch is shown in Figure 4-5. The forward hatch is similar in design to the docking module hatch.

4.2.1.5 The location of the CSM docking system probe is shown in Figure 4-3. Details of the CSM docking system are shown in Figure 4-13. The drogue assembly is mounted in the docking module. The probe and drogue assemblies are removed after CSM/DM docking is achieved and stowed in the command module as shown in Figure 4-9.

4.2.1.6 The layout of the command module displays and controls system is shown in Figure 4-14.

4.2.1.7 The equipment that is transfered from Apollo to Soyuz and from Soyuz to Apollo is identified in IED's 50720 and 50721 respectively.

4.2.2 Docking module (DM)

4.2.2.1 The inboard profile of the docking module is shown in Figure 4-15. The allocation of space within the docking module is shown in Figure 4-16.

4.2.2.2 The docking module dimensions are given in Figures 4-17 and 4-18.

4.2.2.3 Details of the docking module's hatches and pressure equalization valves are shown in IED 50706.

4.2.2.4 The docking module displays and controls arrangements are shown in Figure 4-19 for convenience, and determined in IED's 50706 and 50601.

4.2.2.5 The locations for mounting TV cameras and 16 mm movie cameras in the docking module are shown in Figure 4-20. The docking module interior floodlight provisions are shown in Figure 4-21.

4.3 APOLLO INERTIAL MASS AND STIFFNESS PROPERTIES

4.3.1 The nominal mass values of the Apollo spacecraft at the time of docking are:

	$kg\text{-}sec^2/m$
Command module	605
Service module	640
Docking module	205
Total spacecraft	1450

4.3.2 The Apollo central and centrifugal moments of inertia at docking are given in IED 50401.

The distribution of mass along the length of the Apollo spacecraft is given in IED 50401 together with the distribution of flexural, torsional, shear, and longitudinal stiffness. The distribution of moments of inertia is given along the linear axis.

4.4 FLIGHT CERTIFICATION OF THE APOLLO DOCKING MODULE COMPATIBLE AND INTERACTIVE SYSTEMS.

4.4.1 DYNAMIC CONDITIONS:

4.4.1.1 Acceleration (steady state)

- in the direction of X axis at 4.9g.
- in the direction of Y and Z axes at 0.1g.

4.4.1.2 Sinusoidal Vibration

5-35 Hz at 0.4g peak.

4.4.1.3 Random Vibration

20 - 200 Hz at +6dB/octave

200 - 450 Hz at 0.03 g^2/Hz

450 - 2000 Hz at -3dB/octave

Vibration duration is 60 seconds in each of three mutually perpendicular axes.

4.4.1.4 Shock:

Shock response spectra based on an analysis using Q = 10 and one-sixth-octave center frequencies.

(1) DM primary structure within 304.8mm of the SLA truss-to-DM interface:

100 - 1000 Hz at +9dB/octave

1000 - 6000 Hz at 1000g peak

6000 - 10000 Hz at -6dB/octave

(2) DM primary structure between 304.8mm and 1270.0mm from the SLA truss-to-DM interface:

100 - 1000 Hz at +9dB/octave

1000 - 6000 Hz at 500g peak

6000 - 10000 Hz at -6dB/octave

(3) DM primary structure greater than 1270.0mm from the SLA truss-to-DM interface.

100 - 1000 Hz at +9dB/octave

1000 - 6000 Hz at 100g peak

6000 - 10000 Hz at -6dB/octave

4.4.1.5 Acoustics

1/3 Octave Band Center Frequency Hz	DM External Noise Spectra (1/3 Octave Band Sound Pressure Level-- dB re 20uN/M^2)	
	Lift-Off t - 0 Seconds	Mach 1 t = 60 seconds
20	114	105
25	117	112
31.5	120	114
40	126	116
50	128	116
63	130	117
80	133	117
100	135	118
125	134	118
160	132	118
200	130	120
250	129	121
315	127	121
400	124	122
500	122	119
630	121	119
800	120	118
1000	117	113
1250	116	110
1600	114	109
2000	112	109
2500	108	108
3150	106	107
4000	104	105
5000	102	104
Overall	141	129

4.4.2 Apollo joint flight environmental envelope

4.4.2.1 The range of environmental conditions for the docking module is given IED 50702.

4.4.2.2 The range of environmental conditions for the command module is given in IED 50701.

4.5 COMMAND MODULE AND DOCKING MODULE LIGHTING

4.5.1 Command Module Lighting

Lighting in the command module is provided by six fluorescent light assemblies, located as shown in Figure 4-11. Each assembly contains two lamps, each rated at 600 lumens. The three types of assemblies for sidewall lights, couch lights and couch strut lights are shown in Figures 4-22, 4-23, and 4-24, respectively.

The lighting controls for the six light assemblies are located on three different control panels. The right hand sidewall and couch light controls are located on the right side of the cabin on Panel 5 (Figure 4-14, Sheet 5). The left-hand sidewall and couch light controls are located on the left side of the cabin on Panel 8 (Figure 4-14, Sheet 6). The controls for both strut lights are located on the left side of the cabin in Panel 100 (Figure 4-14, Sheet 8).

Each light control consists of two toggle switches and a rotory rheostat. One toggle switch selects which of the two lamps (no. 1 or no. 2) in each assembly is to be connected to the rheostat. The second toggle switch acts as an "ON-OFF" switch for the other lamp. The rheostat provides a continuous intensity control for the lamp selected for dimming.

The command module cabin illumination may be varied from zero to 430 lux. With the one lamp on full brightness in each of the six light assemblies the illumination in the command module cabin is 215 lux (20 foot-candles) at the main display and control panel. With both lamps on full brightness in all six light assemblies the illumination is 430 lux.

The chromaticity value of the command module lamps is X=0.365 to 0.425 and Y=0.365 to 0.400 on the CIE diagram. The color temperature is 4800K to 5100K. The spectral distribution of the light is shown in Figure 4-25.

4.5.2 Docking Module Lighting

Lighting in the docking module is provided by three fluorescent light assemblies located as shown in Figure 4-21. The docking module light assemblies are the same as those used for the command module strut lights, shown in Figure 4-24.

The lighting control for the three docking module lights is located on Panel 815 (Figure 4-19, Sheet 2). The control consists of two toggle switches. Each toggle switch controls one lamp in all three light assemblies. Toggle switch no. 1 turns on lamp no. 1 in all three assemblies and switch no. 2

turns on lamp no. 2 in all three assemblies. There is no continuous intensity dimming control.

With one lamp on in all three assemblies the illumination in the docking module will range from 32 to 75 lux (3 to 7 foot-candles), depending upon position. With both lamps on in all three light assemblies the illumination will range from 75 to 105 lux (7 to 10 foot-candles).

The chromaticity, color temperature and spectral distribution are the same as for the command module, described in paragraph 4.5.1.

4.5.3 Apollo Portable Light

The dimensions, weight, and other physical characteristics of the Apollo portable light are shown in Figure 4-26. The chromaticity, color temperature, and spectral distribution of the Apollo portable light are approximately the same as for the command module lights, described in paragraph 4.5.1.

4.6 CSM AND DM VENTING CHARACTERISTICS

The gases and liquids vented from the CSM and CM while docked with the Soyuz spacecraft are given in Table 4.1, together with the flow rates, durations, venting frequency, propulsive forces, and vent locations.

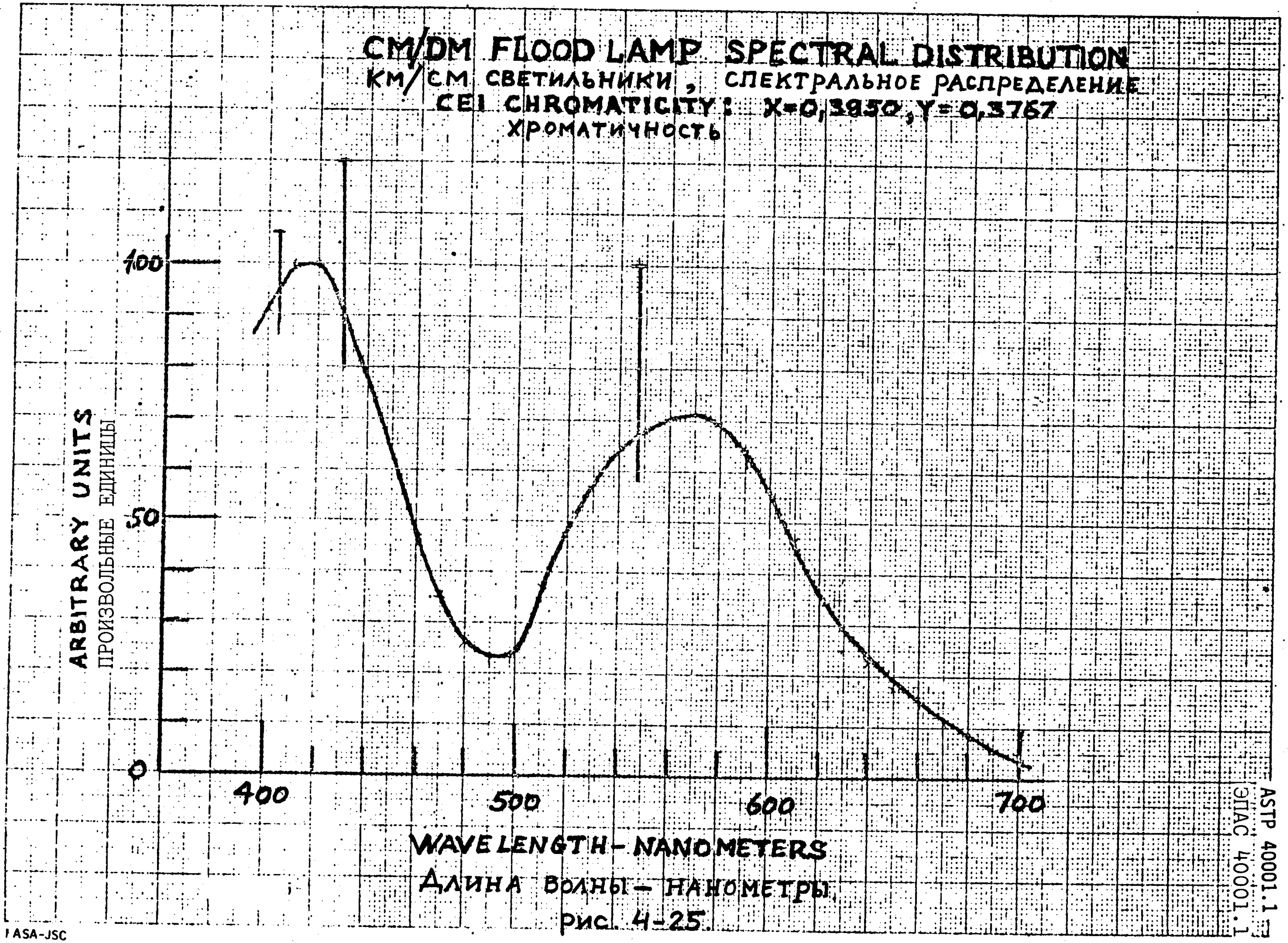
TABLE 4.1 CSM/DM NOMINAL VENTING CHARACTERISTICS WHILE DOCKED WITH SOYUZ

SYSTEM	VENT PURPOSE	MATERIAL VENTED	PROPULSIVE FORCE, NEWTON	FLOW RATE, KG/SEC	DURATION	FREQUENCY	VENT NAME	VENT LOCATION
CSM	CABIN LEAKAGE	CABIN GAS		5.04×10^{-6}	CONTINUOUS			
CSM	FECAL ODOR REMOVAL	CABIN GAS	0.0485	1.008×10^{-4} at 259mmHg	30 SEC.	3/DAY	URINE DUMP NOZZLE *	X_{A6}=26065.5MM Y_{A6}=-1454.2MM Z_{A6}=-1165.0MM
CSM	CABIN OXYGEN ENRICHMENT TO OFFSET N_2 BUILDUP FROM EXPERIMENT	CABIN GAS	0.0485	1.008×10^{-4} at 259mmHg	TBD	TBD	URINE DUMP NOZZLE *	
CSM	URINE DUMP	URINE	0.0859	7.56×10^{-3}	APPROX. 80 SEC.	APPROX. 9/DAY	URINE DUMP NOZZLE *	
CSM	URINE FLUSHING	H_2O	9.34×10^{-3}	5.0×10^{-3}	10 SEC PER DUMP	APPROX. 9/DAY	URINE DUMP NOZZLE *	
CSM	URINE NOZZLE DRYING	CABIN GAS	0.0485	1.008×10^{-4}	2 to 5 MIN- UTES PER DUMP	APPROX. 9/DAY	URINE DUMP NOZZLE *	
CSM	POTABLE AND WASTE WATER BLEED	O_2	7.76×10^{-5}	4.03×10^{-6}	CONTINUOUS		URINE DUMP NOZZLE *	
CSM	EVAPORATIVE COOLING	H_2O	0.0476	6.30×10^{-5}	APPROX. 1/2 OF ORBIT	EACH ORBIT	CM STEAM DUCT *	X_{A6}=26118.7MM Y_{A6}=-1621.4MM Z_{A6}=-847.1MM

* DIRECTED 57.5° TO $+X_6$ AXIS

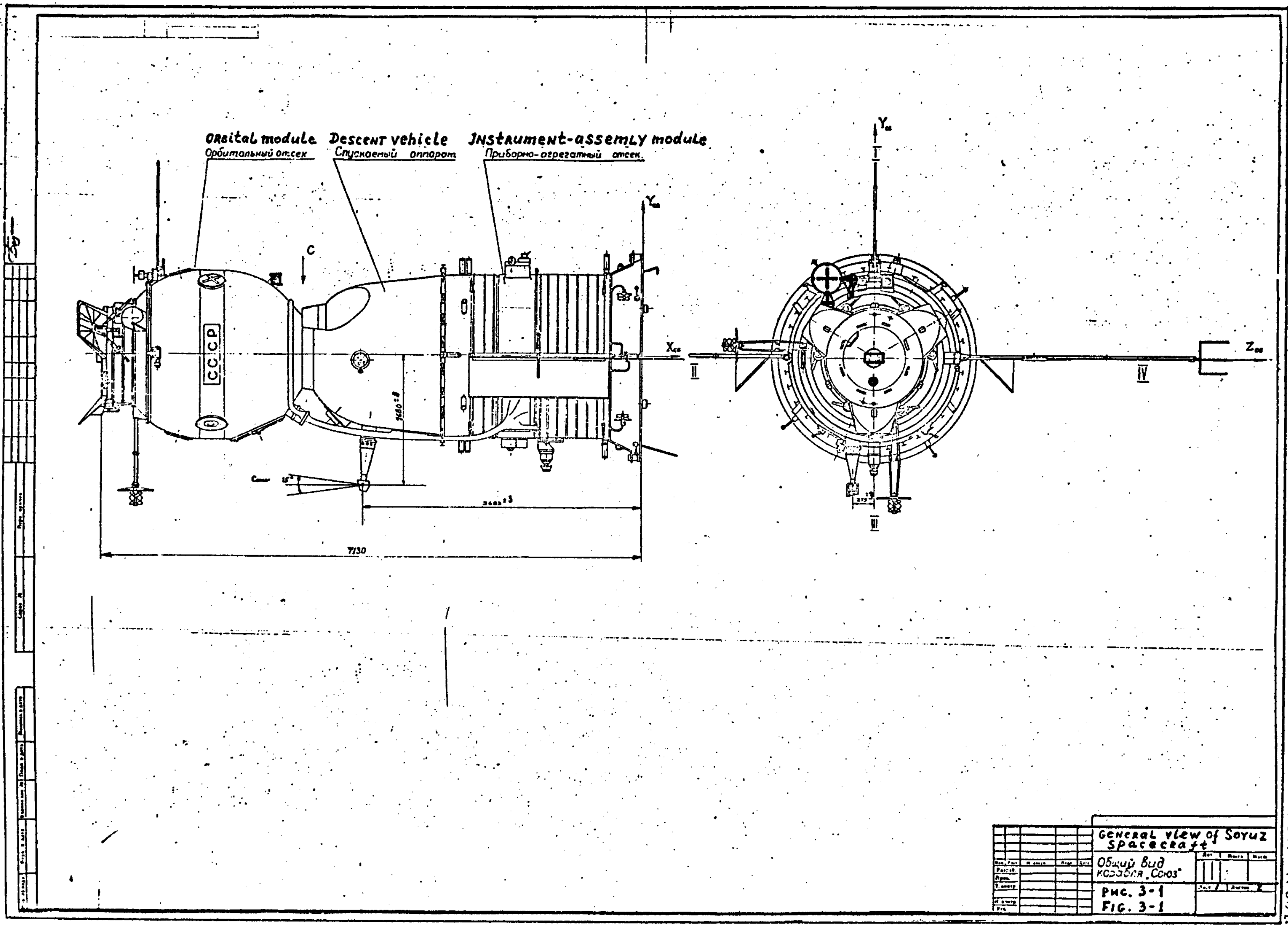
TABLE 4.1 CSM/DM NOMINAL VENTING CHARACTERISTICS WHILE DOCKED WITH SOYUZ (CONT)

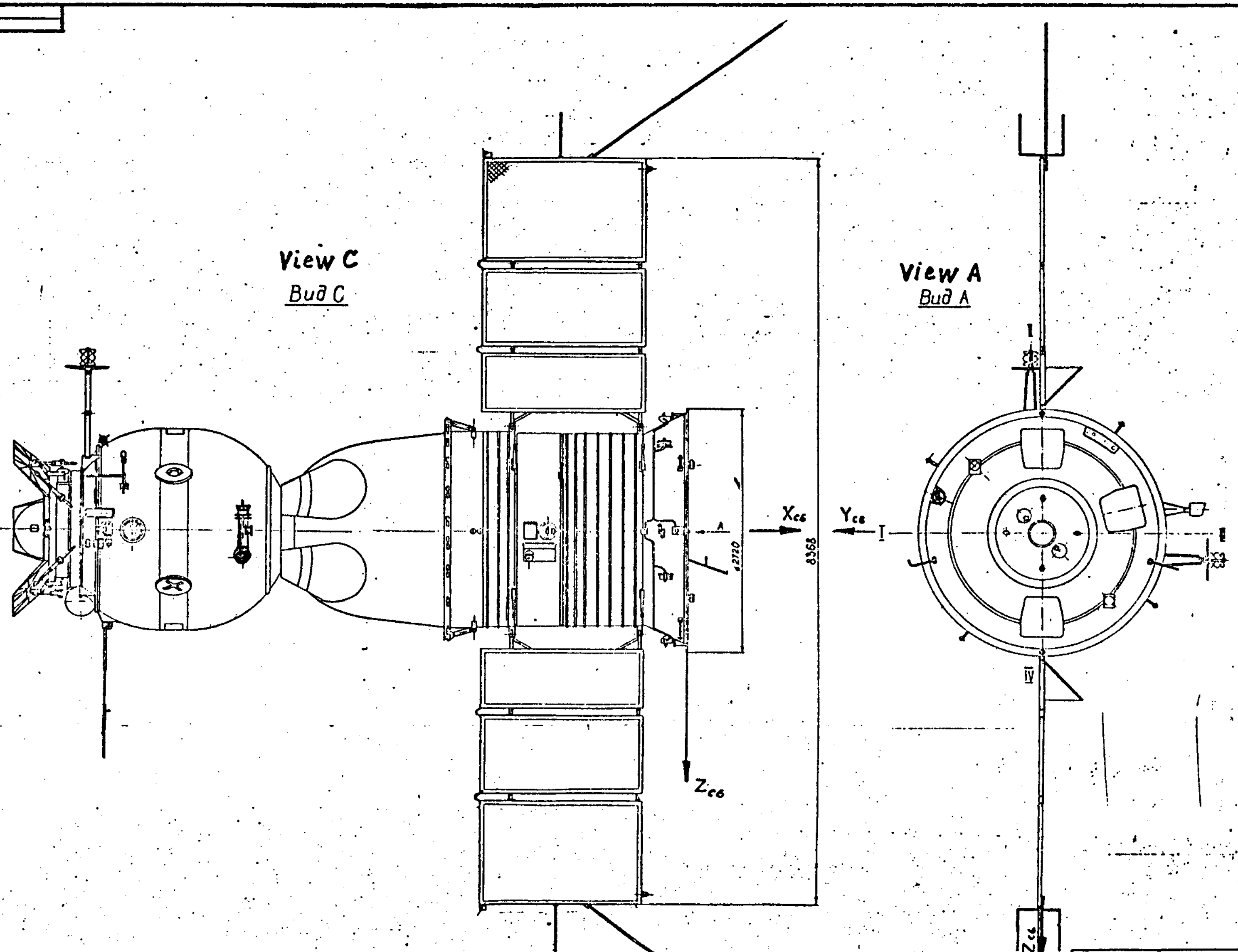
SYSTEM	VENT PURPOSE	MATERIAL VENTED	PROPULSIVE FORCE, NEWTON	FLOW RATE, KG/SEC	DURATION	FREQUENCY	VENT NAME	VENT LOCATION
CSM	WASTE WATER DUMP	H_2O	0.512	0.0208	10 to 15 MINUTES	ONCE PER DAY	WASTE WATER DUMP * NOZZLE *	X_{A6}=26,053.3MM Y_{A6}=1234.4MM Z_{A6}=1397.0MM
CSM (3 FUEL CELLS)	PURGE	O_2	0.0445 FOR EACH CELL	$7.56X10^{-5}$ FOR EACH CELL	120 SEC. EACH CELL	TWICE FOR EACH CELL	FUEL CELL O_2 PURGE VENT	X_{A6}=24,244.0MM Y_{A6}=-1511.3MM Z_{A6}=1244.6MM
CSM (3 FUEL CELLS)	PURGE	$H_2 + H_2O$	0.325 FOR EACH CELL	H_2:$8.82X10^{-5}$ H_2O:$0.64X10^{-5}$ FOR EACH CELL	80 SEC. EACH CELL	ONCE FOR EACH CELL	FUEL CELL H_2 PURGE VENT	X_{A6}=25,476.2MM Y_{A6}=1676.4MM Z_{A6}=-1005.8MM
DM	TUNNEL 2 VENT	CABIN GAS	NON-PROPULSIVE VENT	$3.0X10^{-3}$ at 550 mmHg	84 SEC (66 to 96) 15 MINUTES (12 to 20)	1,2,3 CREW TRANSFERS 4TH TRANSFER	DM VENT	X_{A6}=29253.6MM Y_{A6}=-718.8MM Z_{A6}=0
DM	O_2 PURGE RELIEF	CABIN GAS	NON-PROPULSIVE VENT	$5.0X10^{-3}$ at 479 mmHg	5.8 MINUTES (3.8 - 7.8)	EACH CREW TRANSFER	DM VENT	
DM	LOW PRESSURE DUMP	CABIN GAS	NON-PROPULSIVE VENT	$5.0X10^{-3}$ at 479 mmHg	5.2 MINUTES (5 to 6)	EACH CREW TRANSFER	DM VENT	
SM EXPERIMENT (MA-048)	PURGE SENSORS AND REPLACE GAS	10% CH_4, 90% A	NEGLIGIBLE	10 cc/MIN	CONSTANT		MA-048 VENT	X_{A6}=22333.0MM Y_{A6}=-1003.3MM Z_{A6}=-1676.4MM
DM EXPERIMENT	EVACUATION OF FURNACE	CABIN GAS	TBD	TBD	TBD	ONCE EACH EXPERIMENT	FURNACE EXPERIMENT VENT	X_{A6}=29,255.4MM Y_{A6}=-502.9MM Z_{A6}=-502.9MM
SMRCS	SEE IED 50006, IED 50401 AND USA WG1-010.							



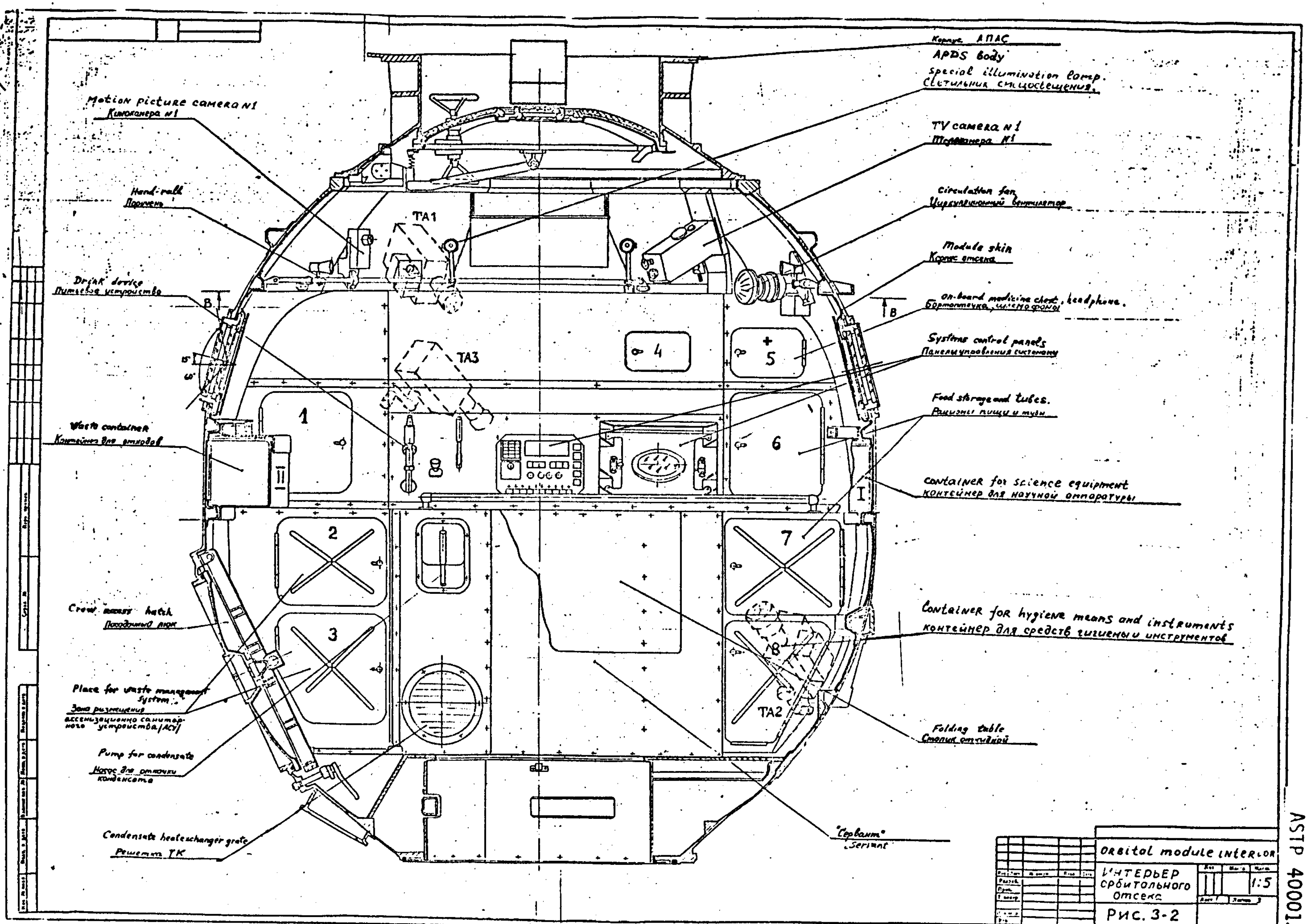
CM/DM FLOOD LAMP SPECTRAL DISTRIBUTION
КМ/СМ СВЕТИЛЬНИКИ, СПЕКТРАЛЬНОЕ РАСПРЕДЕЛЕНИЕ
CEI CHROMATICITY: X=0,3850, Y=0,3767
ХРОМАТИЧНОСТЬ
ARBITRARY UNITS
ПРОИЗВОЛЬНЫЕ ЕДИНИЦЫ
100
50
0
400
500
600
700
WAVE LENGTH - NANOMETERS
ДЛИНА ВОЛНЫ - НАНОМЕТРЫ

Рис. 4-25

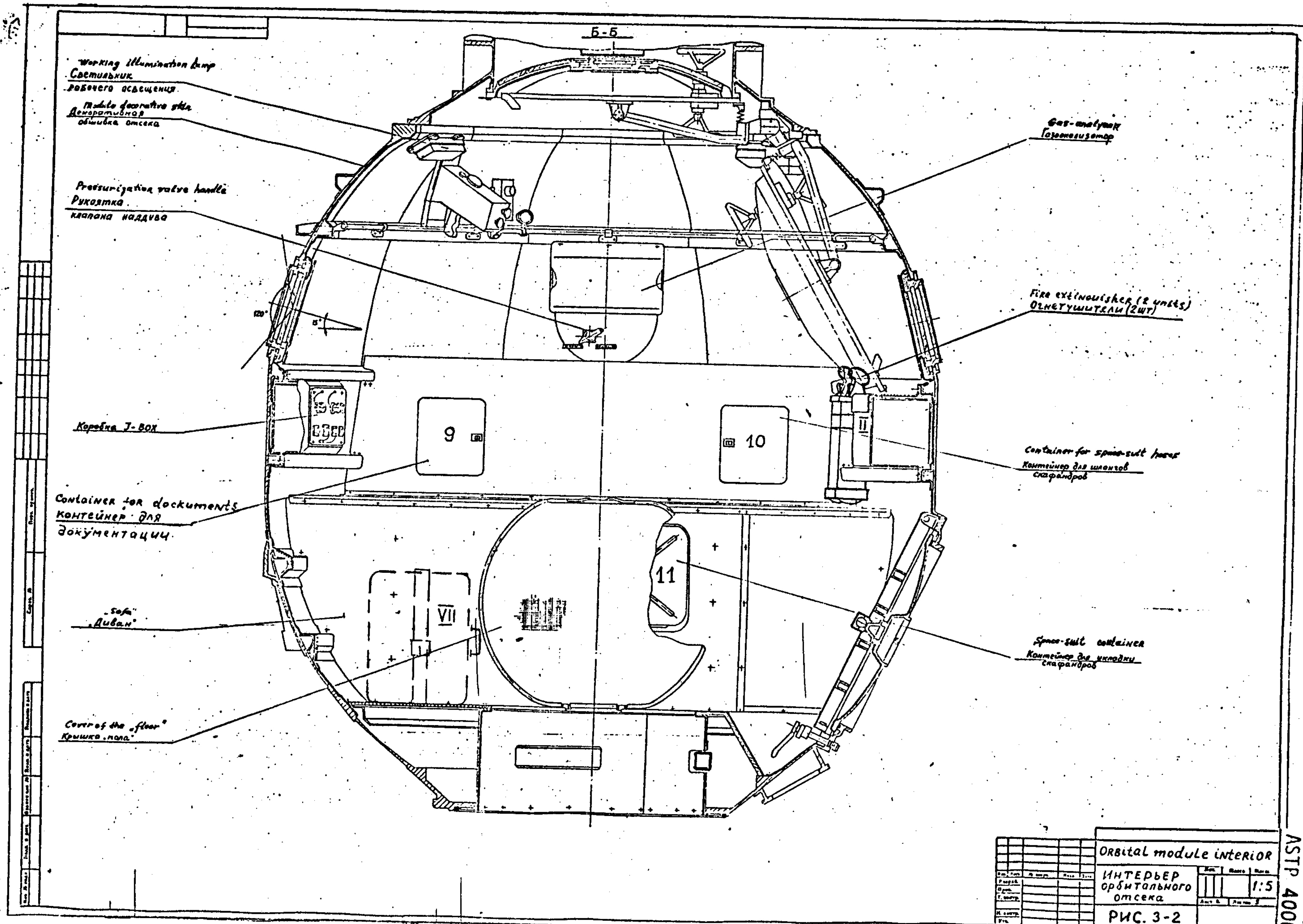

Orbital module
Орбитальный отсек
Descent vehicle
Спускаемый аппарат
Instrument-assemly module
Приборно-агрегатный отсек
C
CCCP
X_{ca}
Y_{ca}
Z_{ca}
I
II
III
IV
7130
General view of Soyuz Spacecraft
Общий вид корабля „Союз"
Рис. 3-1
Fig. 3-1



General View of Soyuz spacecraft
Общий вид корабля „Союз"
Рис. 3-1
Fig 3-1

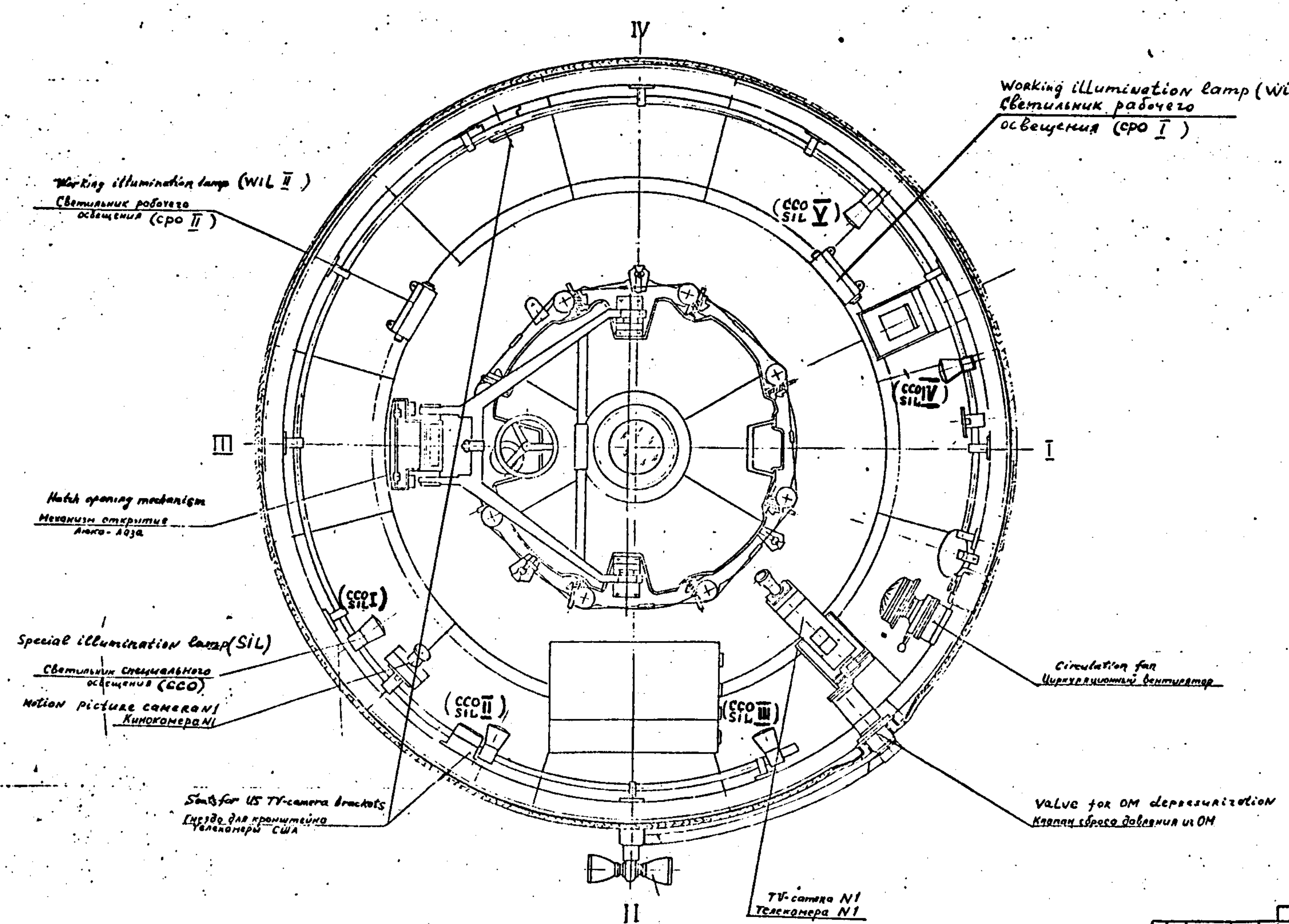


ЭПАС 40001.1
ASTP 40001.1



ЭПАС 40001.1
ASTP 40001.1

B-B



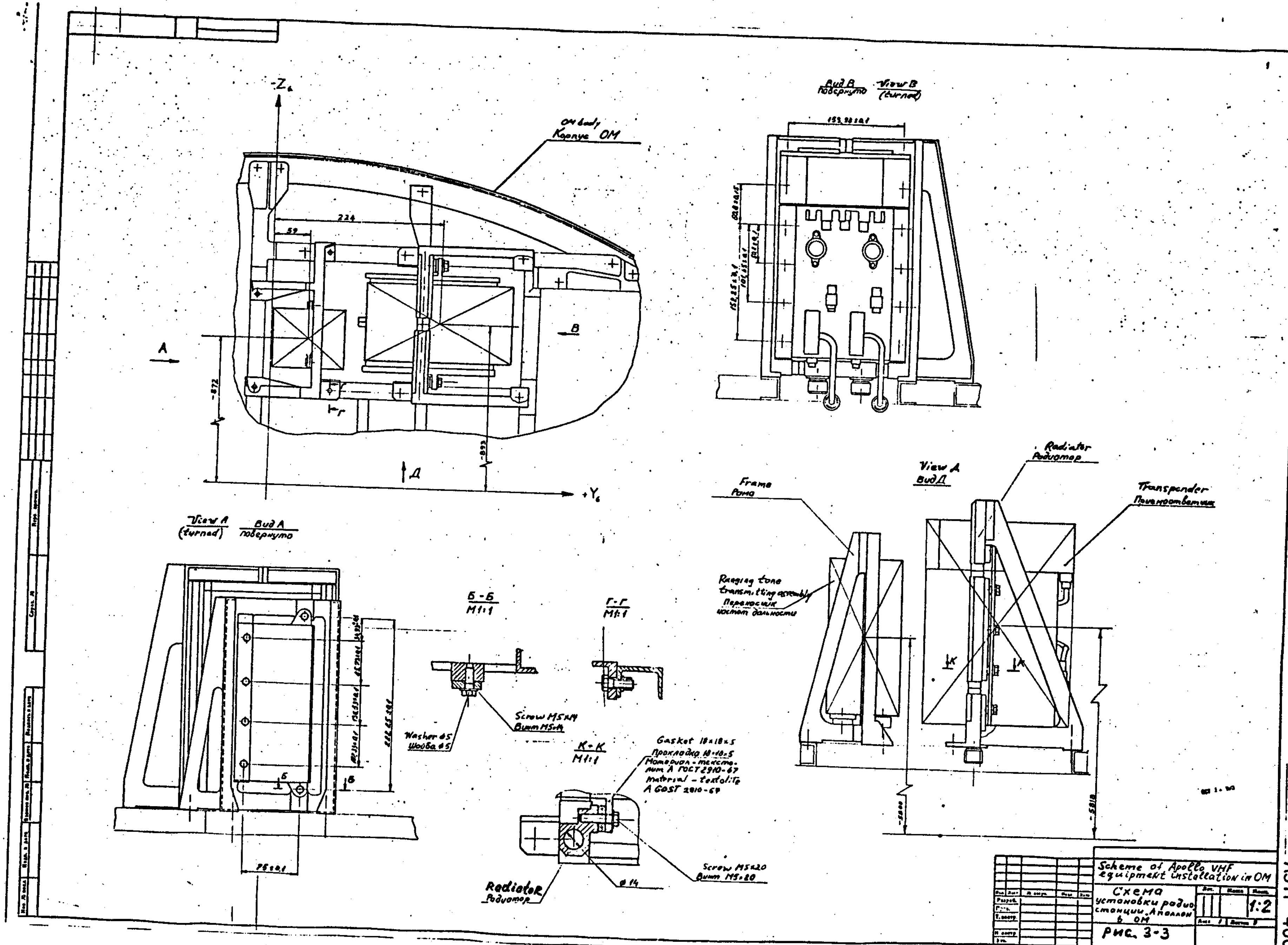
ORBital module interior

Интерьер орбитального отсека

Рис.3-2

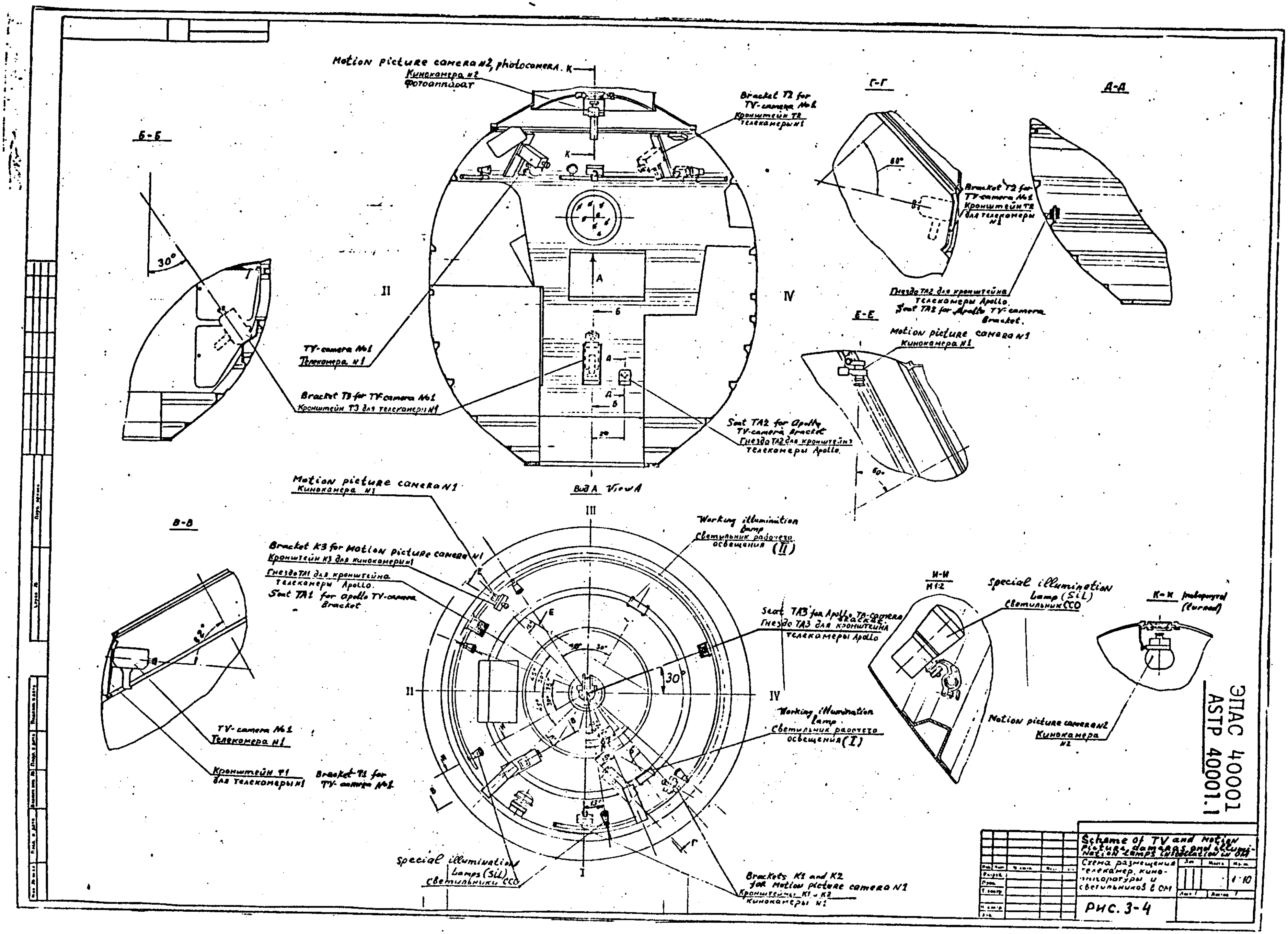
ЭПАС 40001.1

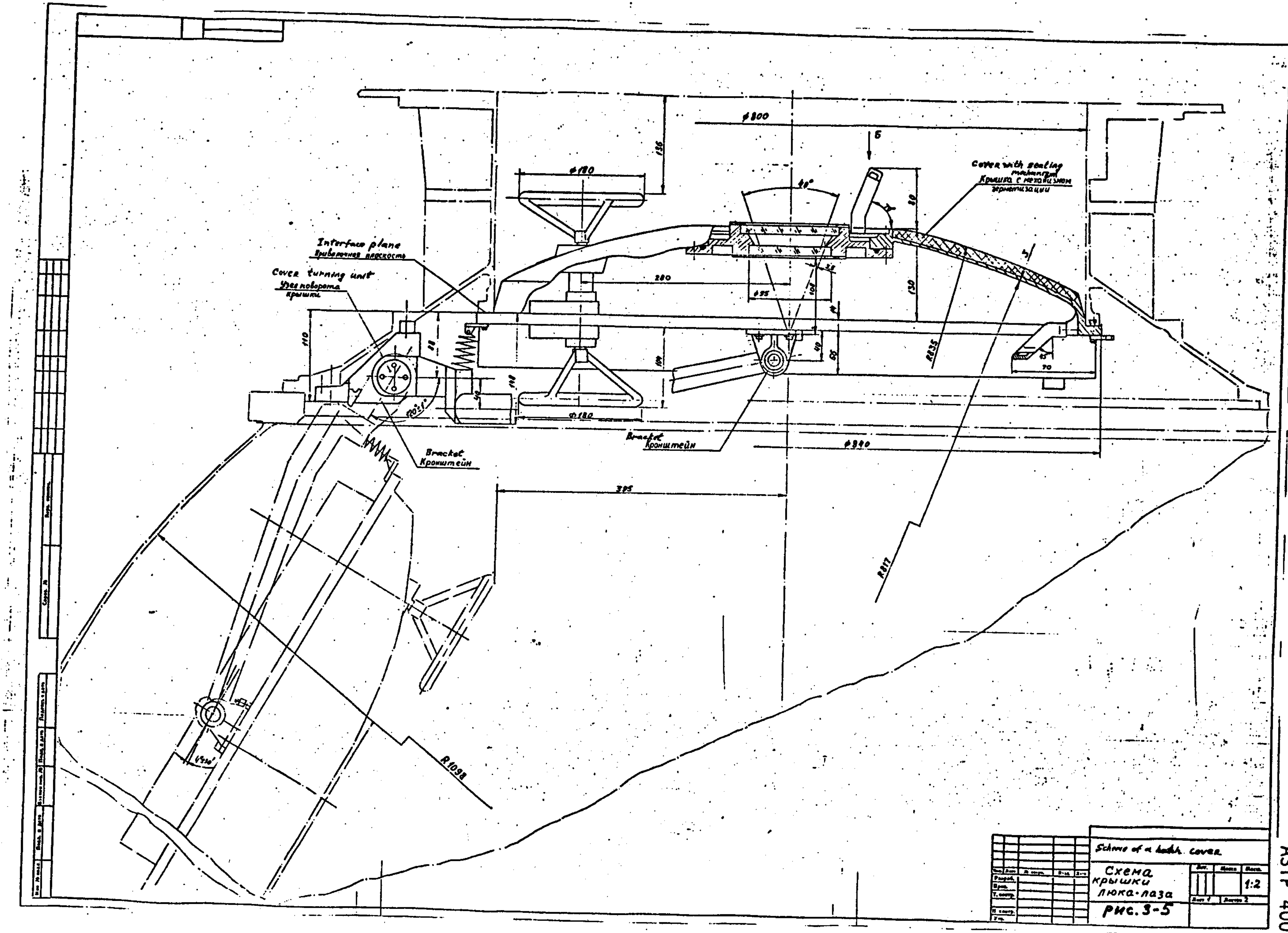
ASTP 40001.1

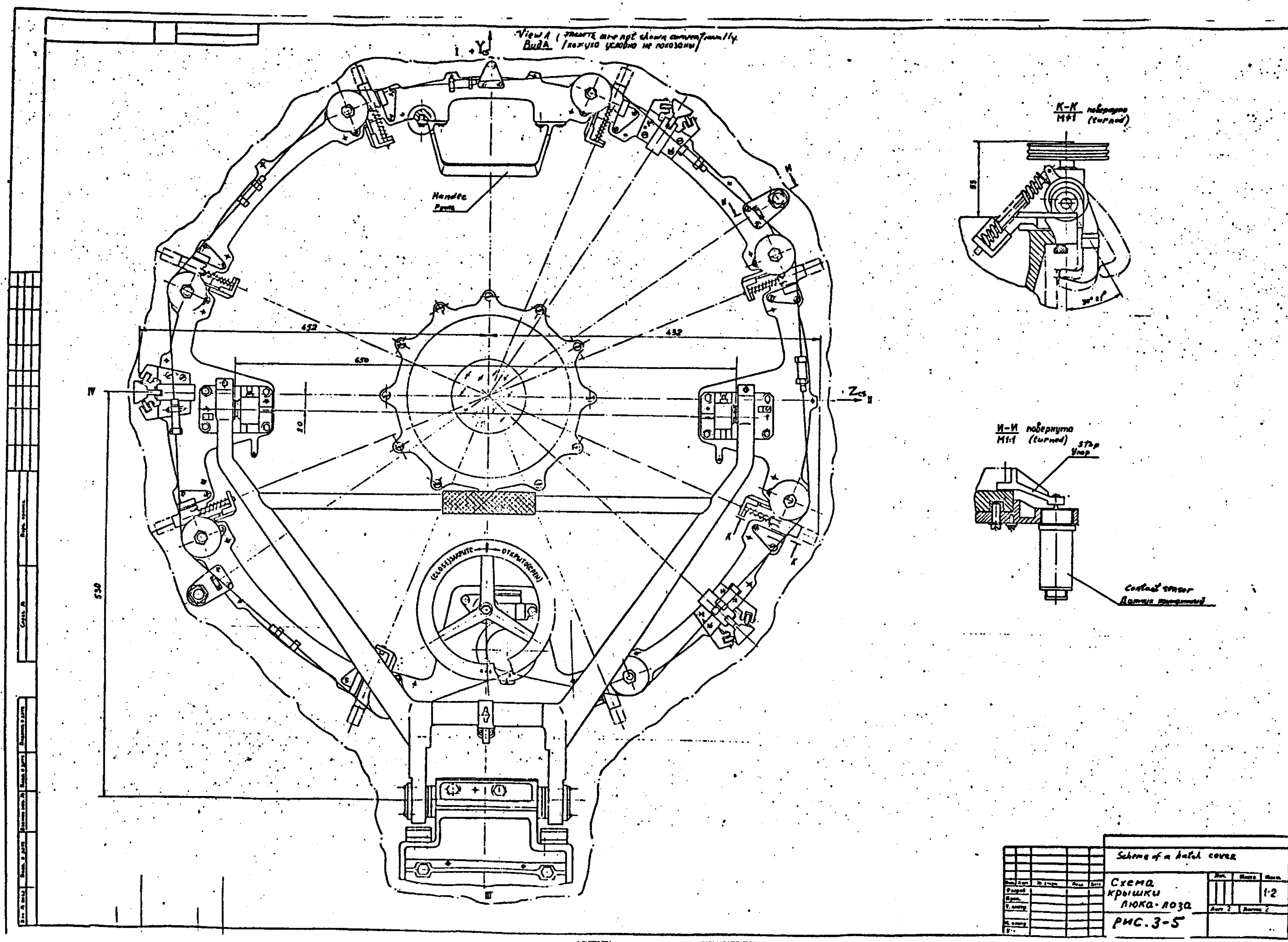


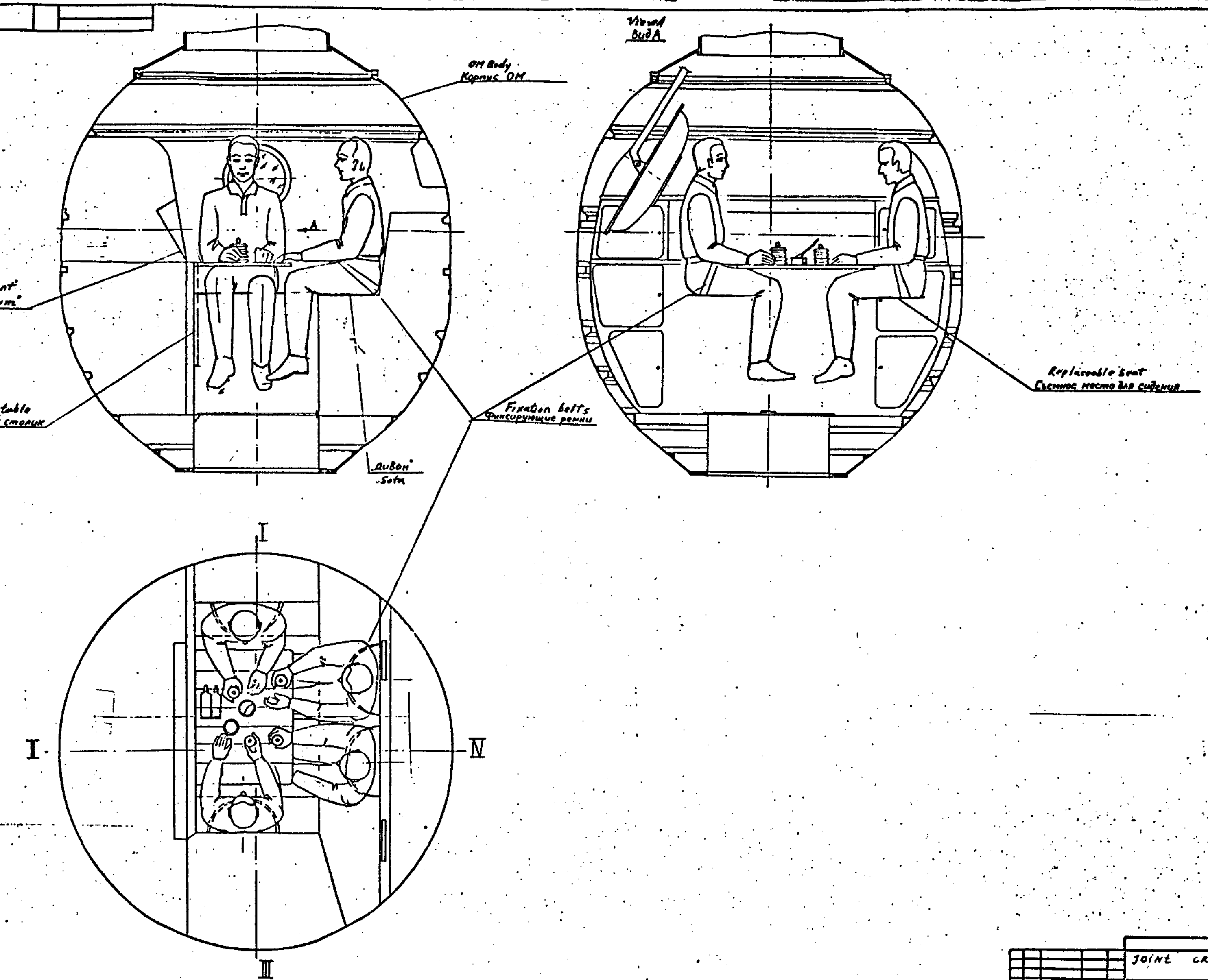
Scheme of Apollo VHF equipment installation in OM
Схема установки радиостанции „Аполлон" в ОМ
1:2
Вид Б повернуто
View B (turned)
OM body
Корпус ОМ
-Z
+Y
A
Б
Д
Г
224
59
-872
-893
View A (turned)
Вид А повернуто
Б-Б
M1:1
Г-Г
M1:1
К-К
M1:1
Screw M5×14
Винт M5×14
Washer ⌀5
Шайба ⌀5
Gasket 18×18×5
Прокладка 18×18×5
Материал - текстолит А ГОСТ 2910-67
material - textolite A GOST 2910-67
Screw M5×20
Винт M5×20
⌀14
Radiator
Радиатор
Frame
Рама
Ranging tone transmitting assembly
Переносчик частот дальности
View A
Вид А
Transponder
Приемоответчик
К
-5800
-5818

Рис. 3-3


Motion picture camera N2, photocamera. K
Кинокамера N2
Фотоаппарат
Bracket T2 for TV-camera No1
Кронштейн T2 телекамеры N1
Г-Г
Д-Д
Б-Б
30°
II
IV
A
TV-camera No1
Телекамера N1
Bracket T3 for TV-camera No1
Кронштейн T3 для телекамеры N1
Seat TA2 for Apollo TV-camera bracket
Гнездо TA2 для кронштейна телекамеры Apollo
60°
Bracket T2 for TV-camera No1
Кронштейн T2 для телекамеры N1
Гнездо TA2 для кронштейна телекамеры Apollo.
Seat TA2 for Apollo TV-camera Bracket.
Е-Е
Motion picture camera N1
Кинокамера N1
Вид А View A
Motion picture camera N1
Кинокамера N1
В-В
Working illumination lamp
Светильник рабочего освещения (II)
Bracket K3 for Motion picture camera N1
Кронштейн K3 для кинокамеры N1
Гнездо TA1 для кронштейна телекамеры Apollo.
Seat TA1 for Apollo TV-camera Bracket
III
II
IV
I
30°
Seat TA3 for Apollo TV-camera bracket
Гнездо TA3 для кронштейна телекамеры Apollo
Working illumination lamp
Светильник рабочего освещения (I)
И-И
M 1:2
Special illumination lamp (SiL)
Светильник ССО
К-К (turned)
Motion picture camera N2
Кинокамера N2
TV-camera No1
Телекамера N1
Кронштейн T1 для телекамеры N1
Bracket T1 for TV-camera No1
Special illumination lamps (SiL)
Светильники ССО
Brackets K1 and K2 for Motion picture camera N1
Кронштейны K1 и K2 кинокамеры N1
ЭПАС 40001
ASTP 40001.1
Scheme of TV and Motion picture cameras and illumination lamps installation in OM
Схема размещения телекамер, кинокиноаппаратуры и светильников в СМ
1:10
РИС. 3-4

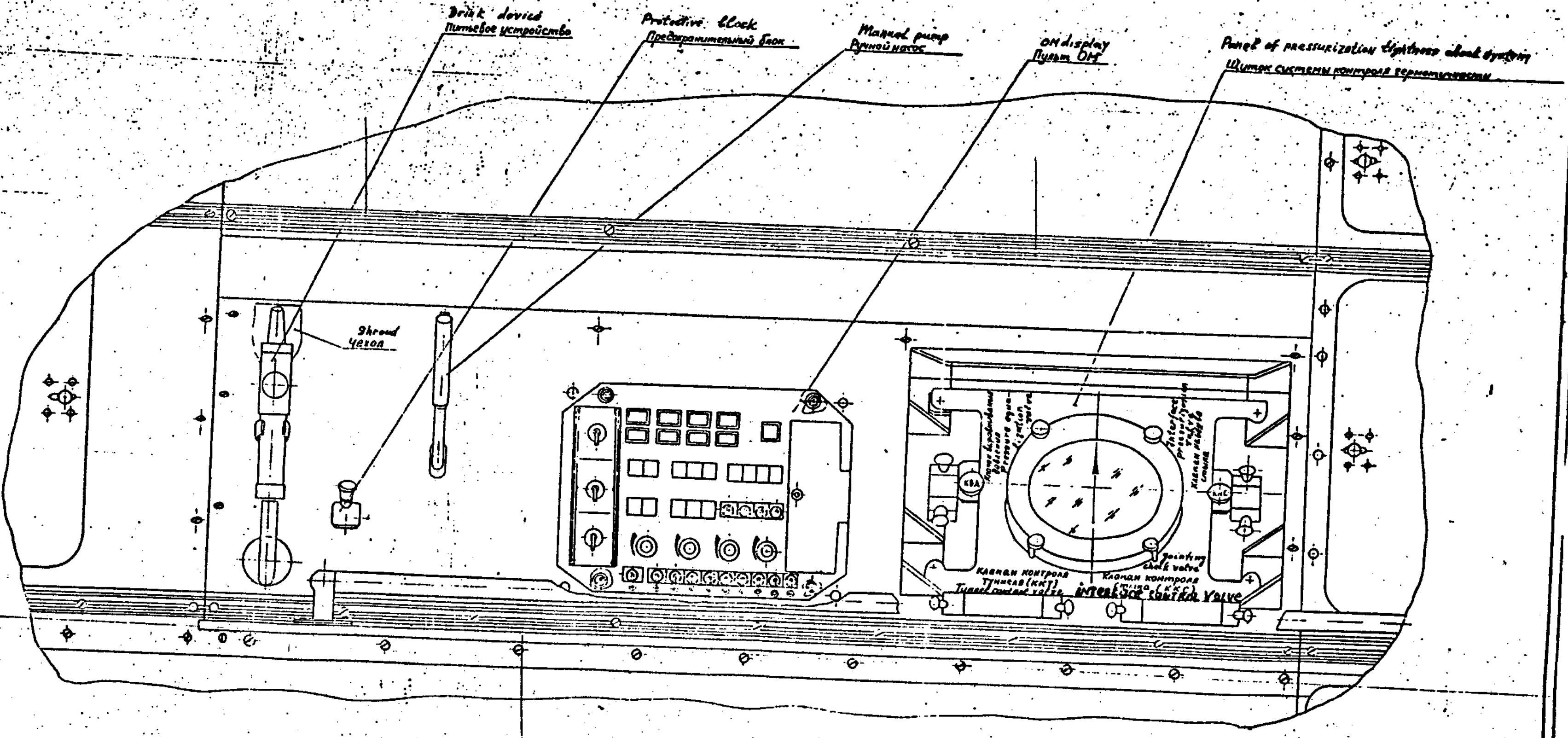

Interface plane
Привалочная плоскость
Cover turning unit
Узел поворота крышки
Cover with sealing mechanism
Крышка с механизмом герметизации
Bracket
Кронштейн
Bracket
Кронштейн
Scheme of a hatch cover
Схема крышки люка-лаза
рис. 3-5
1:2


View A
Вид А
Handle
Ручка
452
432
650
20
530
(CLOSE) ЗАКРЫТО
ОТКРЫТО (OPEN)
Z
К-К повернуто
М1:1 (turned)
И-И повернуто
М1:1 (turned)
Stop
Упор
Contact sensor
Scheme of a hatch cover
Схема крышки люка-лаза
1:2
Рис. 3-5



JOINT CREW LOCATION		
Схема размещения смешанного экипажа в ОМ		1:10
рис. 3-6		

ЭПАС 40001.1
ASTP 40001.1

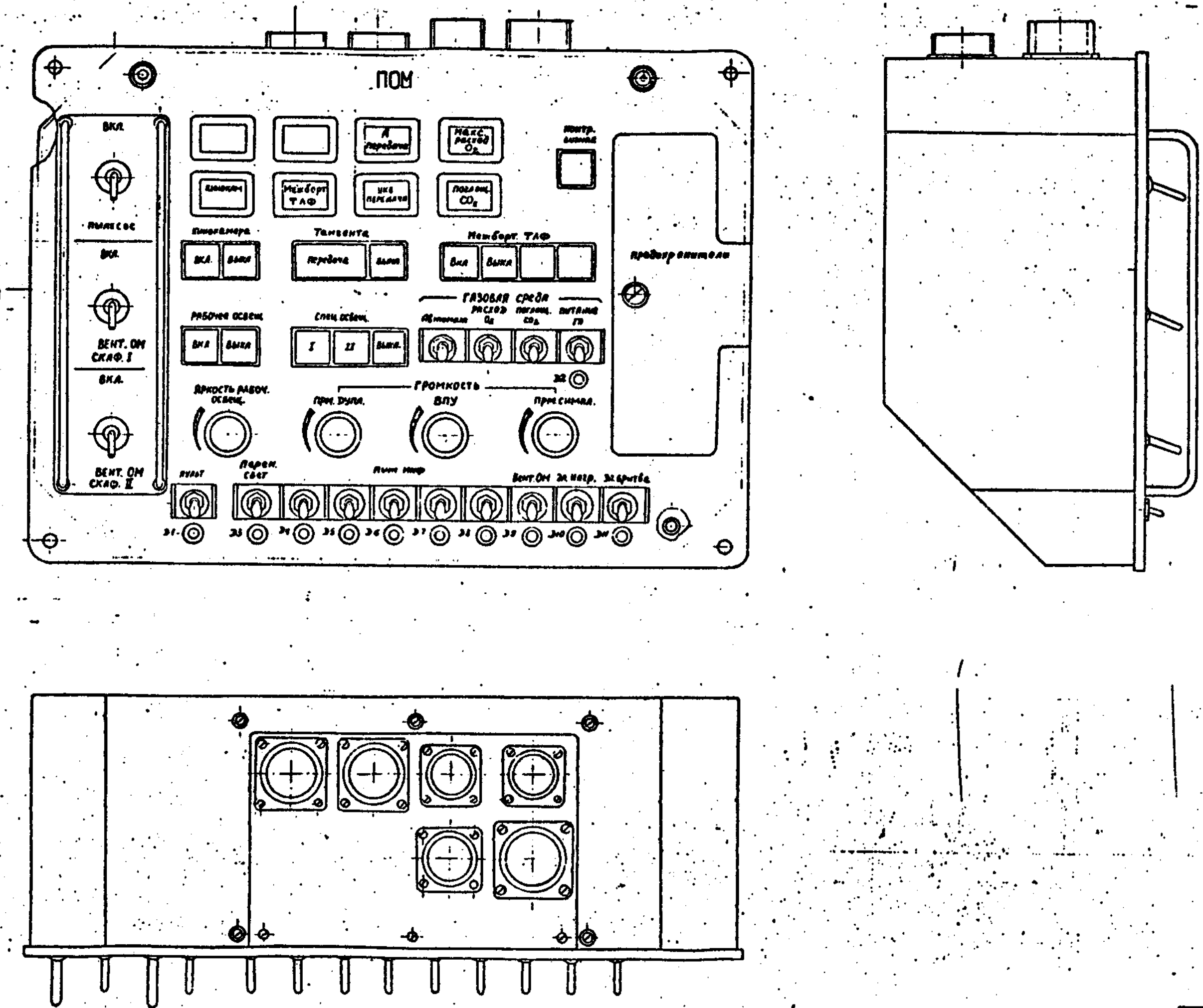


General view of OM system control panel and display console.

Общий вид панели управления системой ОМ.

1:2

Рис. 3-7

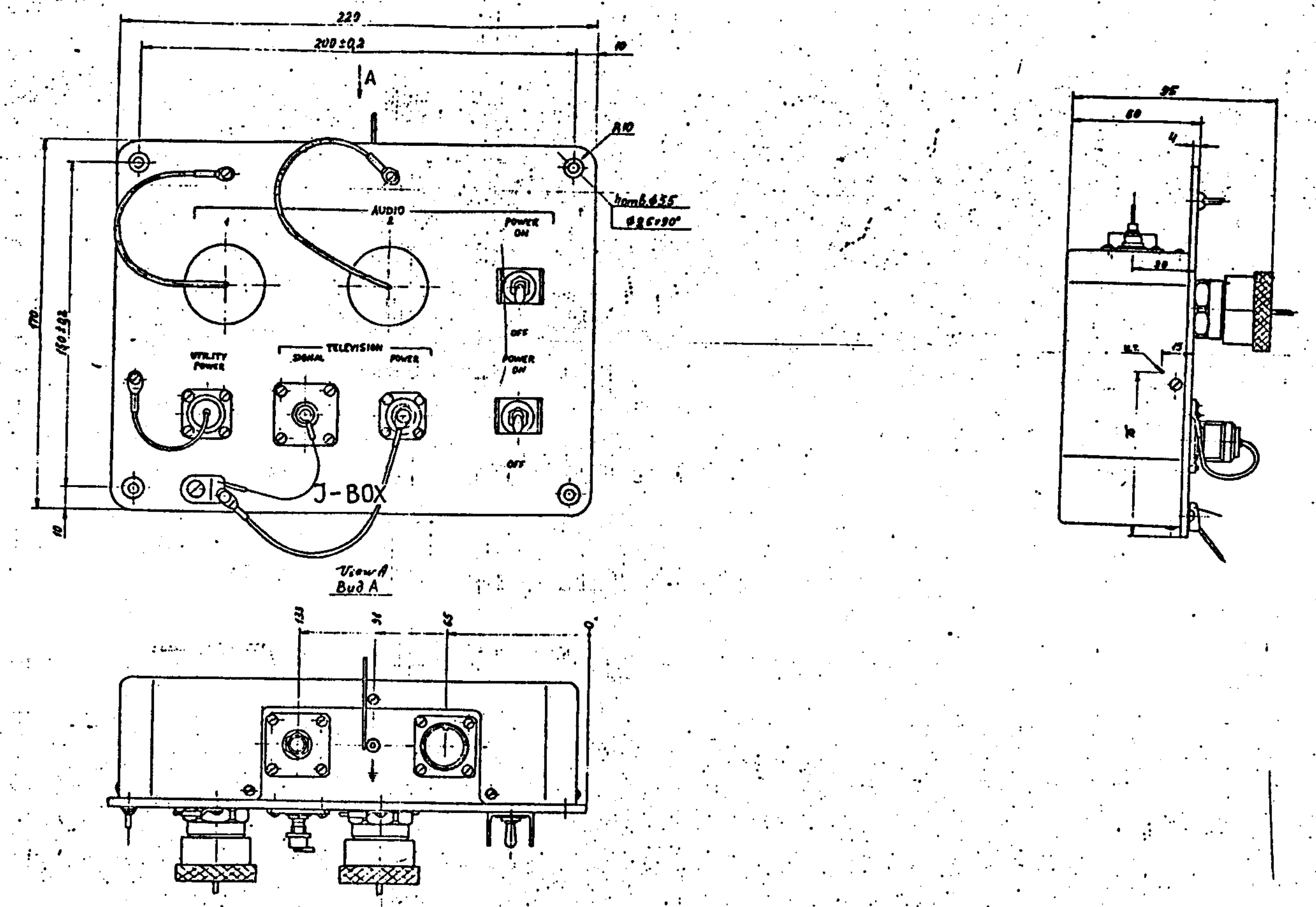


General view of OM display console

Общий вид пульта ОМ

1:1

рис. 3-8

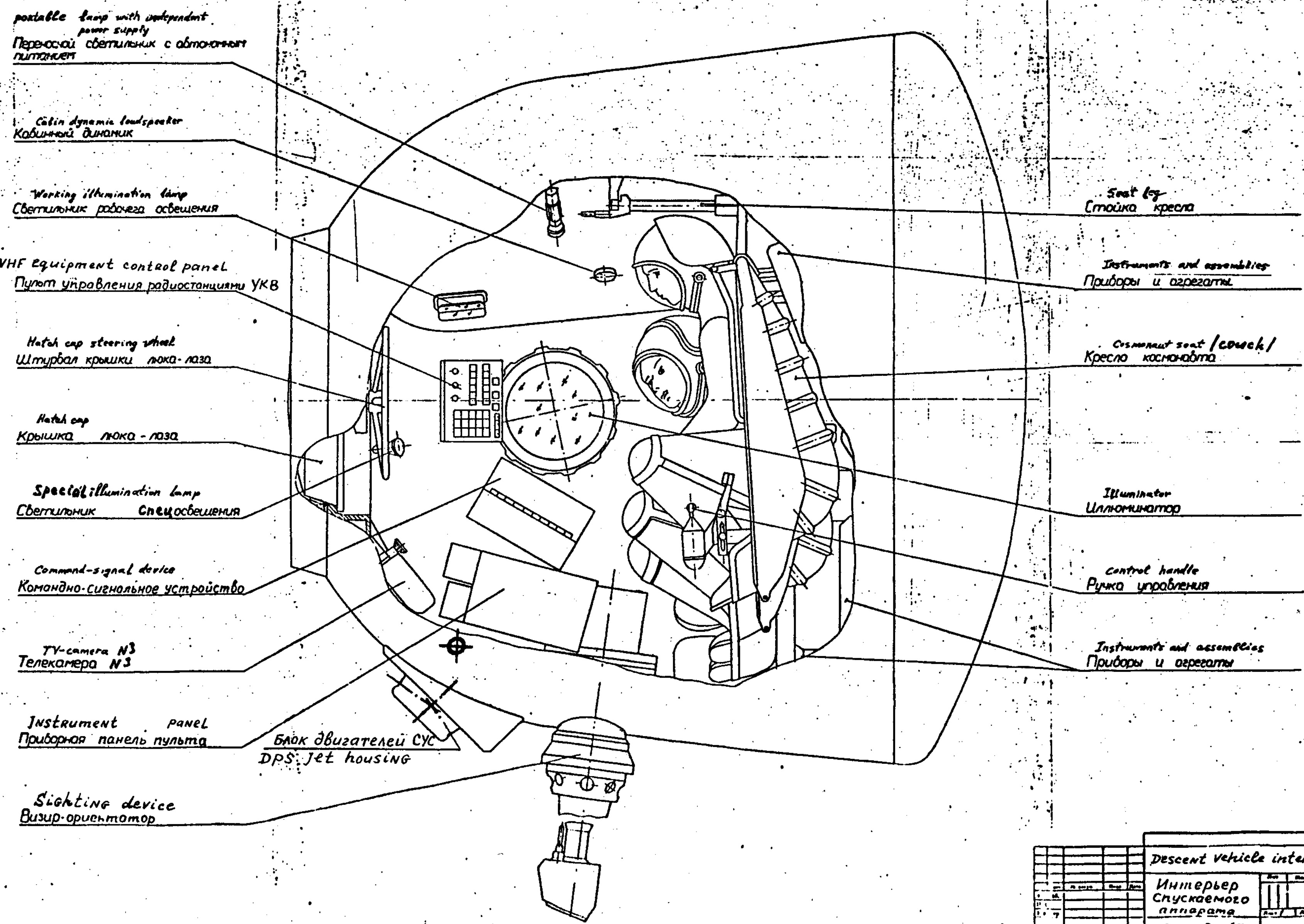


General view of J-box in OM

Общий вид распределительной коробки в ОМ (J-BOX)

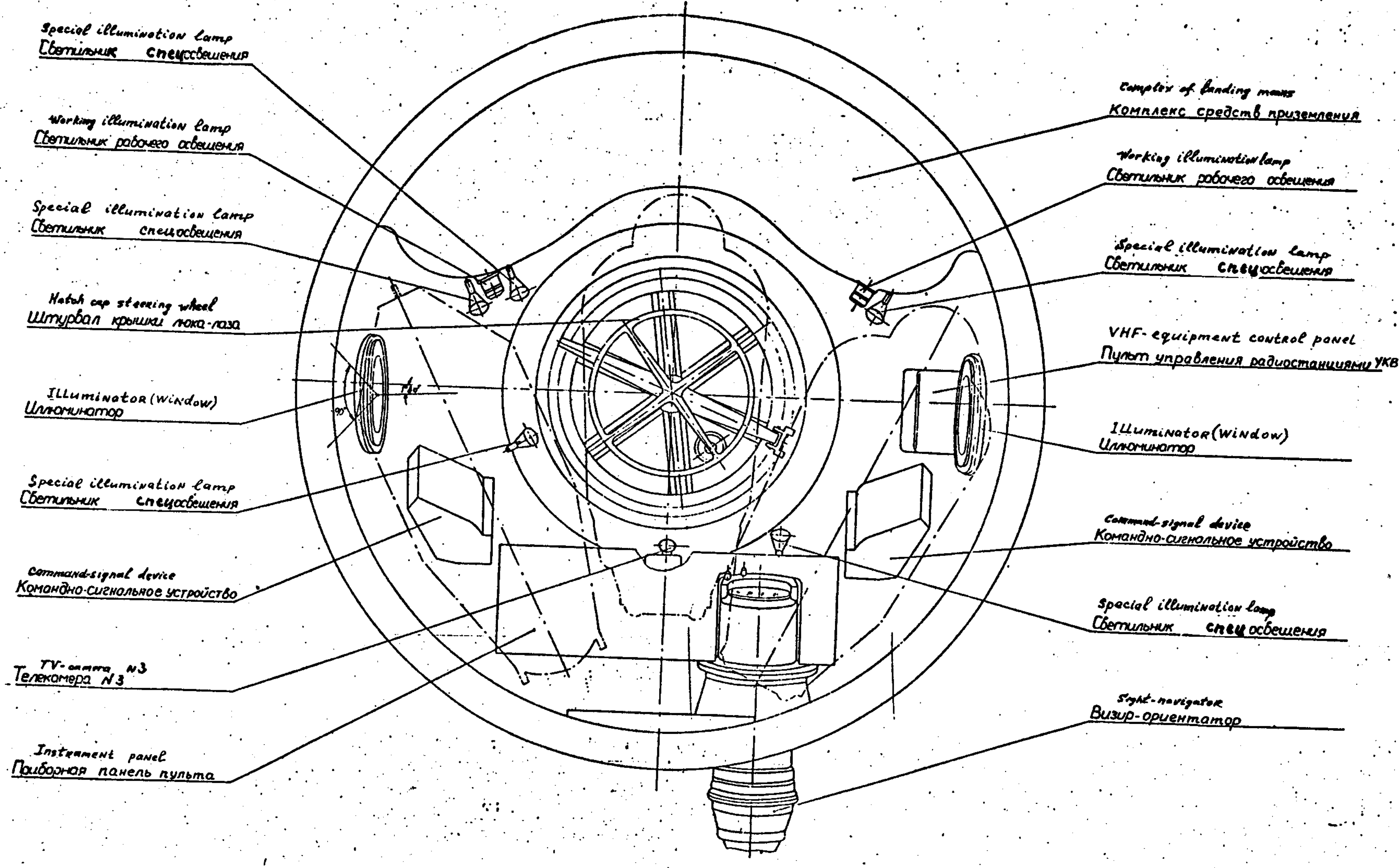
рис. 3-9

ЭПАС 40001.1
ASTP 40001.1



Descent vehicle interior
Интерьер спускаемого аппарата
рис. 3-10

ЭПАС 40001.1
ASTP 40001.1



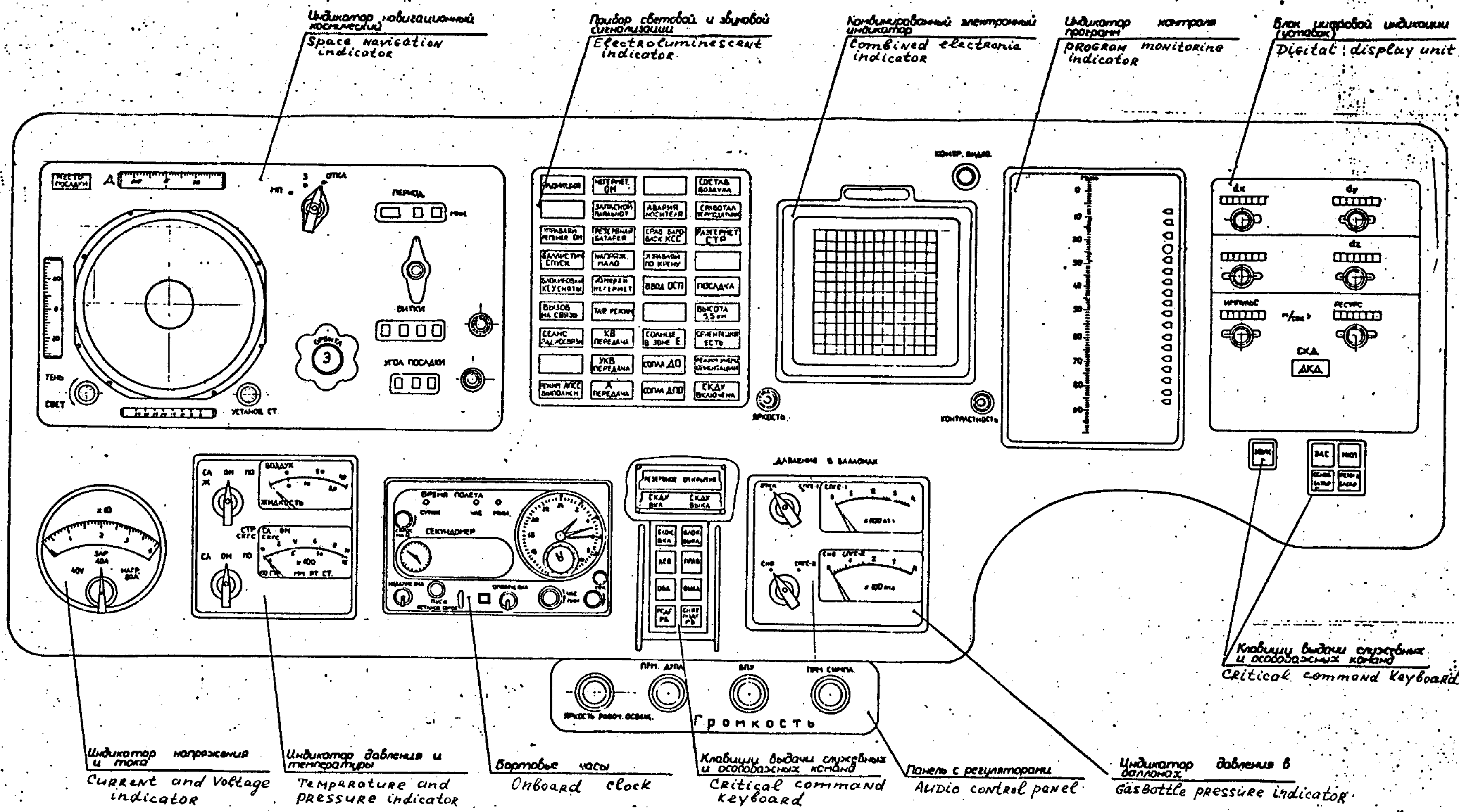
Descent vehicle interior

Интерьер спускаемого аппарата

1:5

Лист 2 Листов 2

Рис. 3-10



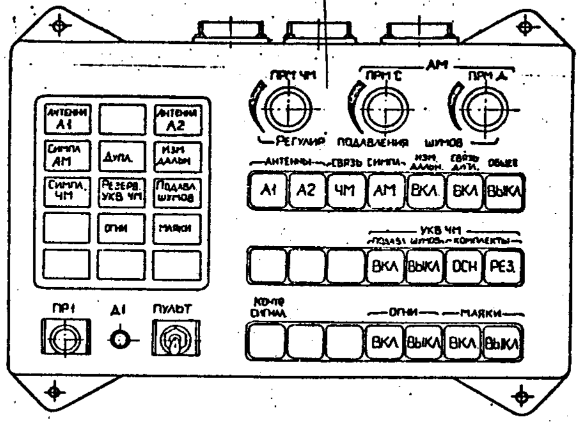
General view of cosmonauts instrument panel in DV

Общий вид пульта космонавтов СА (приборной панели)

1:1

рис. 3-11

ЭПАС 40001.1
ASTP 40001.1

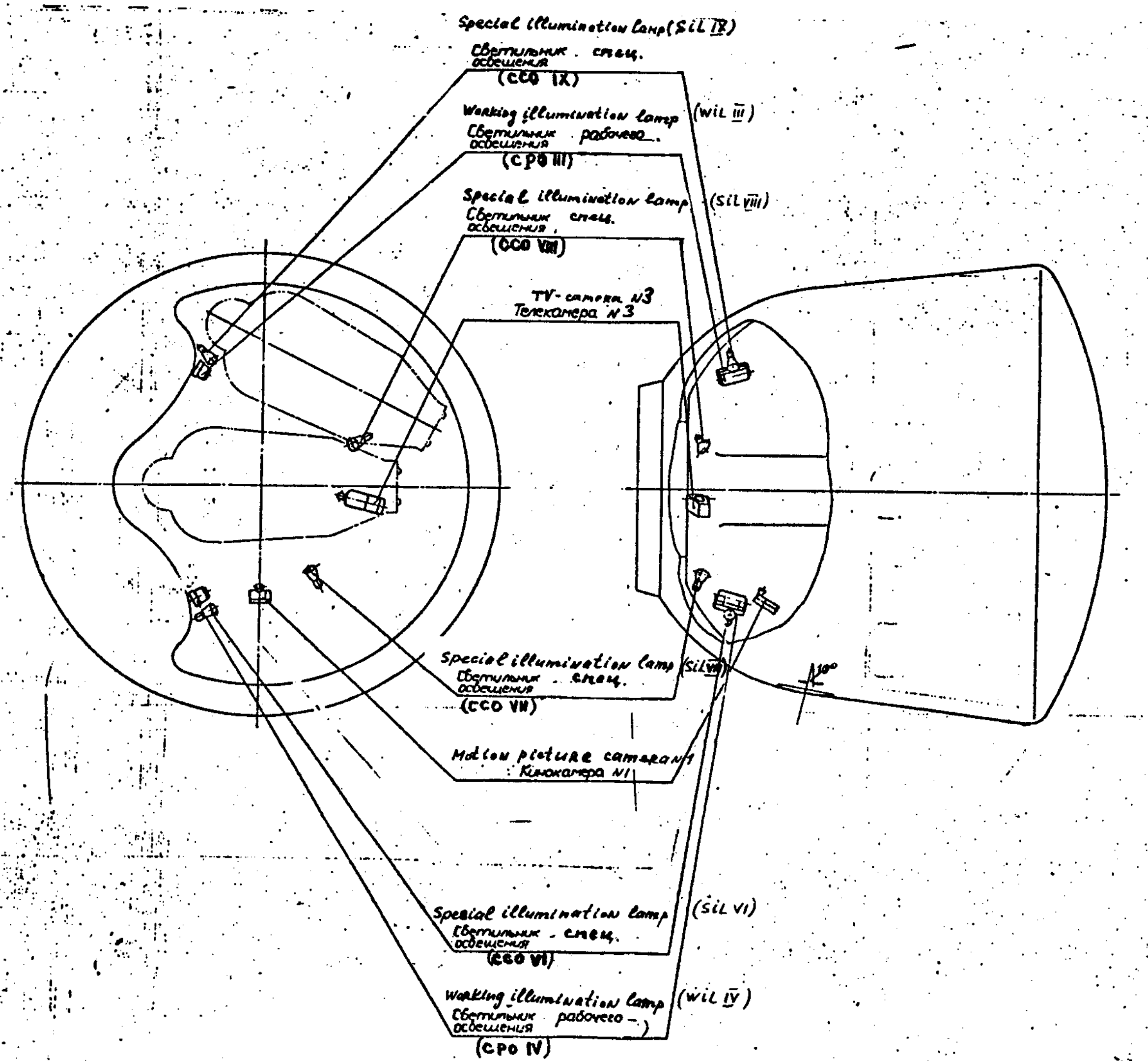


General view of control panel for compatible VHF-equipment in SV

Общий вид пульта управления совместимыми УКВ-радиостанциями в СА

1:1

Рис.3-12

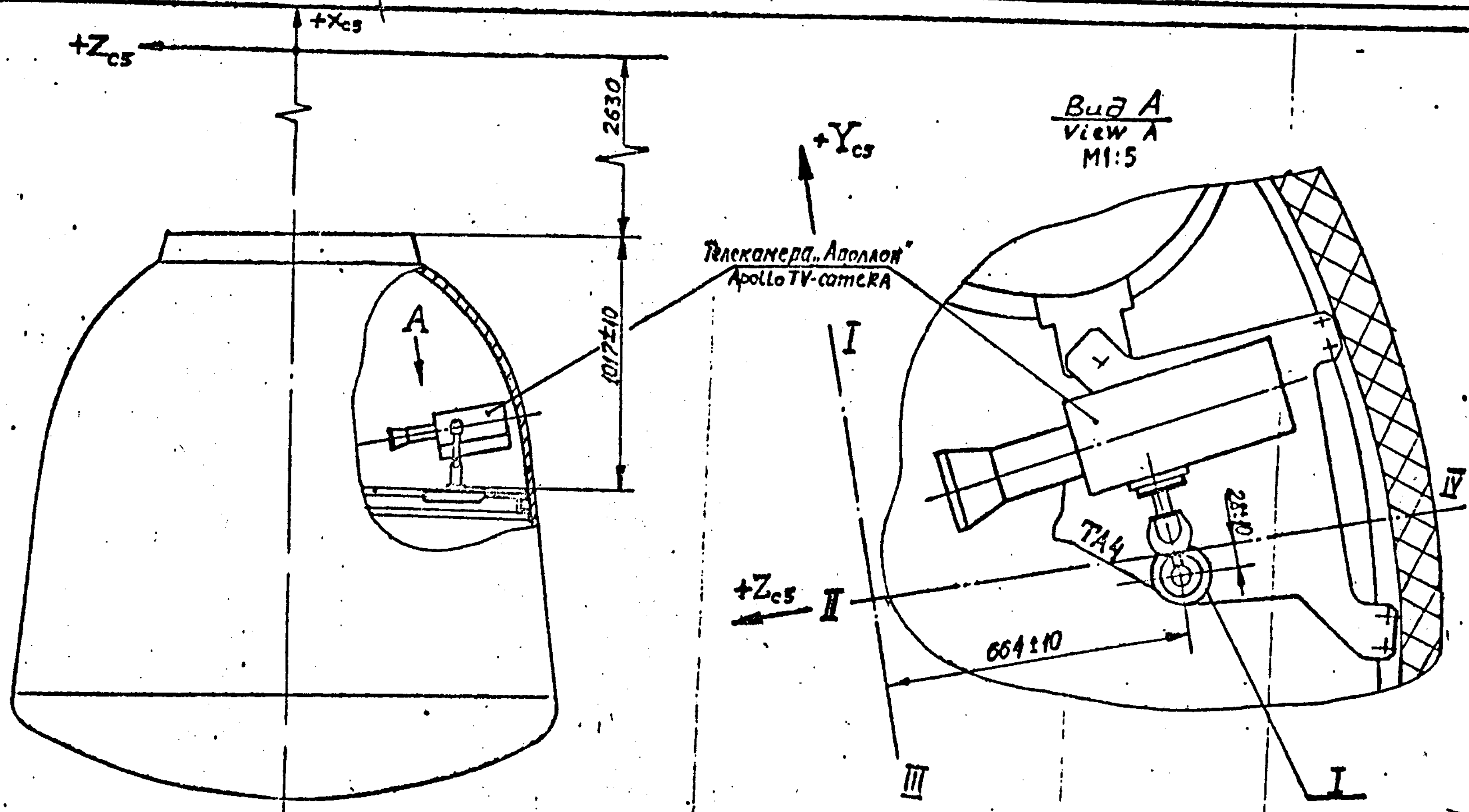


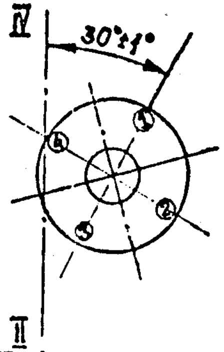
Scheme of TV-camera and illumination lamps allocation in DV.

Схема размещения телекамеры и светильников в СА

1:10

Рис. 3-13





ЭПАС 40001
ASTP 40001.1

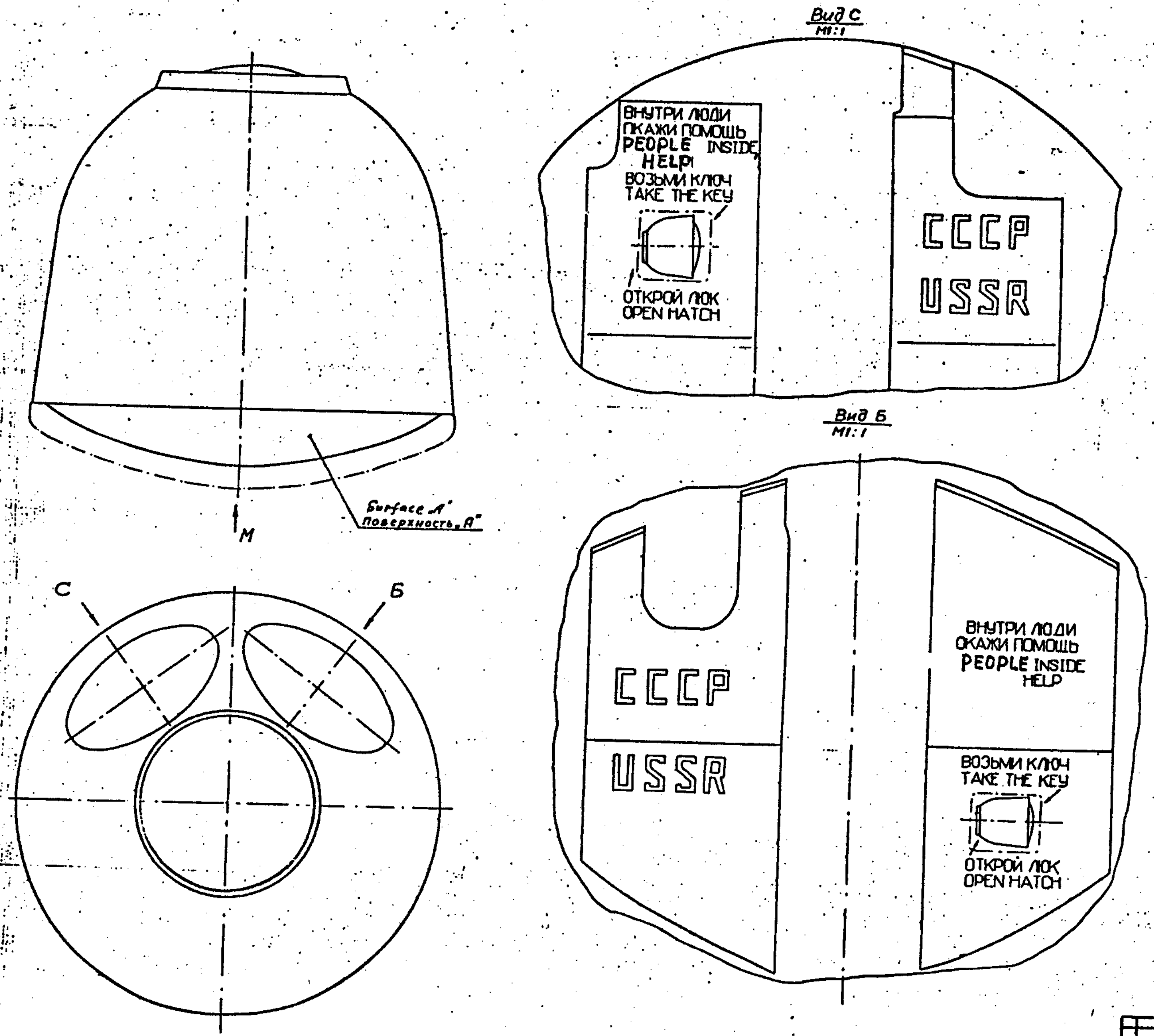
Изм	Лист	№ докум.	Подп.	Дата
Разраб.				
Пров.				
Т. контр.				
Н. контр.				
Утв.				

Apollo TV camera installation on DV TA4 bracket.

Схема установки телекамеры Аполлона на кронштейне ТА4 в СА.

Лит.	Масса	Масштаб
		1:20
Лист 2		Листов 2

Рис. 3-13



1. Поверхность „А" покрывается люминесцентной краской оранжевого цвета
2. Надписи на поверхности „А" выполняются:
   - на русском языке - черной краской на белом фоне;
   - на английском языке - белой краской на черном фоне.
3. Надписи, приведенные на видах выполняются черной краской.

1. Surface „A" is covered with a luminescent paint of yellow-red color.
2. Writings on the surface „A" are made as follows
   - russian with a black paint on the white background
   - english with a white paint on a black background
3. Writings given on views are made with a black paint

Scheme of the identification marks on the decent vehicle

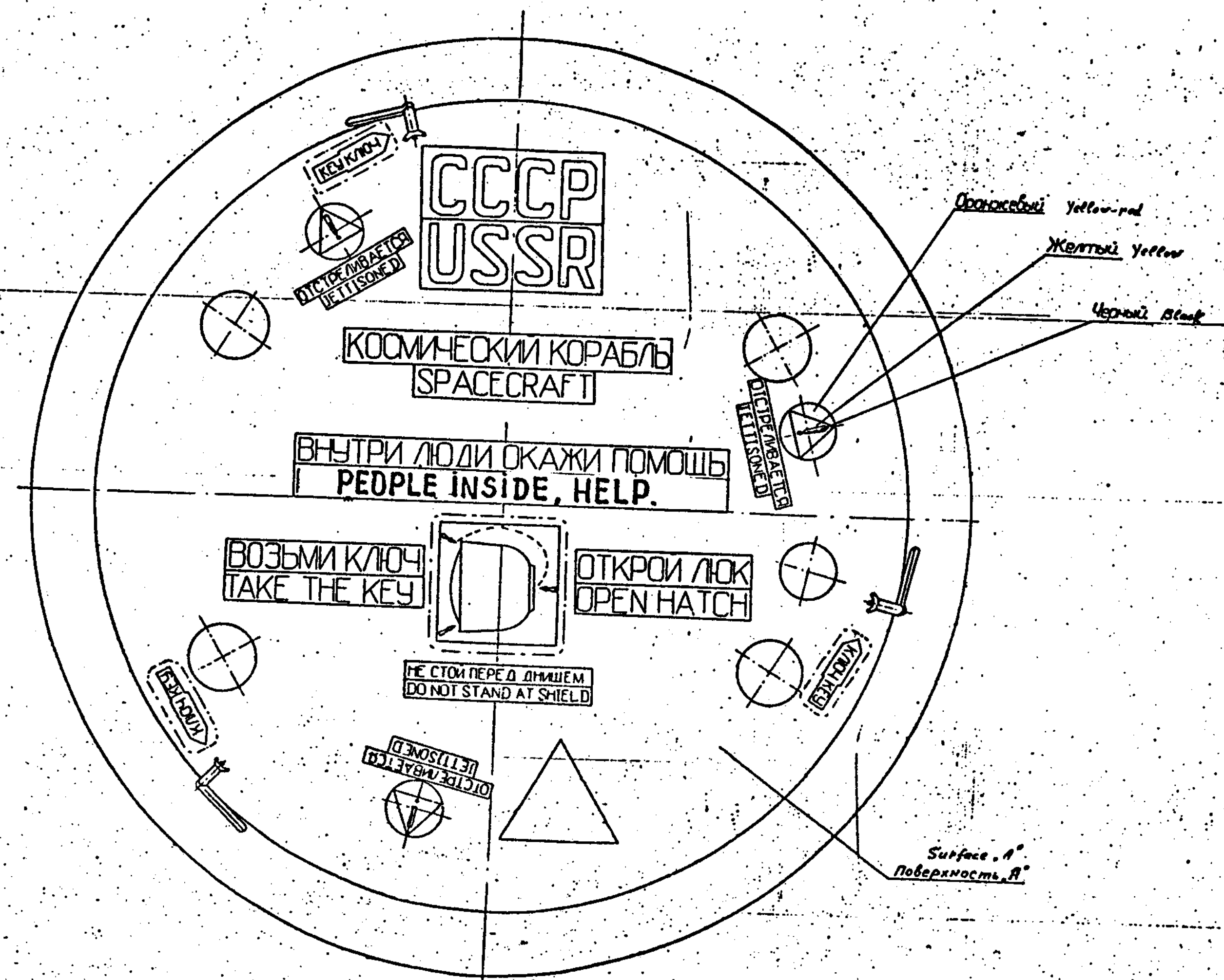
Схема опознавательных знаков на спускаемом аппарате

1:10

Рис. 3-14

ЭПАС 40001.1
ASTP 40001.1

Вид М View M
М1:5



Scheme of the identification marks on the descent vehicle

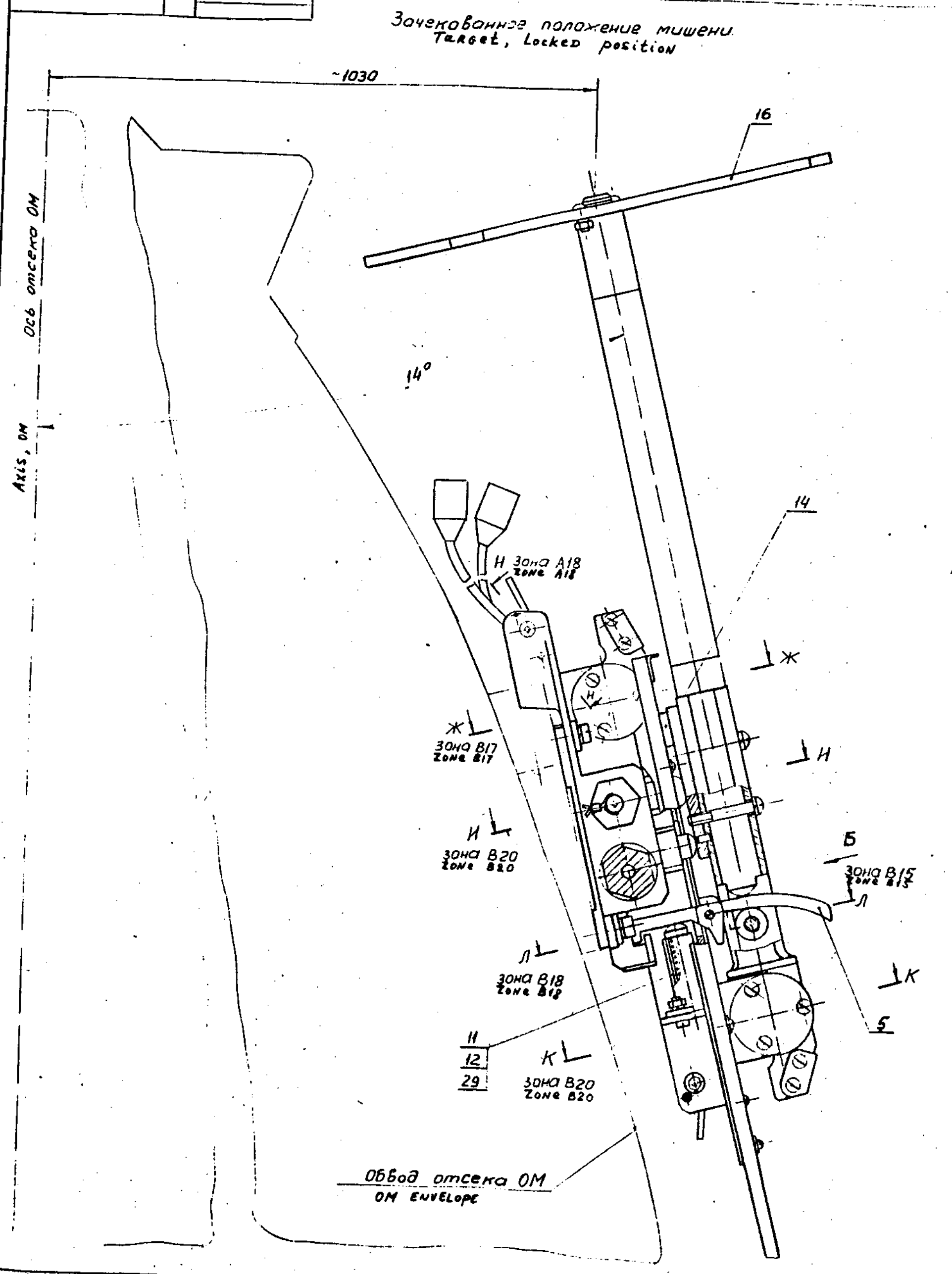
Схема опознавательных знаков на спускаемом аппарате

1:5

Рис. 3-14

51

ЭПАС 40001.1
ASTP 40001.1



1 Неперпендикулярность поверхности Р относительно оси Я не более ±10'

2 В раскрытом положении мишени:

а) непараллельность поверхности Р относительно поверхности П не более ±20';

б) непараллельность поверхности Р относительно поверхности С не более ±10';

в) непараллельность линии Ю относительно плоскости I-III не более ±15';

г) непараллельность кромки Т паза экрана поз. 3 относительно линии Ю не более ±15'.

3. После выполнения требований по п.2 установить винты поз 31, 32 и штифты поз. 33.

4. Произвести три контрольных раскрытия мишени в горизонтальной плоскости. Перед проверкой на раскрытие и после нее проверить показания датчиков контактных поз.36

5 Фактические величины точностей, установленные по п.2, и размеров Э и Ф занести в сопроводительную документацию.

Поз.		Наименование	Кол.	Примечание
37		Пиропатрон	2	A18
36		Датчик контактный	2	B3, B20
35				
34				
33		Штифт Pin	2	A6
32		Винт Screw	2	A10
31		Винт Screw	2	A9
30		Шайба Washer	1	B18
29		Пружина Spring	1	A3
28		Планка	1	B15
27		Винт Screw	2	B19
26		Пружина сдвоенная Double spring	1	B19
25		Пружина сдвоенная Double spring	1	B17
24		Винт Screw	1	B15
23		Крышка Cover	2	B13, B20
22		Втулка Bush	1	B17
21		Ось Axle	1	B18
20		Крышка Cover	2	B17, B19
19		Втулка Bush	1	B20
18		Ось Axle	1	B19
17		Винт Screw	1	A9
16		Крест выносной	1	B3
15		Ось Axle	1	A19
14		Прокладка Packing	1	B3
13		Серьга	1	A28
12		Толкатель Pusher	1	A3
11		Корпус Body	1	A3
10		Пружина Spring	2	A18
9		Ось Axle	2	A18
8		Защелка Latch	2	A18
7		Винт Screw	1	A18
6		Ось Axle	1	A18
5		Копир	1	A2
4		Кронштейн	1	A6
3		Экран Screen	1	B13
2		Штанга Rod	1	B6
1		Механизм зачековки	1	A6

Docking target

Стыковочная Мишень

1:1

Рис. 3-15

ЭПАС 40001.1

ASTP 40001.1

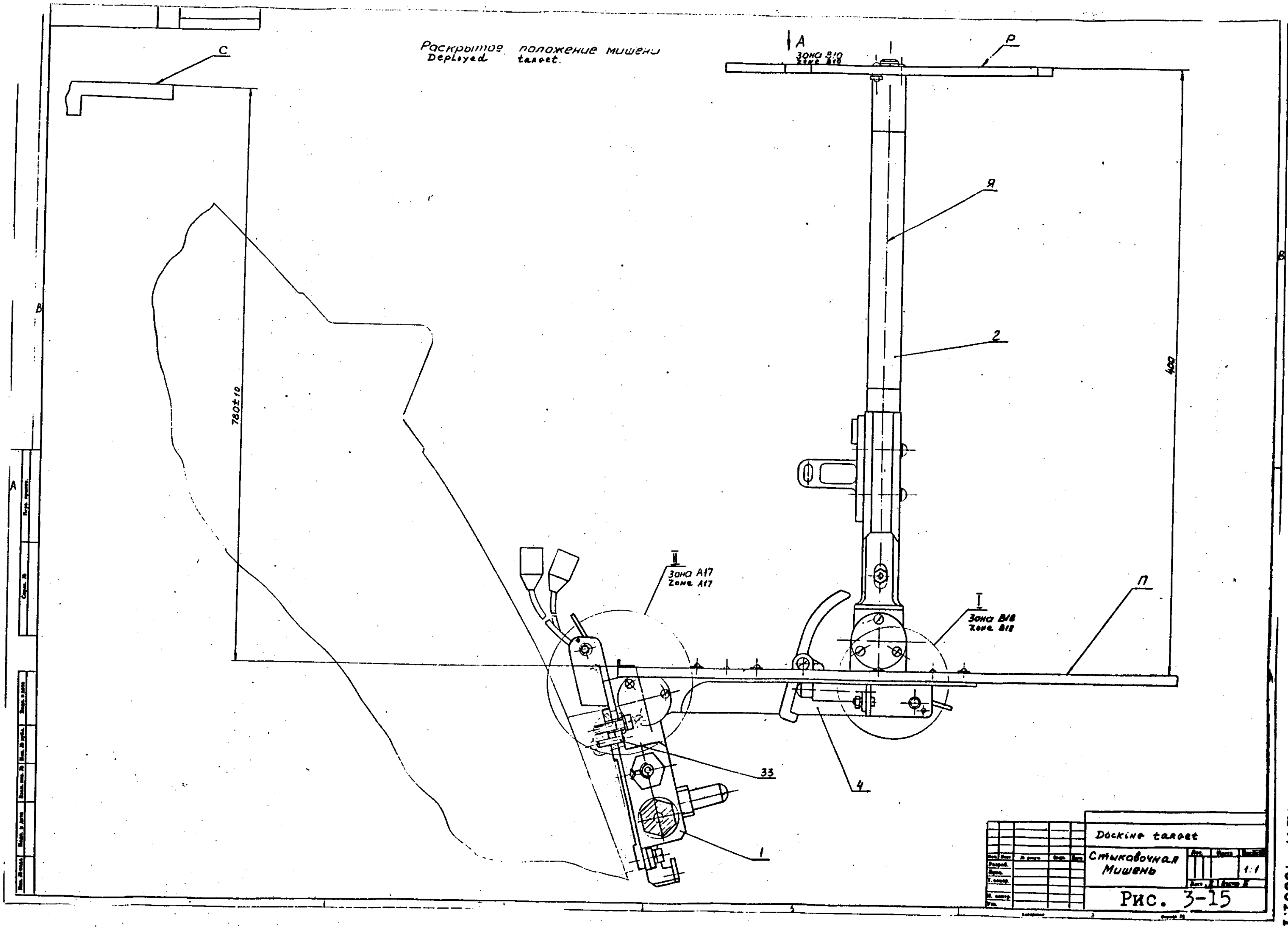
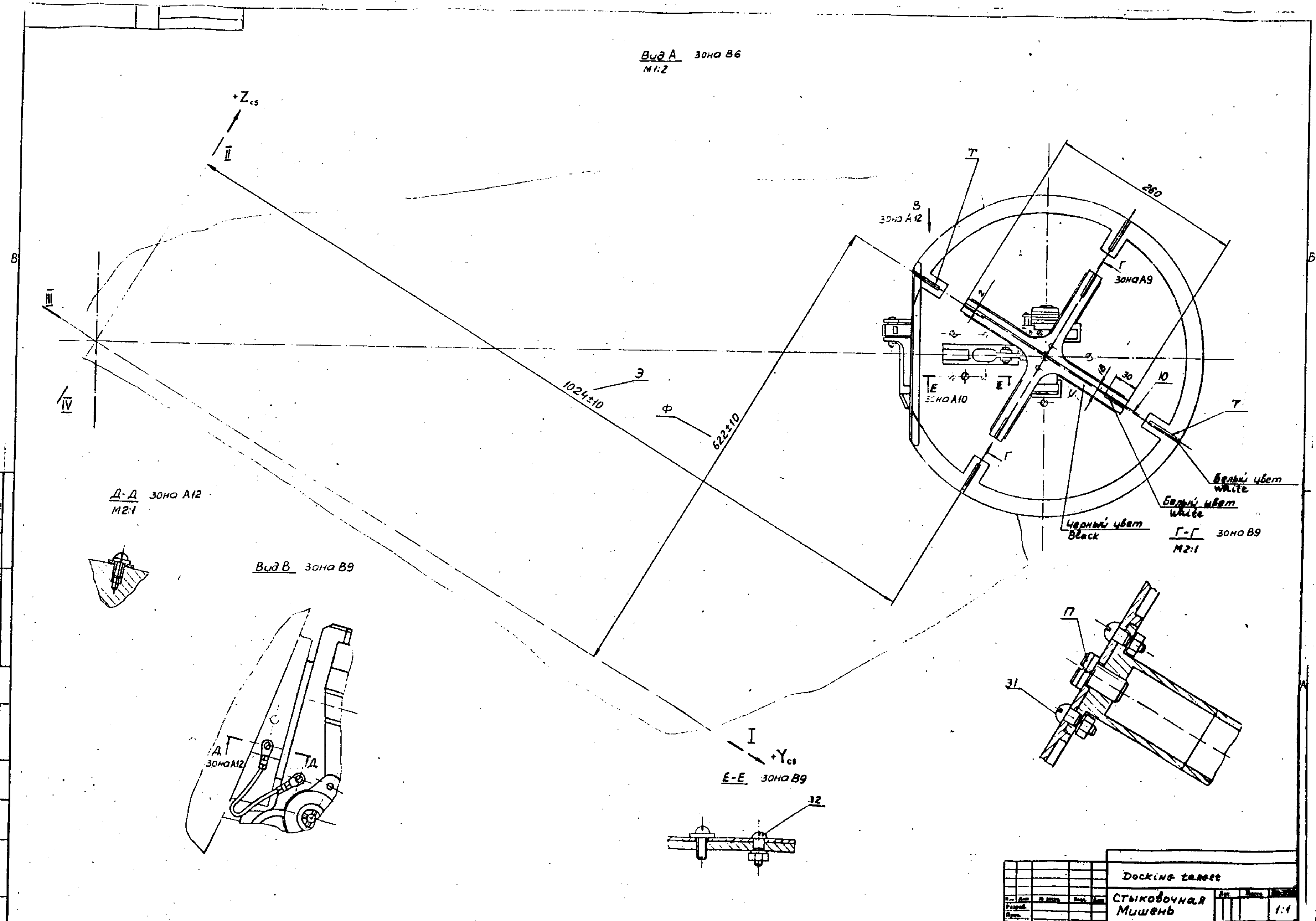


Рис. 3-15

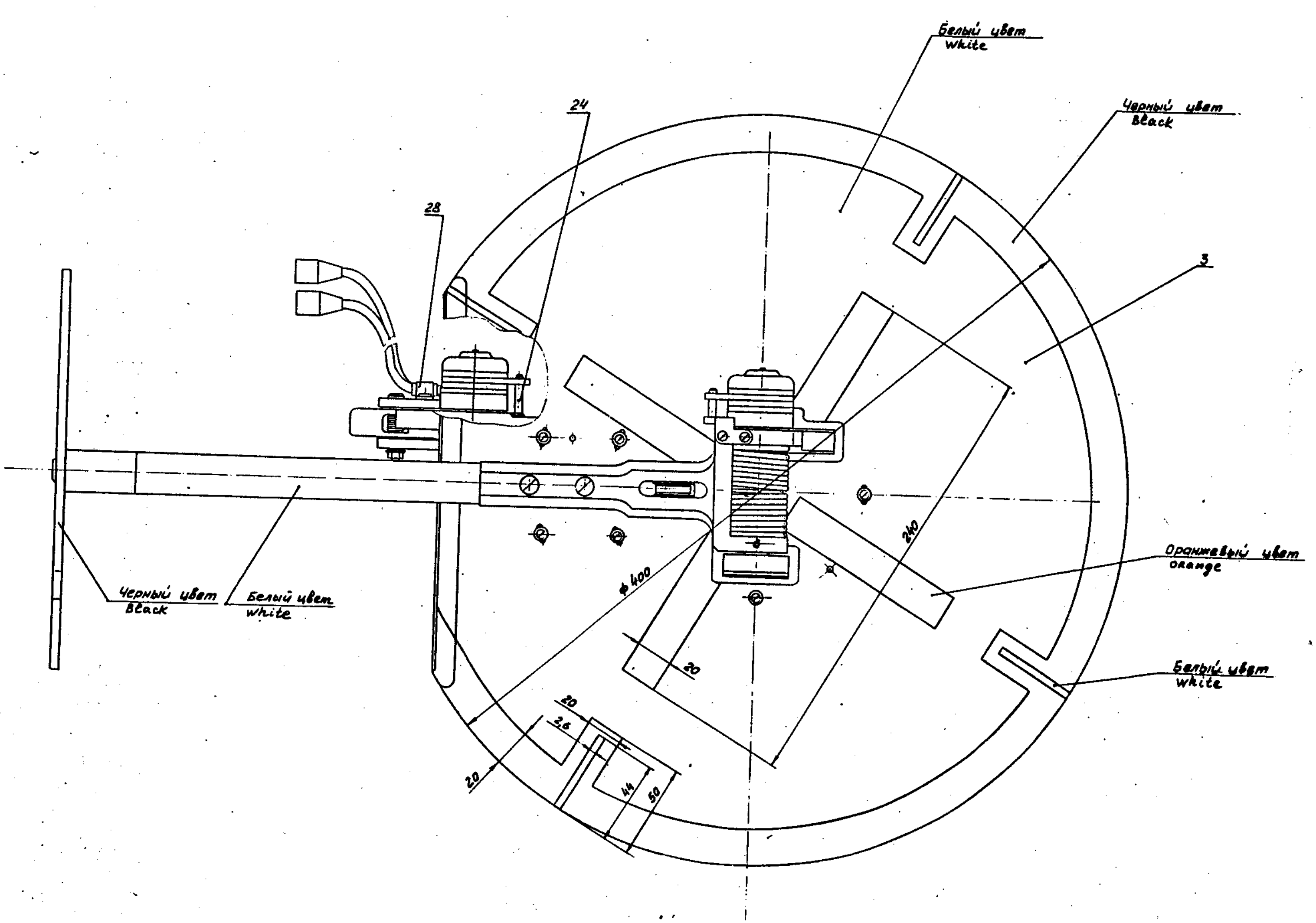
ЭПАС 40001.1
ASTP 40001.I



Вид А зона В6
М1:2
+Z cs
II
III
IV
I
+Y cs
1024±10
622±10
Э
Ф
260
В
зона А12
Г
зона А9
Т
Ю
30
Е
зона А10
Белый цвет white
Белый цвет white
Черный цвет Black
Г-Г зона В9
М2:1
Д-Д зона А12
М2:1
Вид В зона В9
Д
зона А12
17
31
Е-Е зона В9
32
Docking target
Стыковочная Мишень
1:1

Рис. 3-15

Вид Б повернуто зона А3



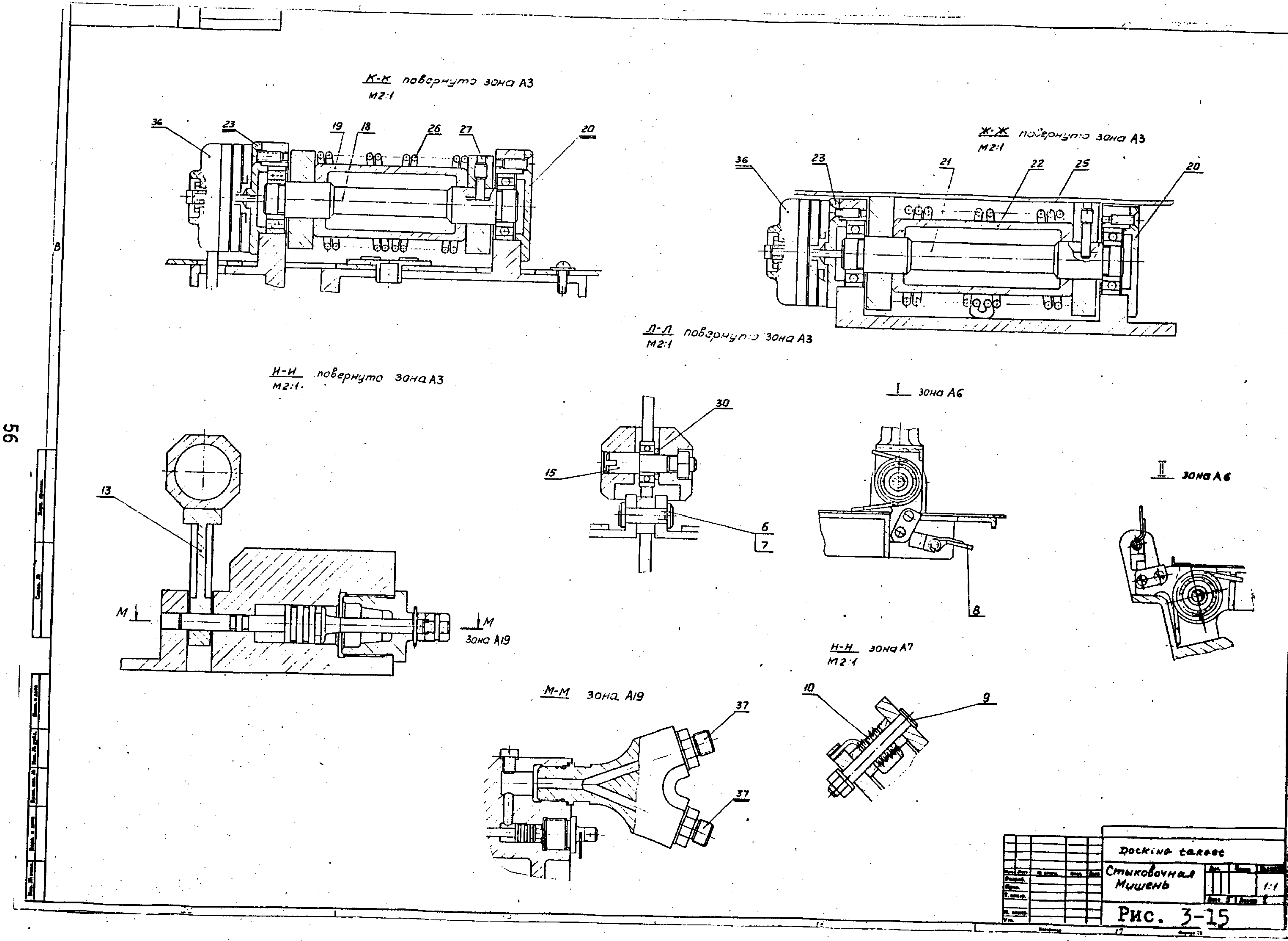
Docking target

Стыковочная Мишень

1:1

Рис. 3-15

ЭПАС 40001.1
ASTP 40001.1


К-К повернуто зона А3
М2:1
36
23
19
18
26
27
20
Ж-Ж повернуто зона А3
М2:1
36
23
21
22
25
20
Л-Л повернуто зона А3
М2:1
И-И повернуто зона А3
М2:1
30
15
6
7
I зона А6
8
II зона А6
13
М
М
Зона А19
Н-Н зона А7
М2:1
10
9
М-М зона А19
37
37
Docking target
Стыковочная
Мишень
1:1
Рис. 3-15

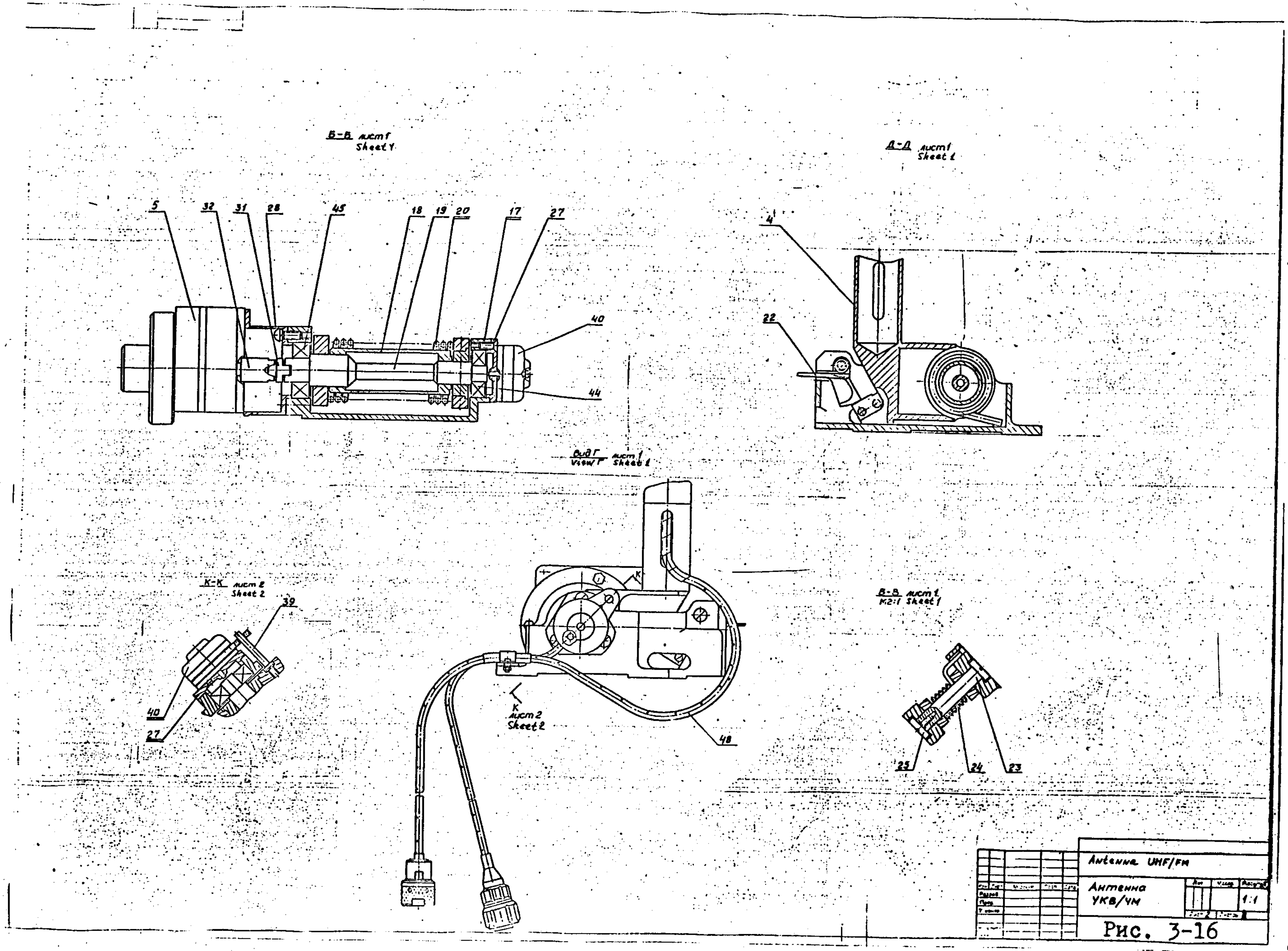
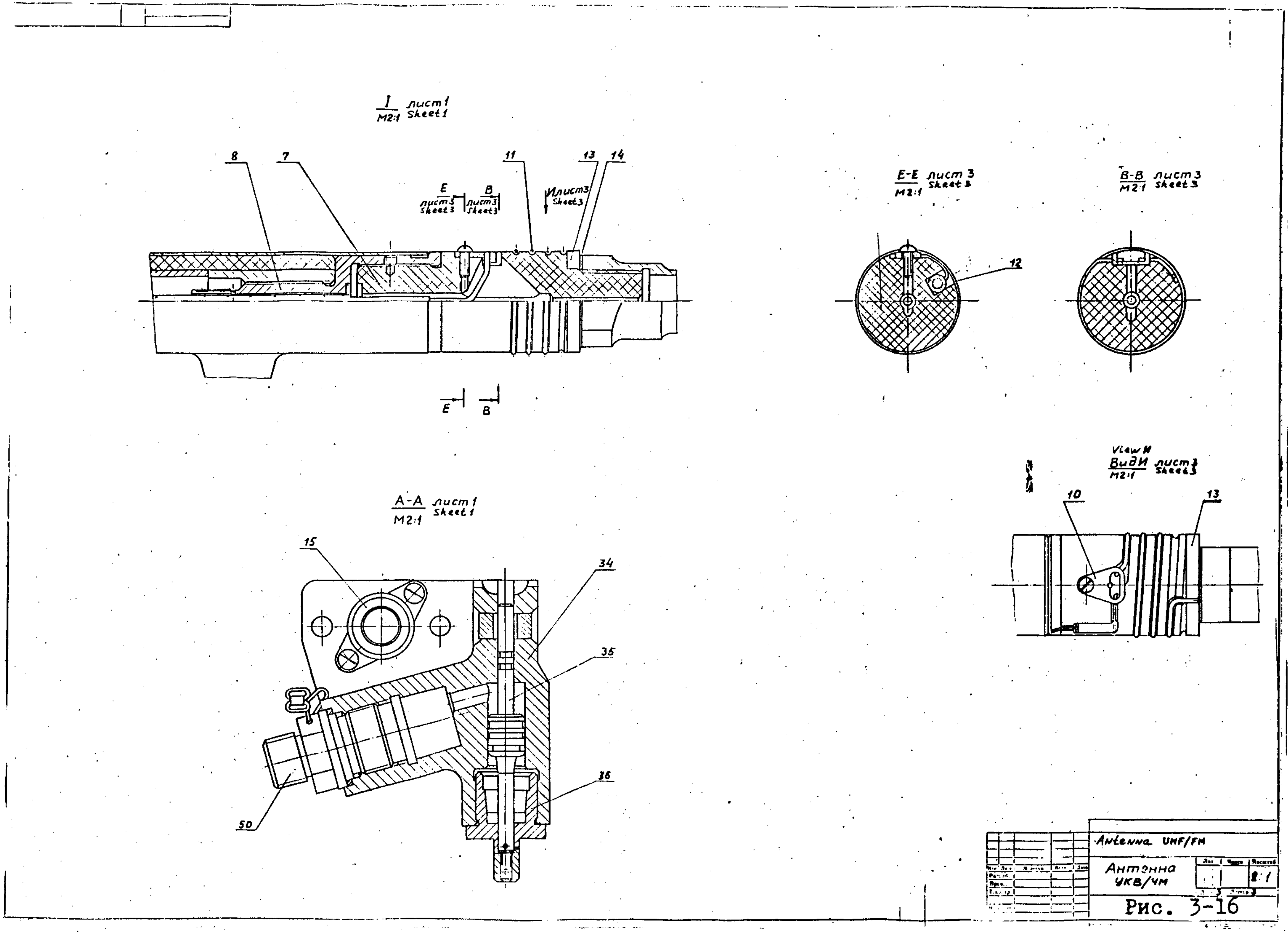


Рис. 3-16

ЭПАС 40001.1
ASTP 40001.1


I лист 1 / M2:1 Sheet 1
8
7
11
13
14
E лист 3 Sheet 3
B лист 3 Sheet 3
И лист 3 Sheet 3
E
B
E-E лист 3 / M2:1 Sheet 3
12
B-B лист 3 / M2:1 Sheet 3
View И
Вид И лист 3 / M2:1 Sheet 3
10
13
A-A лист 1 / M2:1 Sheet 1
15
34
35
36
50
Antenna UHF/FM
Антенна УКВ/ЧМ
2:1
Рис. 3-16

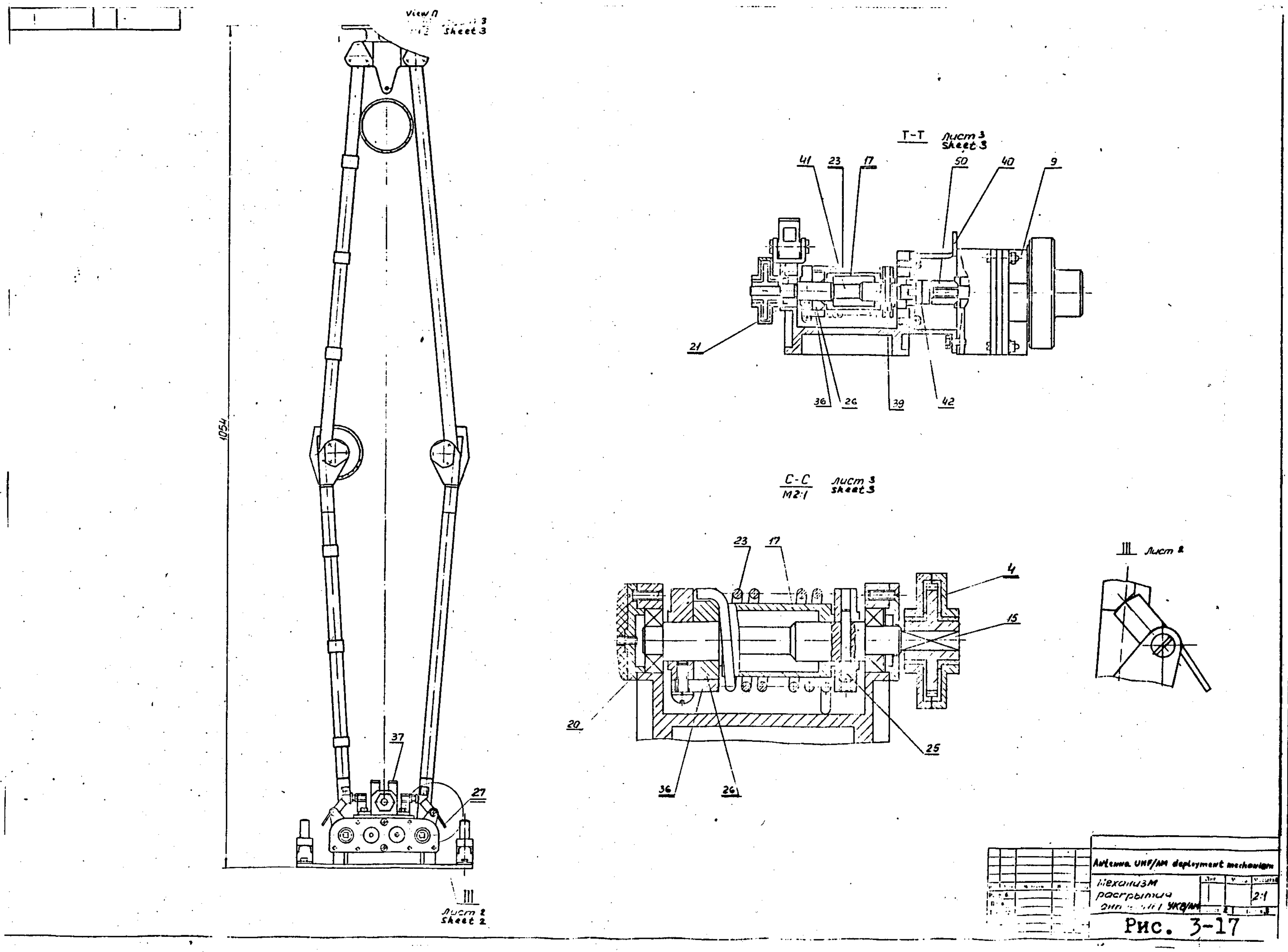
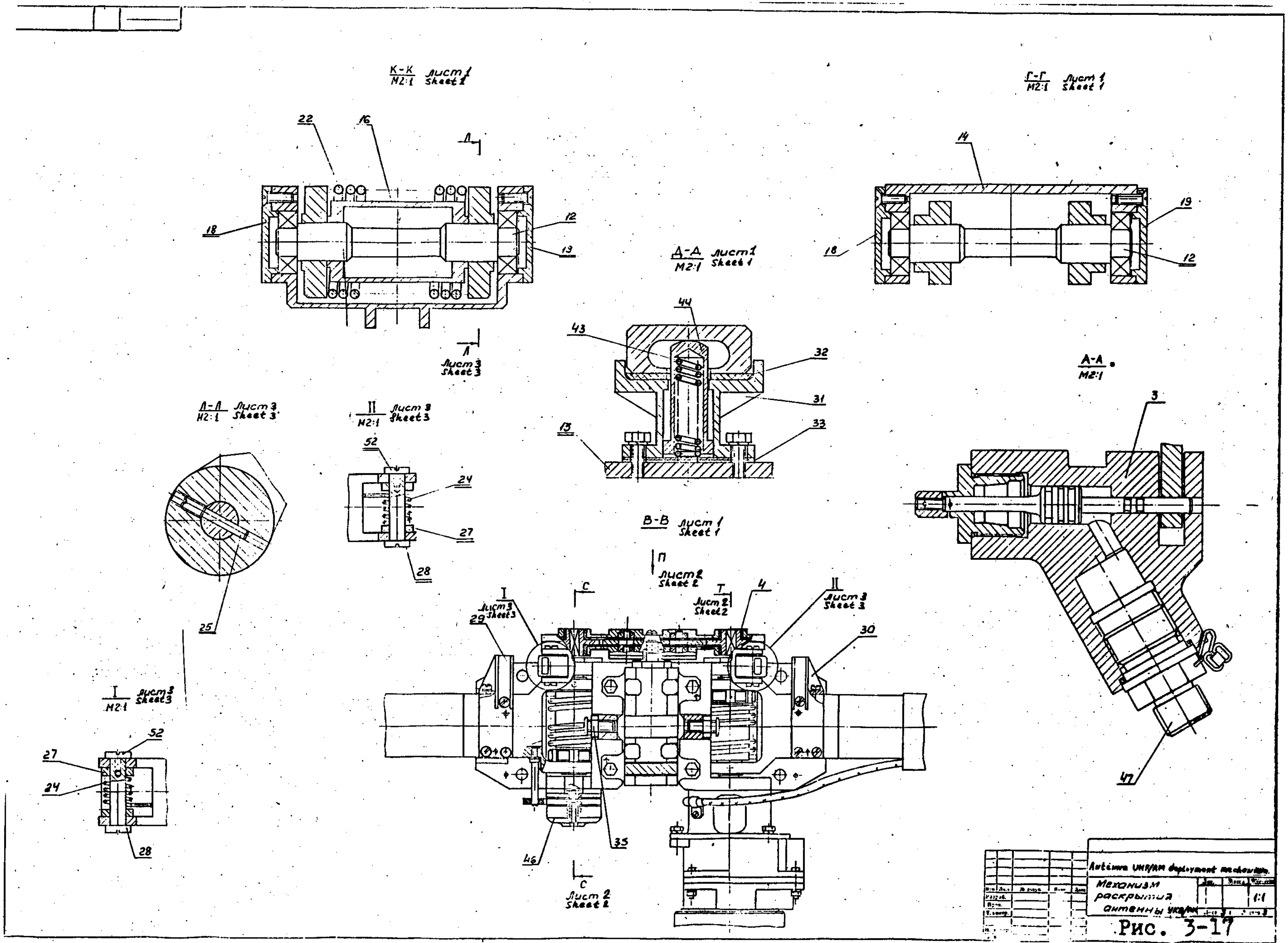


Рис. 3-17

ЭПАС 40001.1
ASTP 40001.1


К-К Лист 1
М2:1 Sheet 1
Г-Г Лист 1
М2:1 Sheet 1
Д-Д Лист 1
М2:1 Sheet 1
Л-Л Лист 3
М2:1 Sheet 3
II Лист 3
М2:1 Sheet 3
А-А
М2:1
В-В Лист 1
Sheet 1
П Лист 2
Sheet 2
С Лист 2
Sheet 2
Т Лист 2
Sheet 2
I Лист 3
Sheet 3
I Лист 3
М2:1 Sheet 3
II Лист 3
Sheet 3
Л Лист 3
Sheet 3
22
16
18
12
13
14
19
44
43
32
31
33
3
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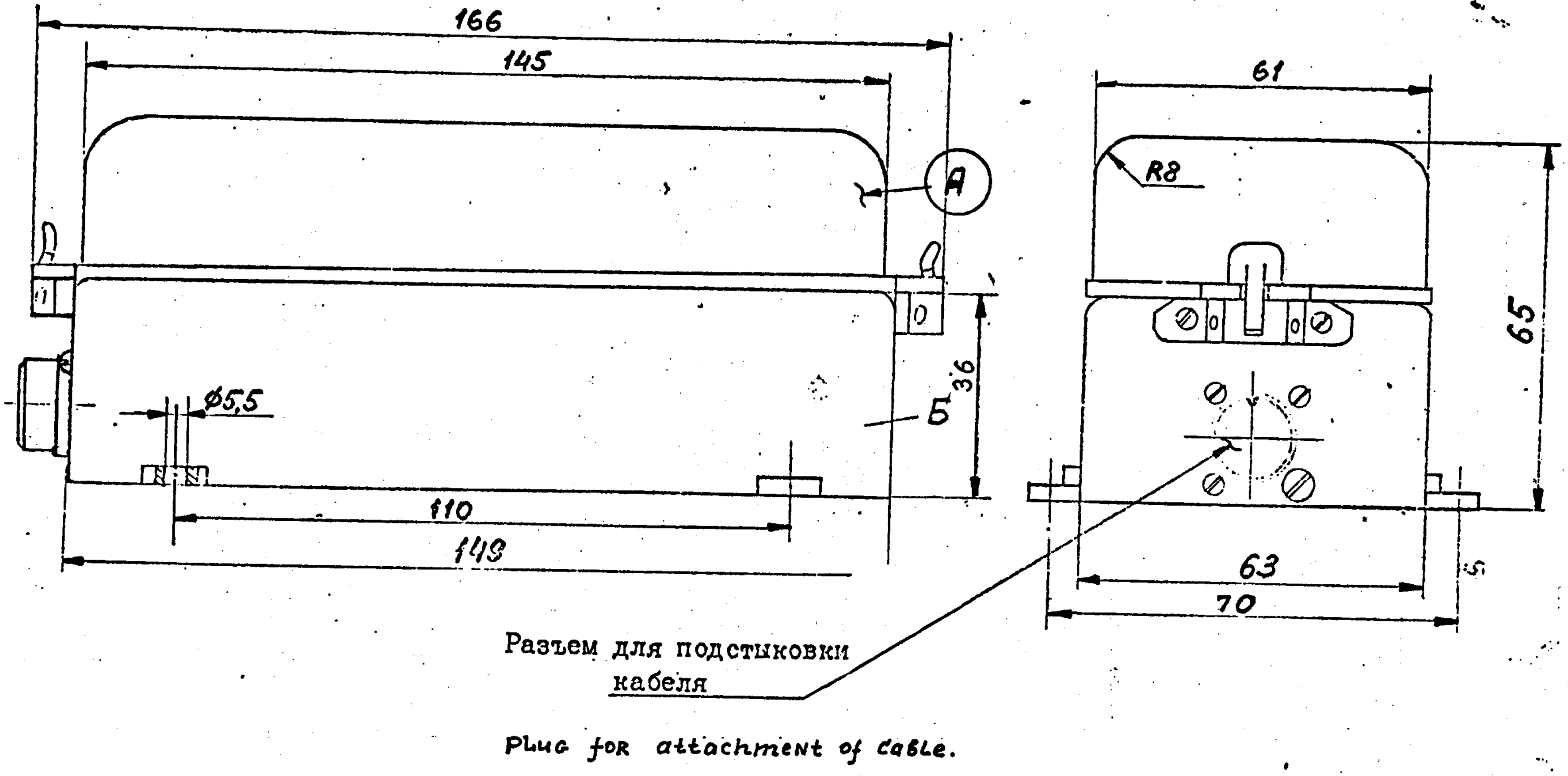
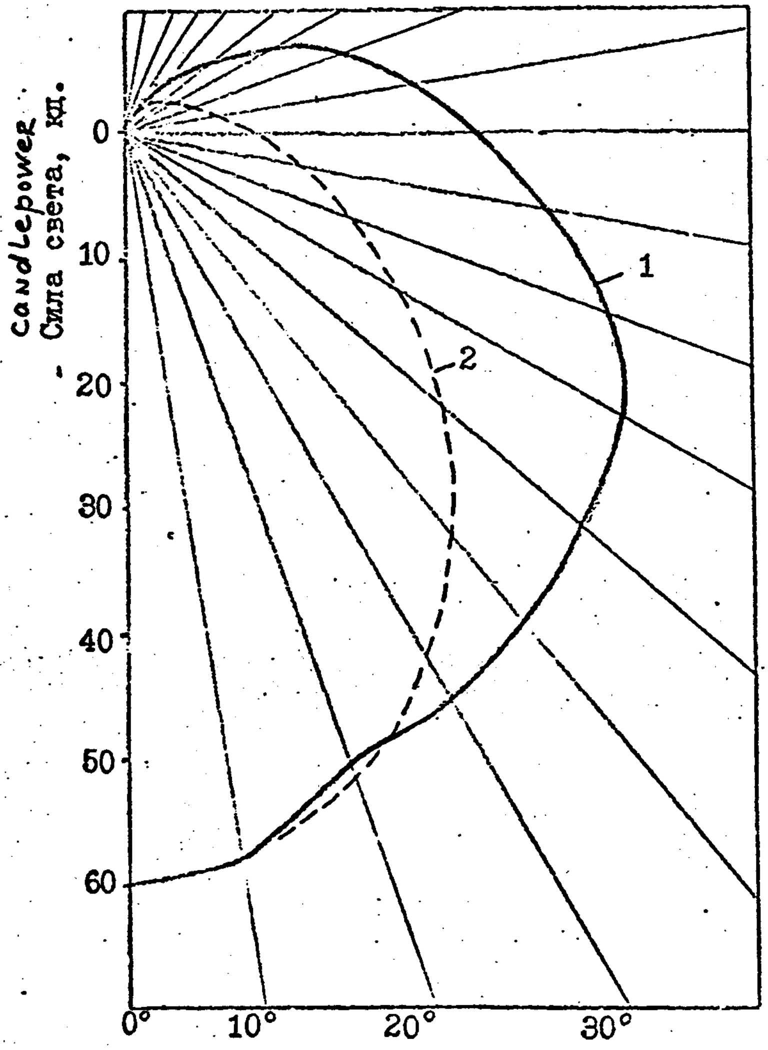
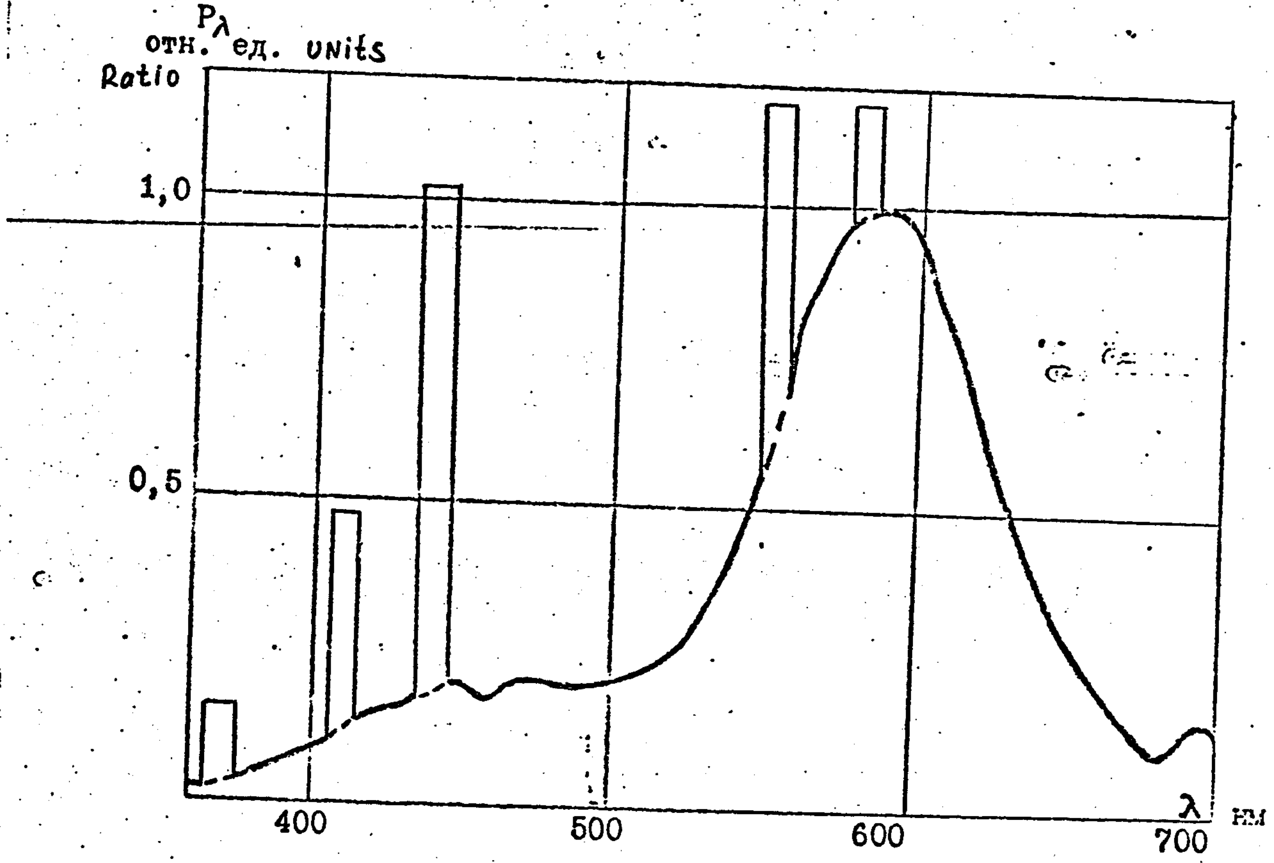
27
28
52
25
29
4
30
35
46
47
Antenna UHF/AM deployment mechanism
Механизм раскрытия антенны УКВ/АМ
1:1
Рис. 3-17



Working illumination lamp (WIL)
Светильник рабочего освещения (СРО)
Рис. 3-18

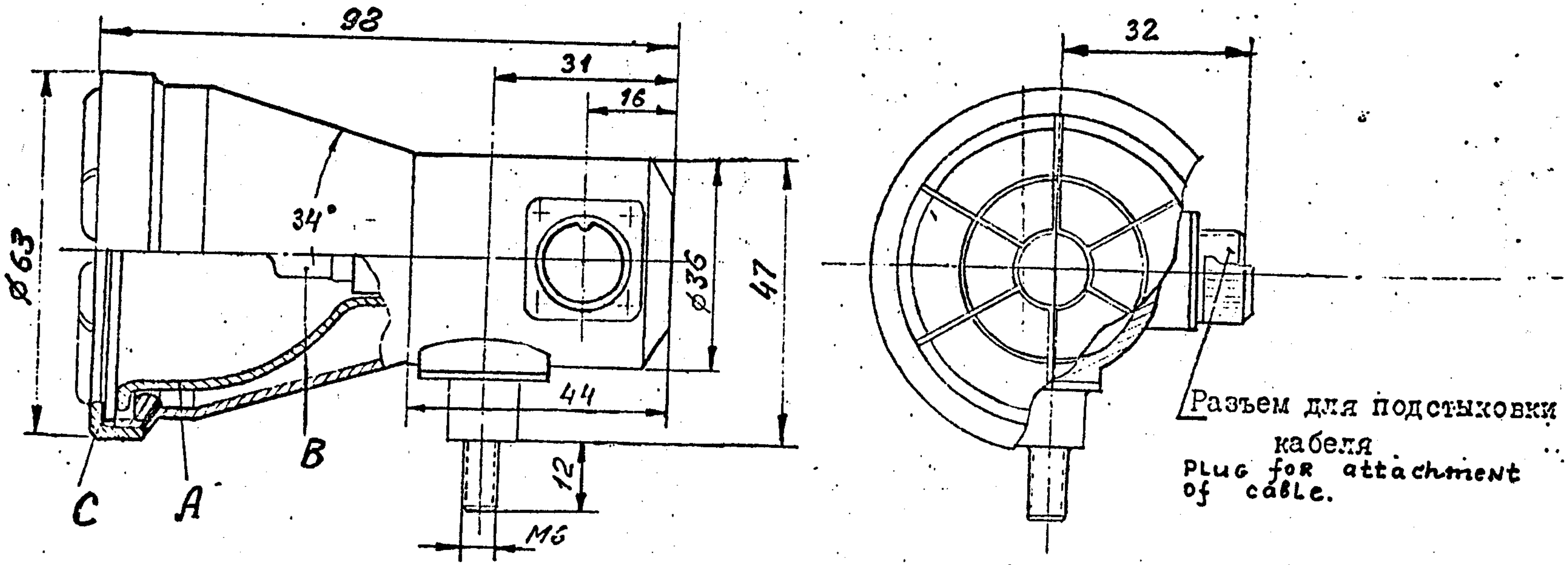


Light Distribution Pattern of WIL
Рис.3-19 Светораспределение светильника СРО
in cross section of plane
1 - в поперечной плоскости
in Longitudinal plane
2 - в продольной плоскости



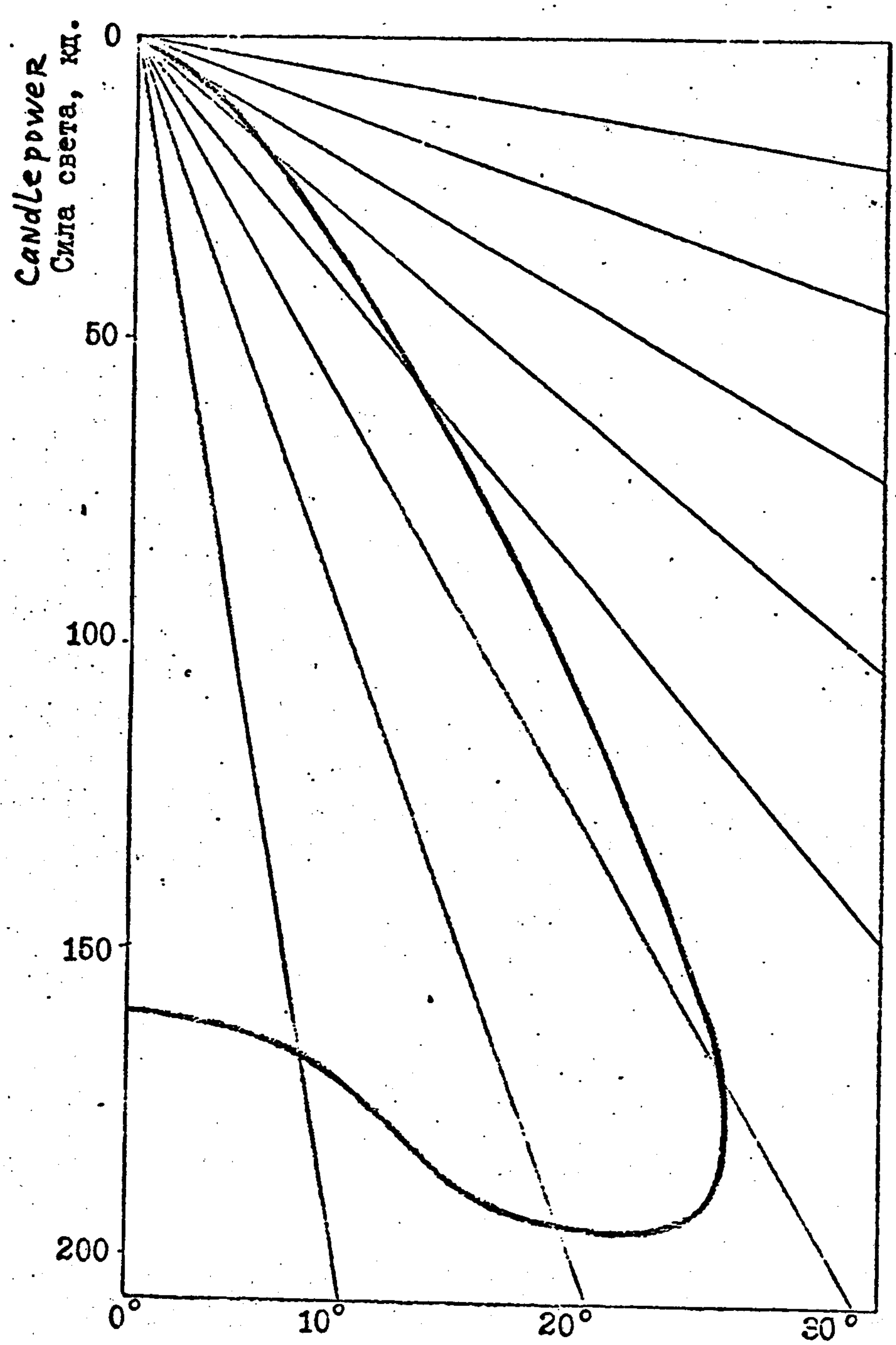
Spectral characteristics of WIL
Рис. 3-20 Спектральная характеристика светильника СРО

M1:1

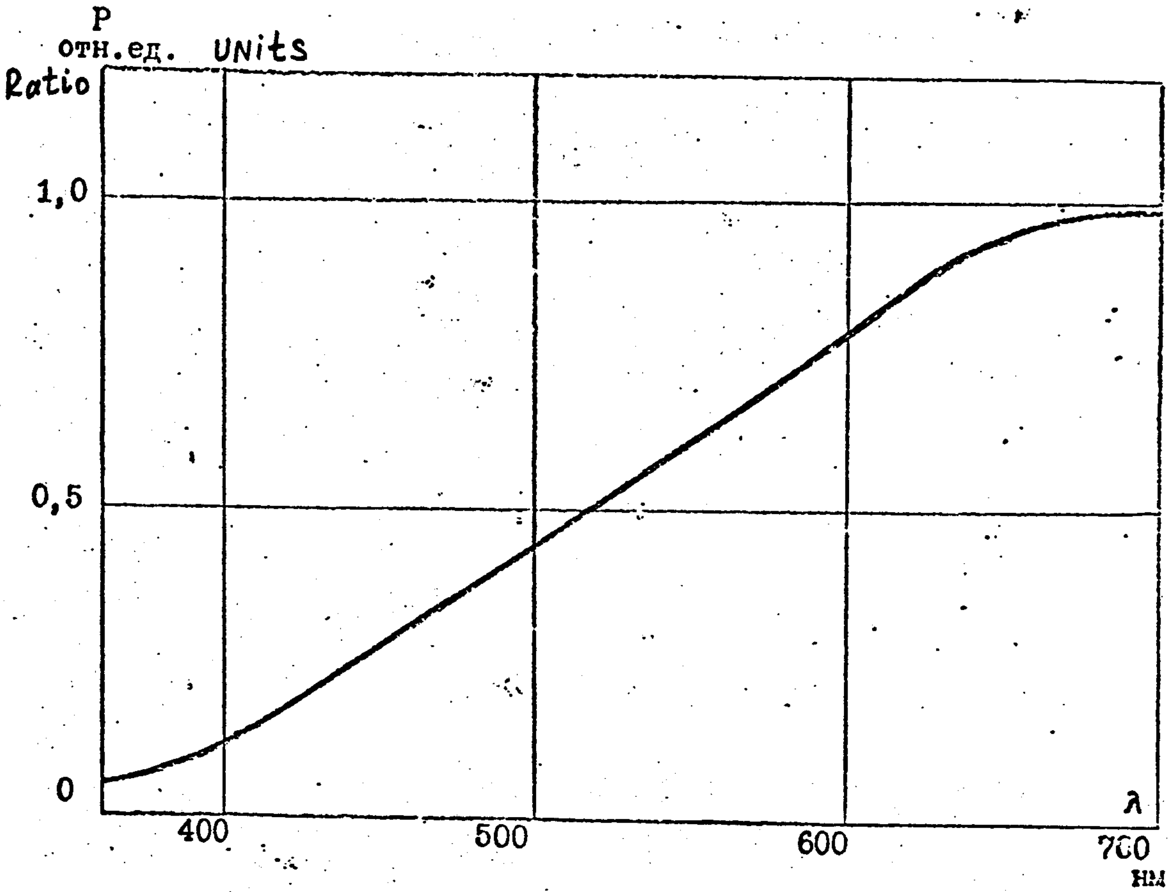


Special illumination lamp (SIL)
Светильник специального освещения (ССО)
рис. 3-21

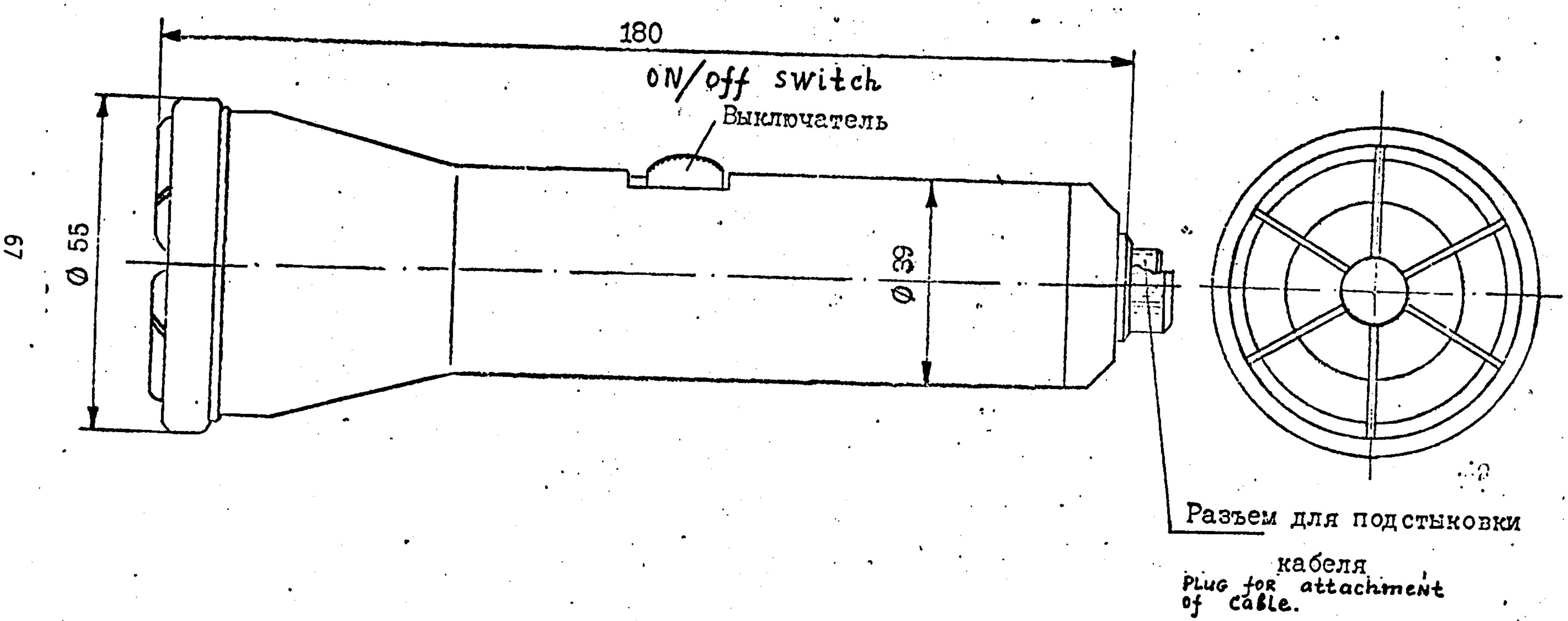
ЭПАС 40001.1.
ASTP 40001.1.



Light Distribution Pattern of SIL
Рис.3-22' Светораспределение светильника ССО



Spectral characteristics of SIL
Рис.3-23 Спектральная характеристика светильника ССО



TRANSFERABLE Illumination Lamp (TIL)

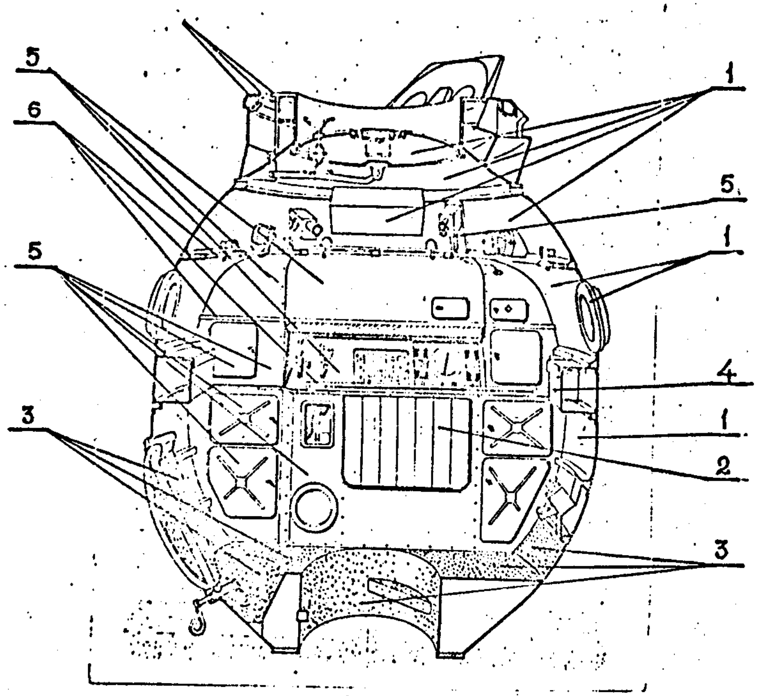
Светильник переносного освещения (СПО)

рис. 3-24

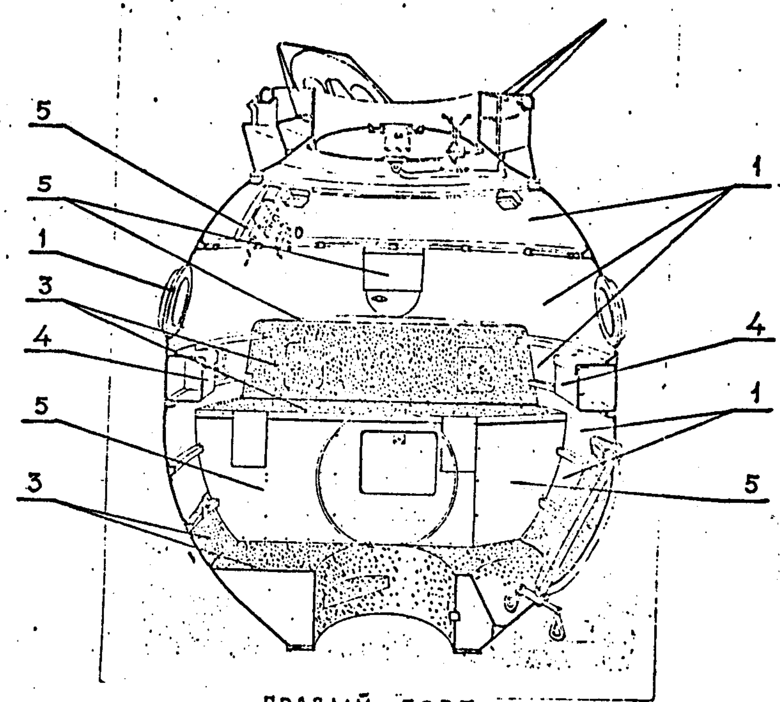
ЭПАС 40001.1
ASTP 40001.1

Схема размещения декоративно-отделочных материалов в ОМ

Lay-out of decoration materials in OM



ЛЕВЫЙ БОРТ
left board



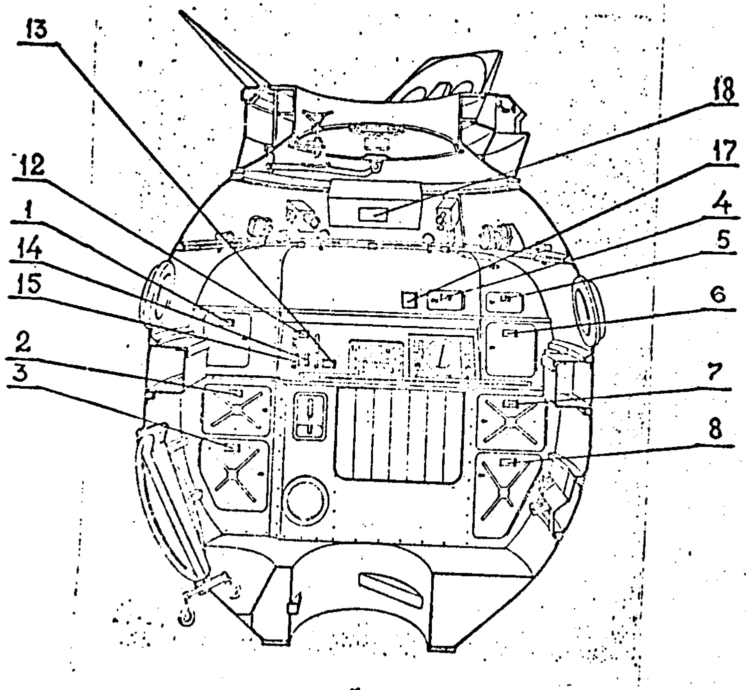
ПРАВЫЙ БОРТ
right board

ПОЗ. (No)	ТИП ОТДЕЛКИ (decoration type)	ЦВЕТ ОТДЕЛКИ (decoration colour)
1	decoration fabric ДЕКОРАТИВНАЯ ТКАНЬ	Light yellow СВЕТЛОЖЕЛТЫЙ
2	decoration fabric ДЕКОРАТИВНАЯ ТКАНЬ	Blue ГОЛУБОЙ
3	decoration fabric ДЕКОРАТИВНАЯ ТКАНЬ	DARK GREEN ТЕМНОЗЕЛЕНЫЙ
4	decoration material ДЕКОРАТИВНЫЙ МАТЕРИАЛ	Light GREEN СВЕТЛОЗЕЛЕНЫЙ
5	enamel on metal ЭМАЛЬ НА МЕТАЛЛЕ	GRey Blue СЕРОГОЛУБОЙ
6	anodired metal АНОДИРОВАННЫЙ МЕТАЛЛ	Golden ЗОЛОТОЙ

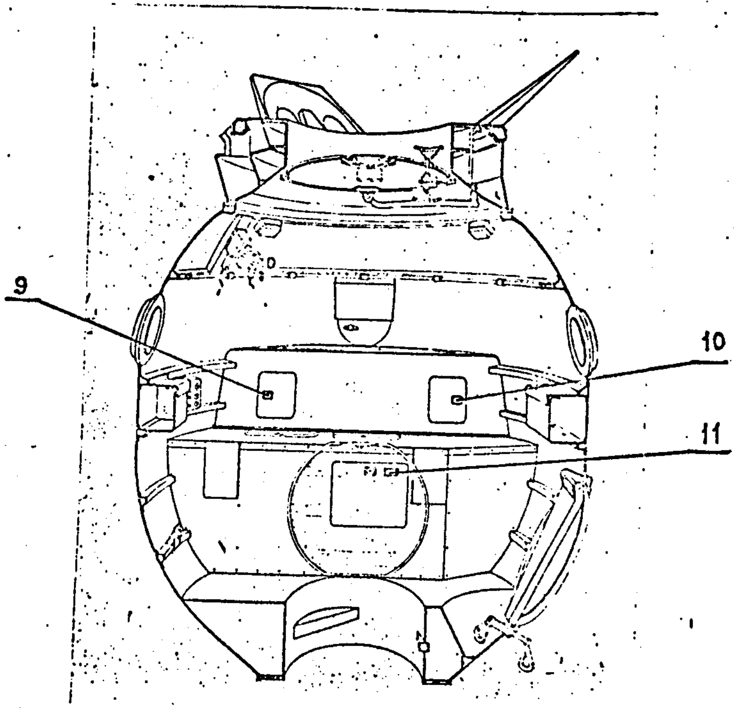
РИС. 3-25
FIG. 3-25

СХЕМА РАЗМЕЩЕНИЯ НАДПИСЕЙ СОЖ в ОМ.

Lay-out of LSS inscriptions in OM



ЛЕВЫЙ БОРТ
left board

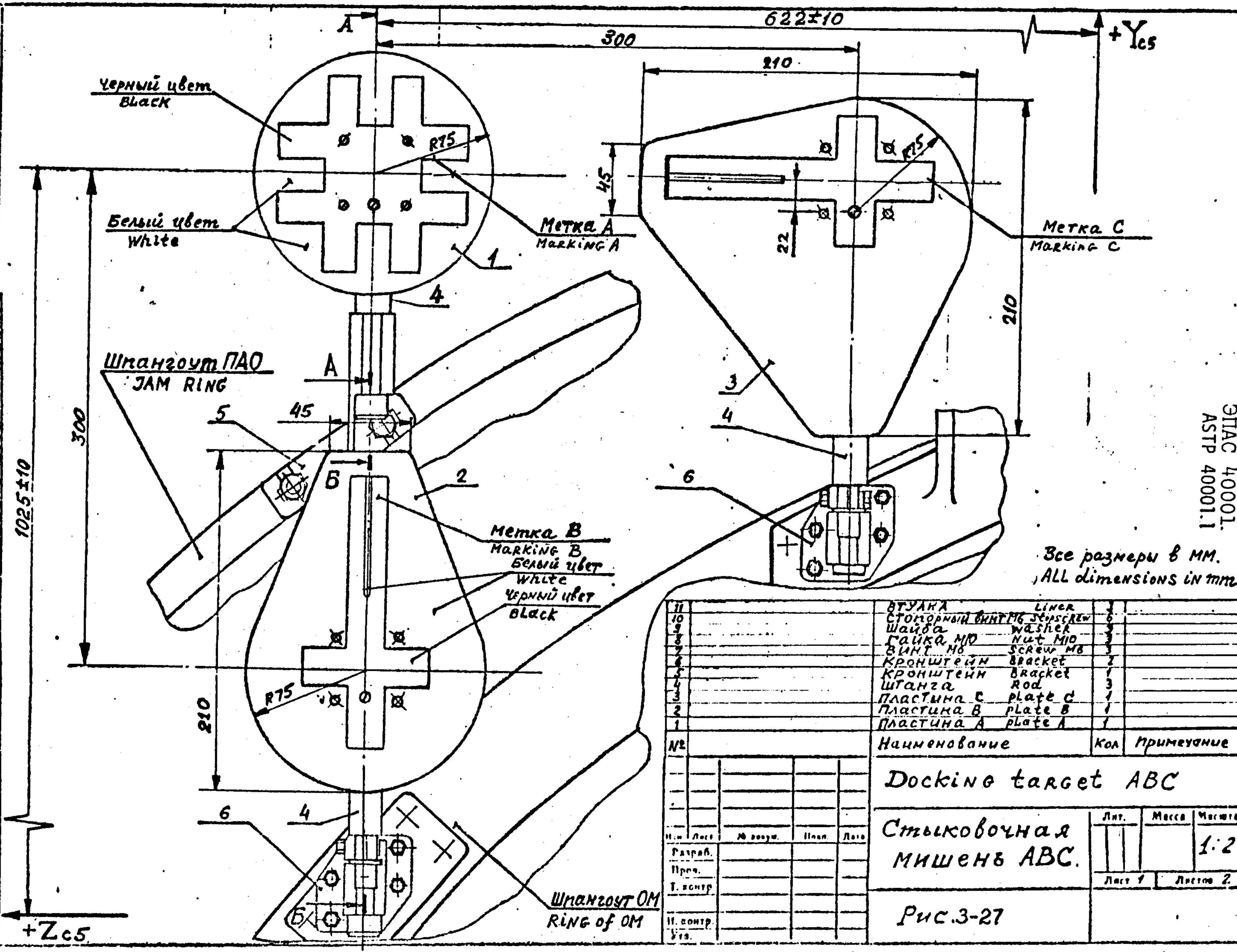


ПРАВЫЙ БОРТ
right board

No поз.	inscription НАДПИСЬ
1	1, включение АСУ
2	2
3	3, АСУ
4	4, КСД
5	5, ГНШ, аптечка
6	6, PERSONELL HYGIENE KIT,
	СЛГ, рационы питания
7	7, тубы, одежда
8	8
9	9

10	10
11	11, скафандры
12	WATER, вода
13	PUMP, насос
14	закр ←→ откр
15	CLOSE ←→ OPEN
16	FE, SC, AC, CP, DP, БИ, КС, КА, ПК, ПС
	(на обратной стороне дверцы №6)
17	пневмосхема СКГ
18	инструкция по работе с крышкой люка АПАС

Fig 3-26
Рис 3-26



Все размеры в мм.
ALL dimensions in mm

№		Наименование		Кол	Примечание
11		Втулка	Liner	3	
10		Стопорный винт M6	Stopscrew	6	
9		Шайба	Washer	3	
8		Гайка M10	Nut M10	3	
7		Винт M6	Screw M6	3	
6		Кронштейн	Bracket	2	
5		Кронштейн	Bracket	1	
4		Штанга	Rod	3	
3		Пластина C	Plate C	1	
2		Пластина B	Plate B	1	
1		Пластина A	Plate A	1	

Docking target ABC

Стыковочная мишень ABC.

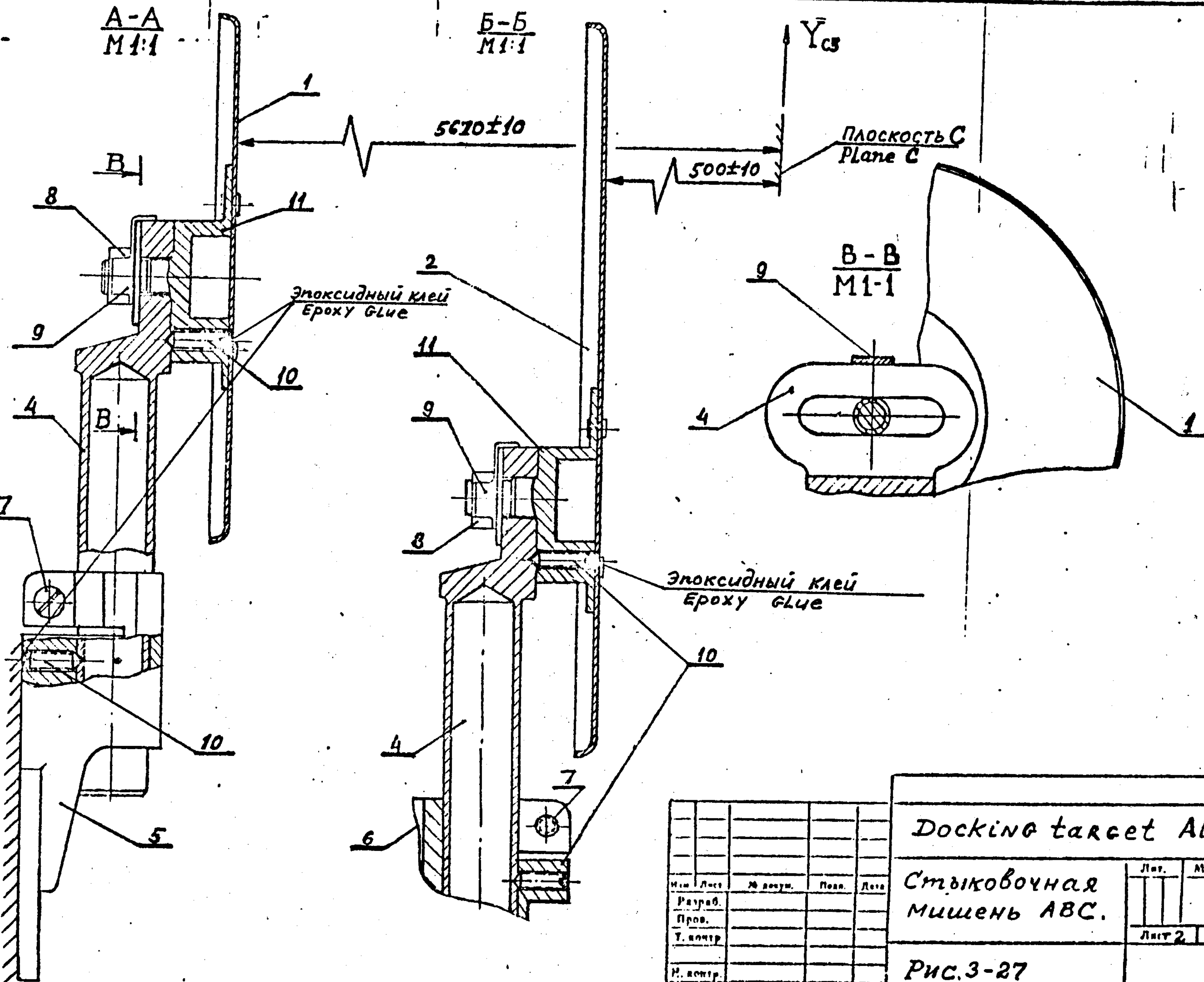
Изм	Лист	№ докум.	Подп.	Дата
Разраб.				
Пров.				
Т. контр.				
Н. контр.				
Утв.				

Лит.	Масса	Масштаб
		1:2

Лист 1 Листов 2

Рис. 3-27

70



Изм	Лист	№ докум.	Подп.	Дата
Разраб.				
Пров.				
Т. контр.				
Н. контр.				
Утв.				

Docking target ABC

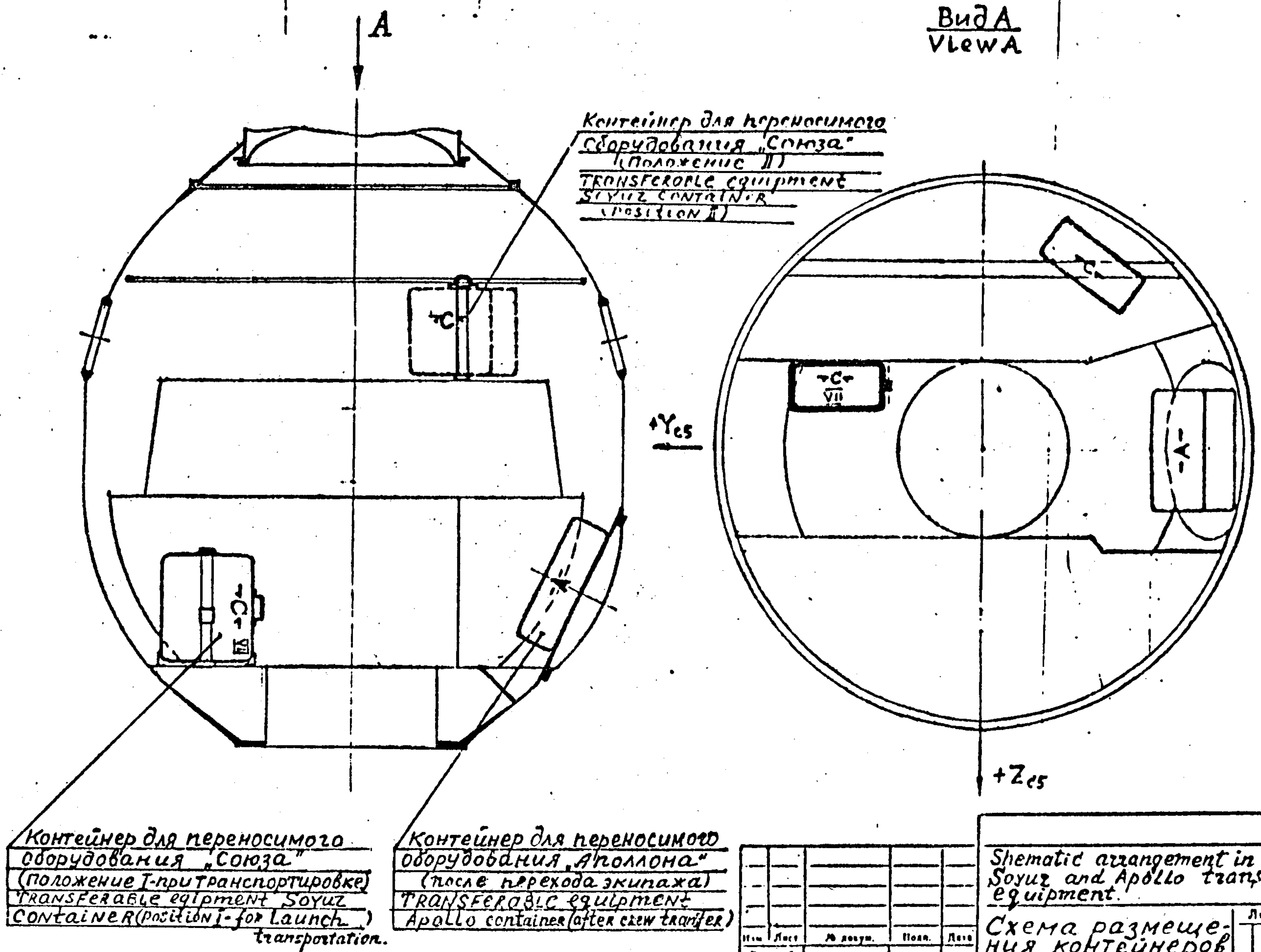
Стыковочная мишень АВС.

Лит.	Масса	Масштаб
		1:1
Лист 2	Листов 2	

Рис.3-27

ЭПАС 40001.
ASTP 40001.1

17



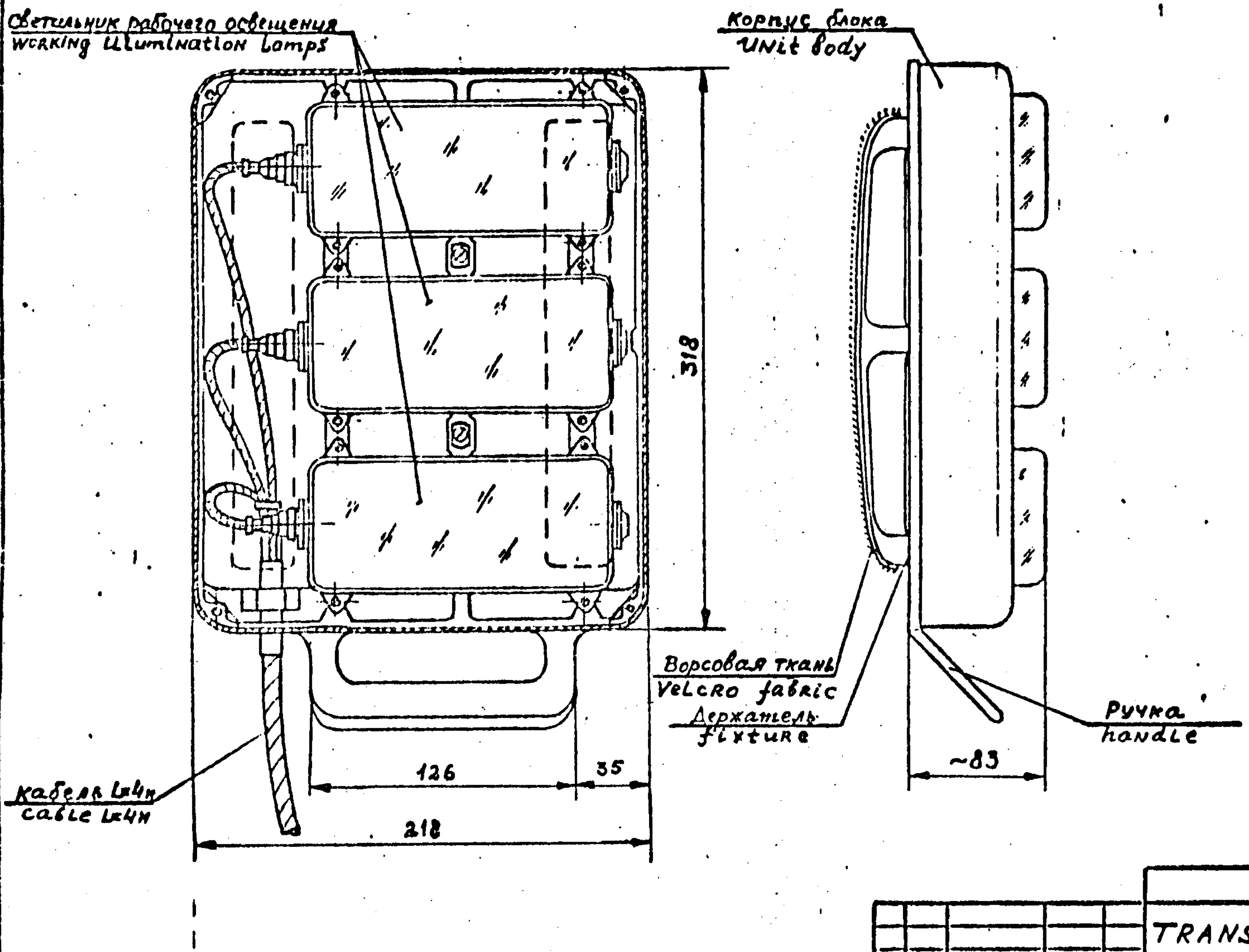
Shematic arrangement in OM for Soyuz and Apollo transferable equipment.

Схема размещения контейнеров для переносимого оборудования в ОМ

Рис. 3-28

Изм	Лист	№ докум.	Подп.	Дата
Разраб.				
Пров.				
Т. контр				
Н. контр				
Утв.				

Лит.	Масса	Масштаб
Лист 1	Листов 1	



ЭПАС 40001.
ASTP 40001.1

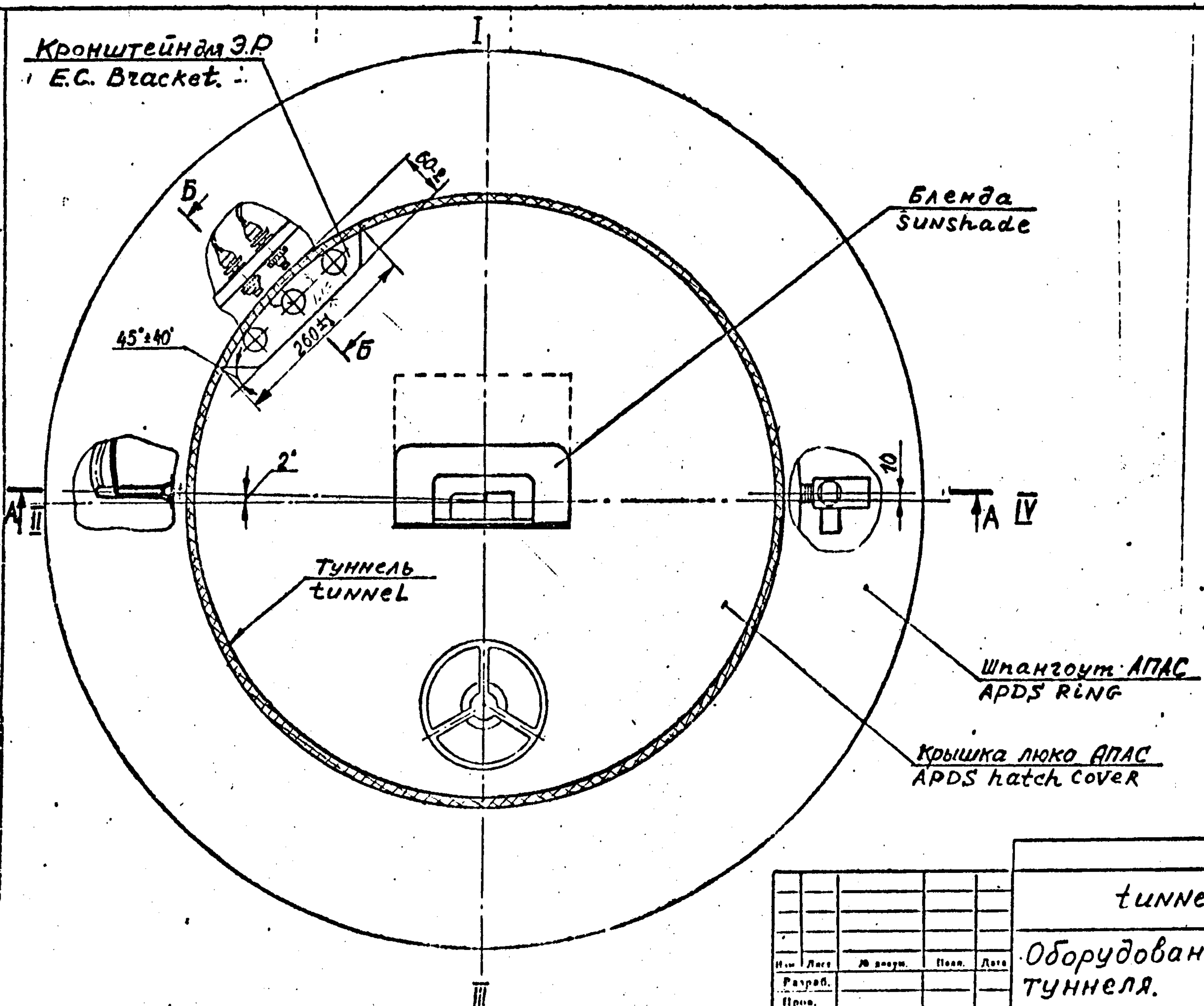
TRANSFERABLE LIGHTING UNIT (TLU)

Переносной световой блок (ПСБ)

Изм.	Лист	№ докум.	Подп.	Дата
Разраб.				
Пров.				
Т. контр.				
Н. контр.				
Утв.				

Лит.	Масса	Масштаб
		1:2
Лист 1	Листов 1	

Рис. 3-29



ЭПАС 40001.
ASTP 40001.1

tunnel equipment

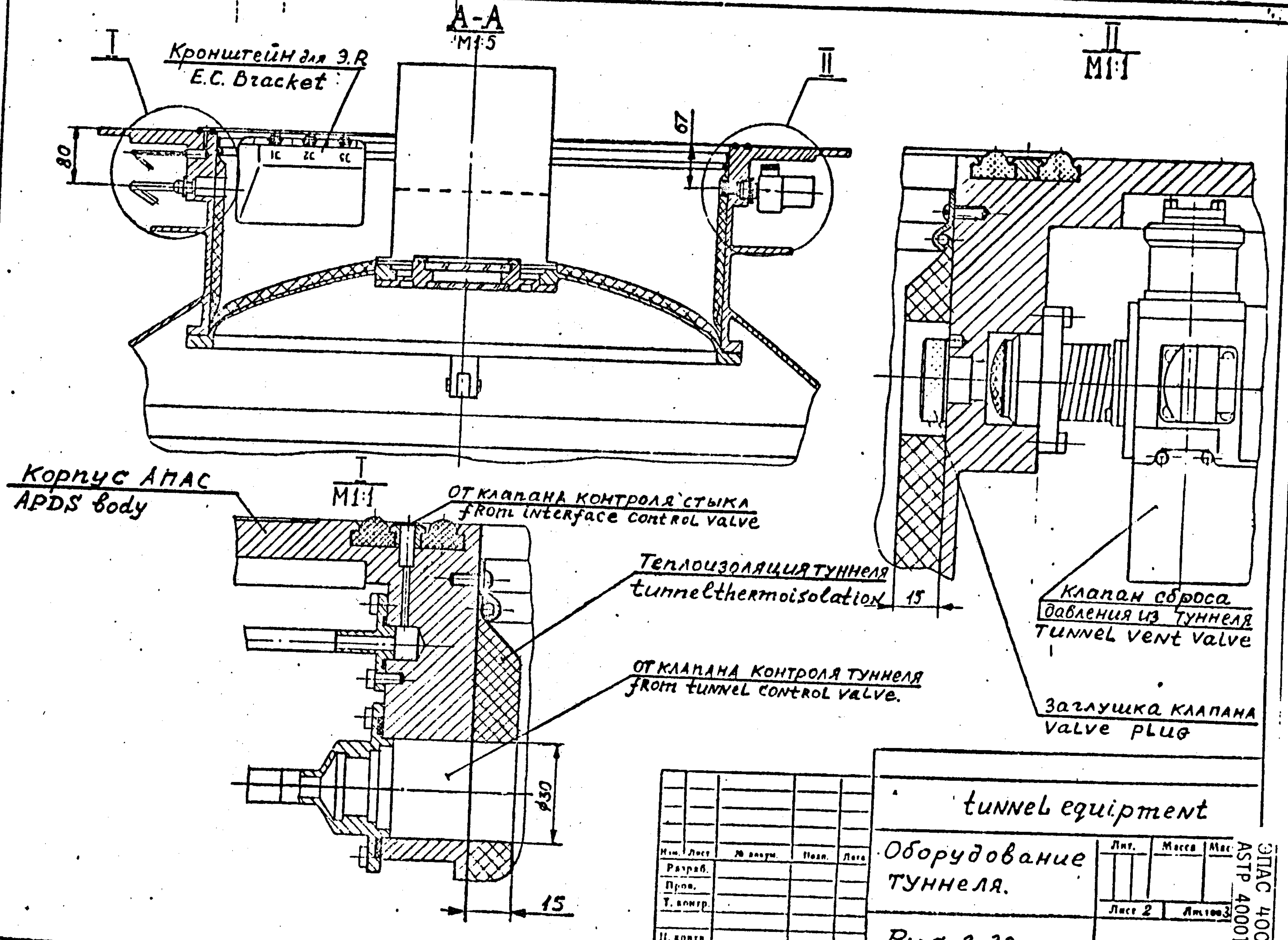
Оборудование туннеля.

Лит.	Масса	Масштаб
		1:5

Лист 1 Листов 3

Изм. Лист № докум. Подп. Дата
Разраб.
Пров.
Т. контр.
Н. контр.
Утв.

Рис. 3-30.



tunnel equipment

Оборудование туннеля.

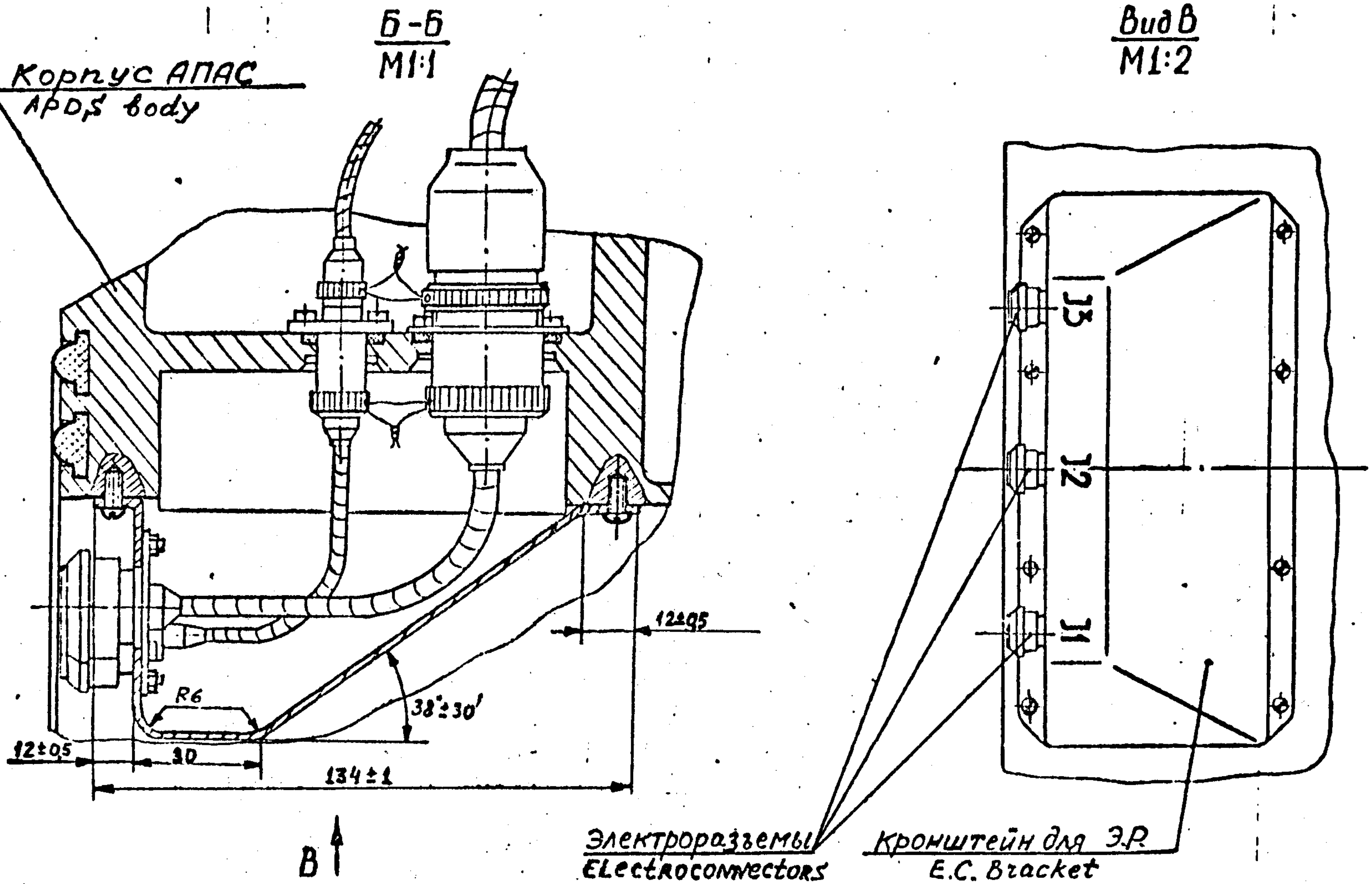
Рис. 3-30.

Изм.	Лист	№ докум.	Подп.	Дата
Разраб.				
Пров.				
Т. контр.				
Н. контр.				
Утв.				

Лит. | Масса | Масштаб

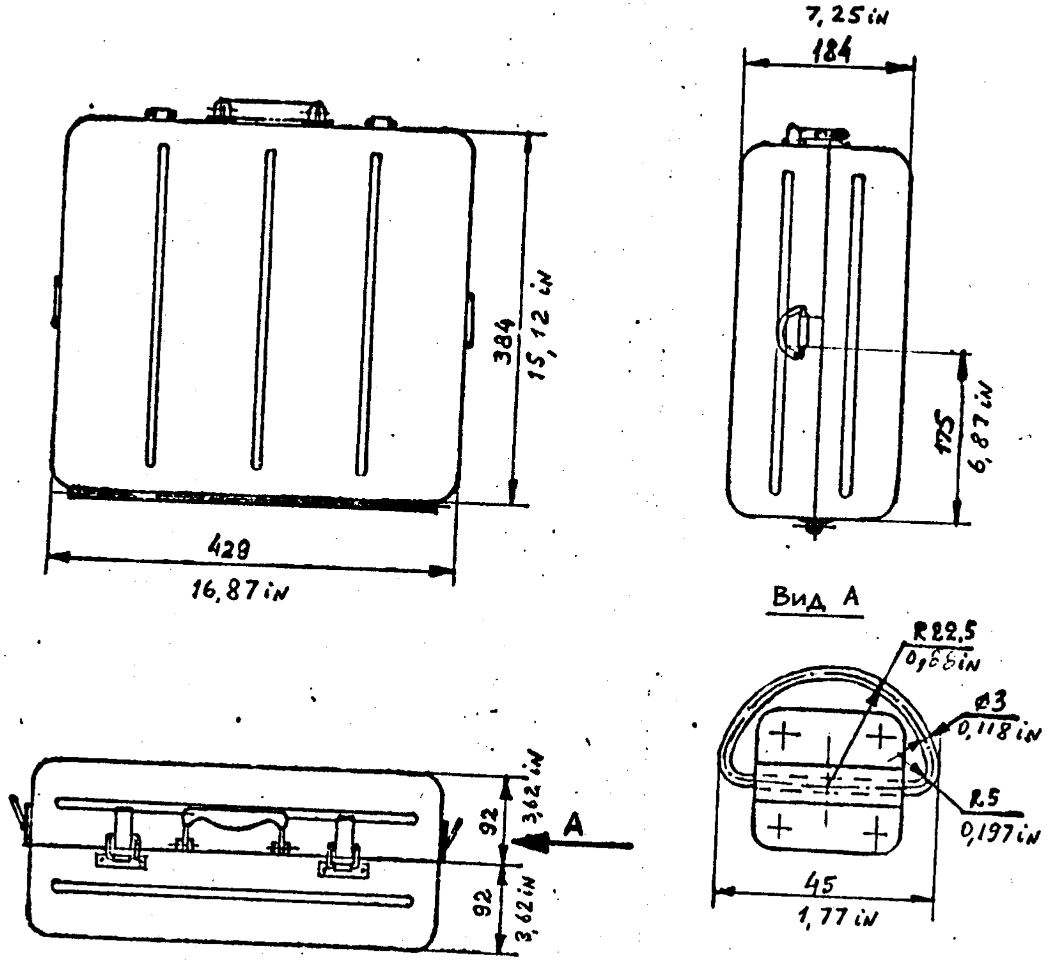
Лист 2 | Листов 3

ЭПАС 40001.1
ASTP 40001.1



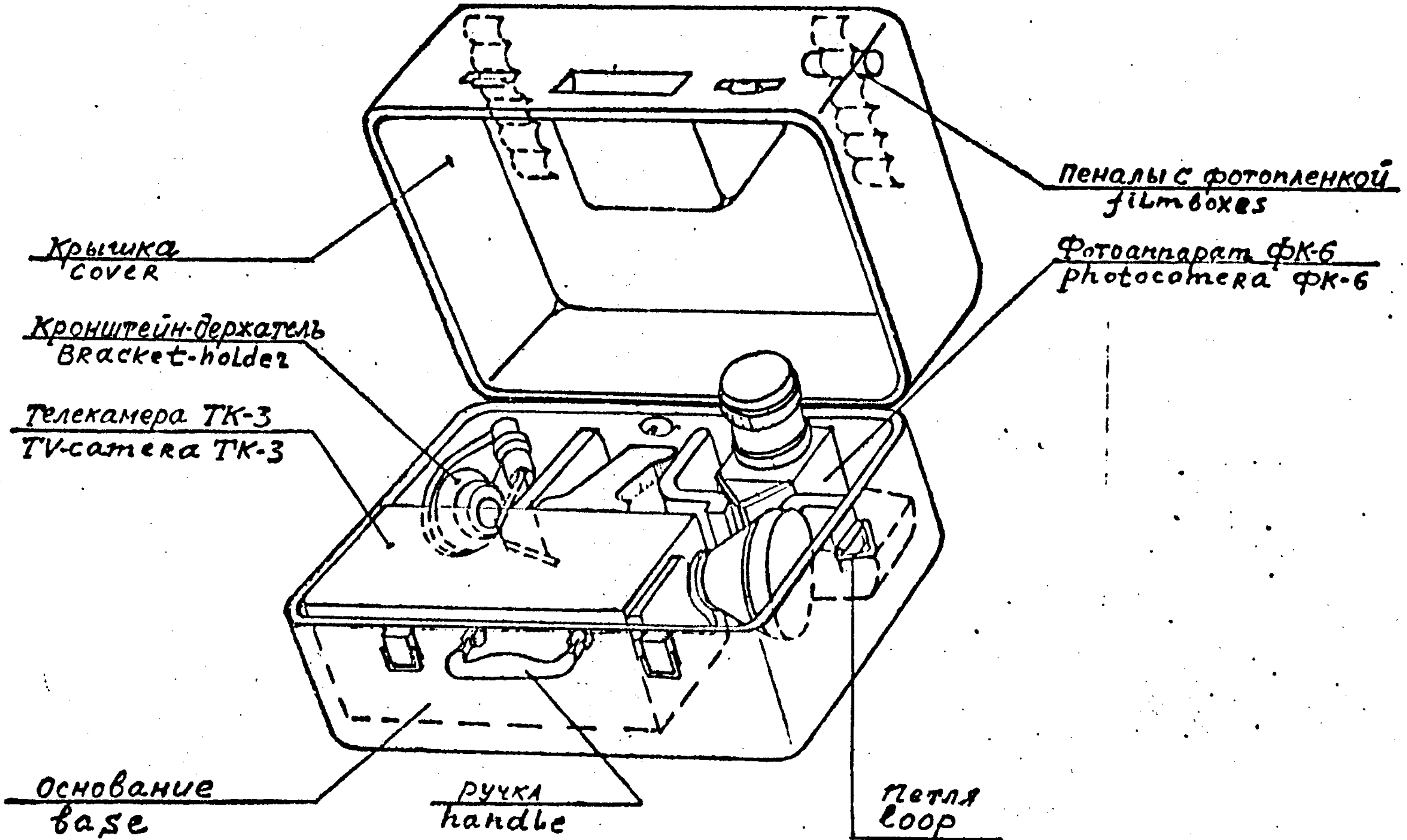
ЭПАС 40001.1
ASTP 40001.1

Изм.	Лист	№ докум.	Подп.	Дата	tunnel equipment		
Разраб.					Оборудование туннеля.	Лит. Масса Масштаб	
Пров.						Лист 3	Листов 3
Т. контр.							
Н. контр.					Рис. 3-30		
Утв.							



ЭПАС 40001.1
ASTP 40001.1

Изм	Лист	№ докум.	Подп.	Дата	TRANSFERABLE equipment container
Разраб.					Контейнер для переносимого оборудования
Пров.					Лит. / Масса / Масштаб 1:5
Т. контр.					Лист 1 / Листов 2
Н. контр.					Рис. 3-31
Утв.					



Изм.	Лист	№ докум.	Подп.	Дата
Разраб.				
Пров.				
Т. контр.				
Н. контр.				
Утв.				

Transferable equipment container

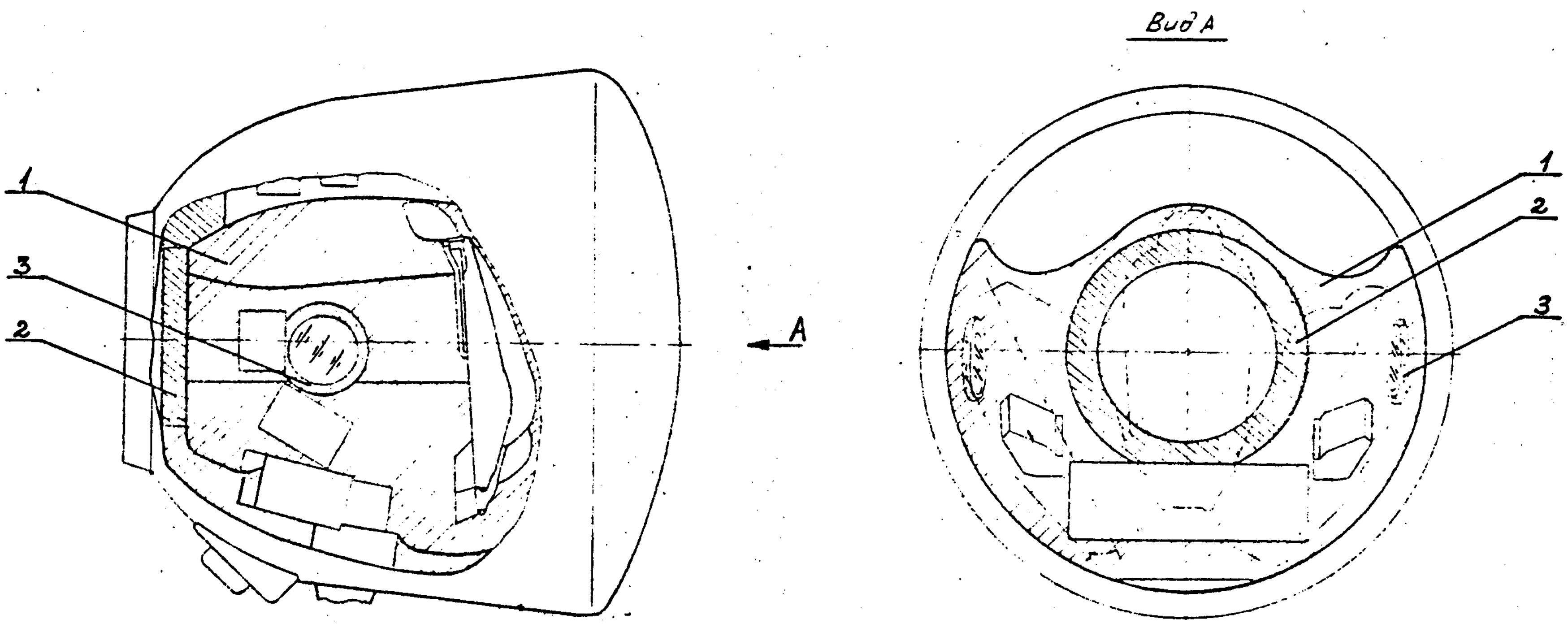
Контейнер для переносимого оборудования

Лит.	Масса	Масштаб
Лист 2	Листов 2	

Рис. 3-31

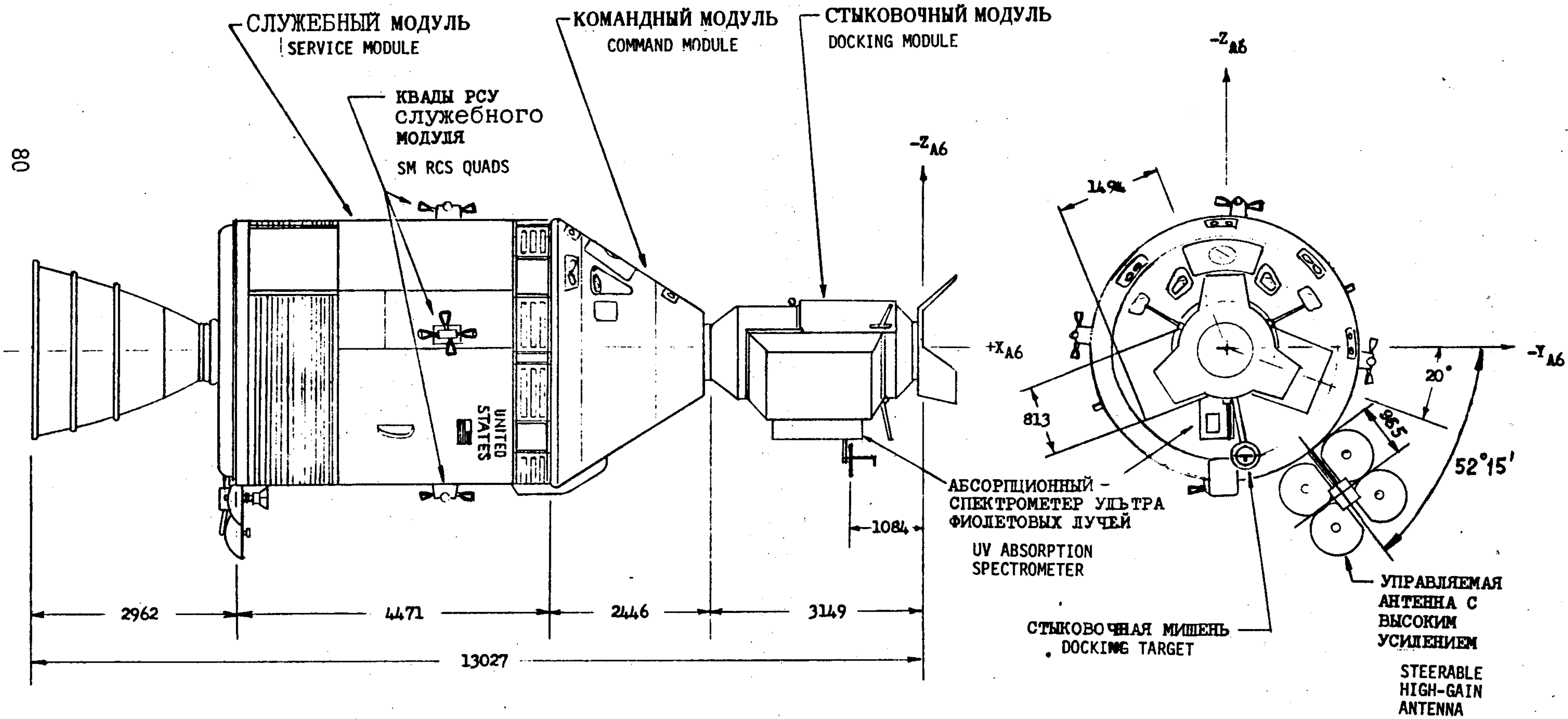
ЭПАС 40001.1
ASTP 40001.1

СХЕМА РАЗМЕЩЕНИЯ ДЕКОРАТИВНО - ОТДЕЛОЧНЫХ МАТЕРИАЛОВ В СА
Lay-out of decoration materials in DV



No Поз.	decoration type Тип отделки	decoration colour Цвет отделки
1.	decoration fabric Декоративная ткань	Light green светлозеленый
2	Artificial leather Искусственная кожа	Grey серый
3	Fiberglass Стеклопластик	yellow желтый

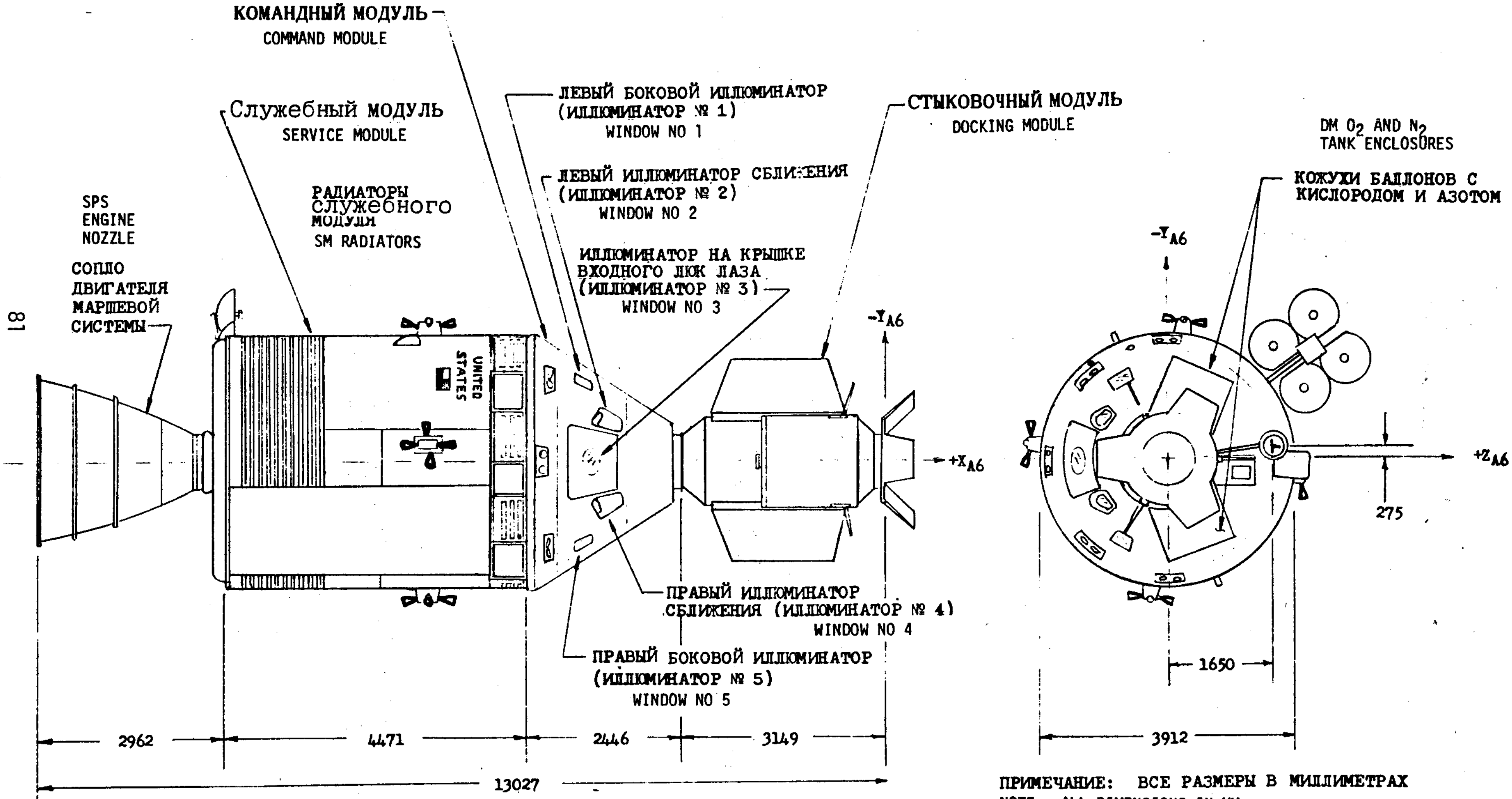
РИС. 3-32
FIG. 3-32



ПРИМЕЧАНИЕ: ВСЕ РАЗМЕРЫ В МИЛЛИМЕТРАХ
NOTE: ALL DIMENSIONS IN MM

РИС 4-1 КОНФИГУРАЦИЯ КОРАБЛЯ АПОЛЛОН (ВИД СБОКУ И СПЕРЕДИ)

FIGURE 4-1 APOLLO SPACECRAFT CONFIGURATION (SIDE AND FRONT VIEWS)



ПРИМЕЧАНИЕ: ВСЕ РАЗМЕРЫ В МИЛЛИМЕТРАХ
NOTE: ALL DIMENSIONS IN MM

РИС 4-2 КОНФИГУРАЦИЯ КОРАБЛЯ АПОЛЛОН (ВИД СВЕРХУ И СПЕРЕДИ)

FIGURE 4-2 APOLLO SPACECRAFT CONFIGURATION (TOP AND FRONT VIEWS)

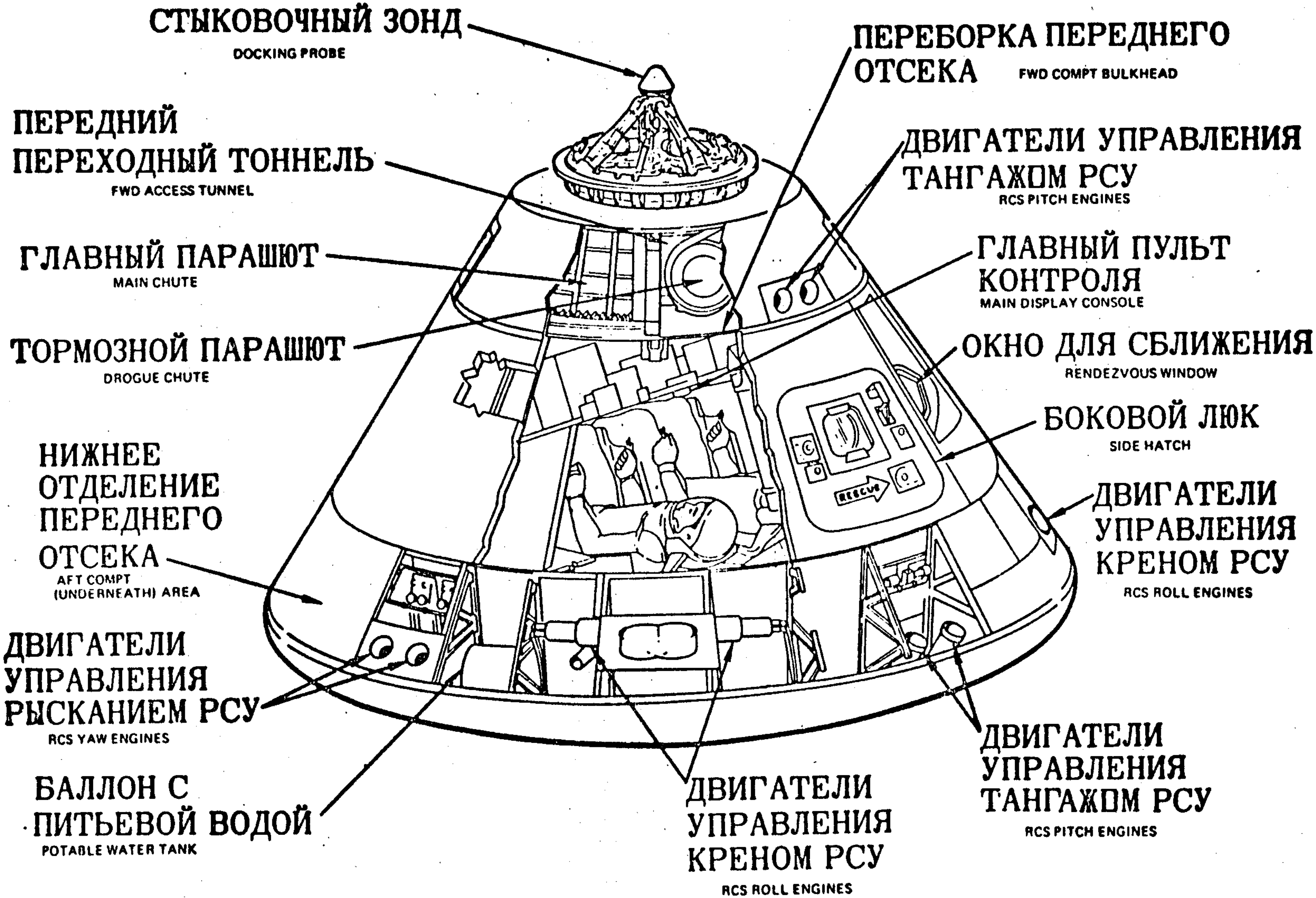


РИС 4-3 **ОБЩЕЕ УСТРОЙСТВО КОМАНДНОГО МОДУЛЯ**

FIGURE 4-3 CM GENERAL ARRANGEMENT

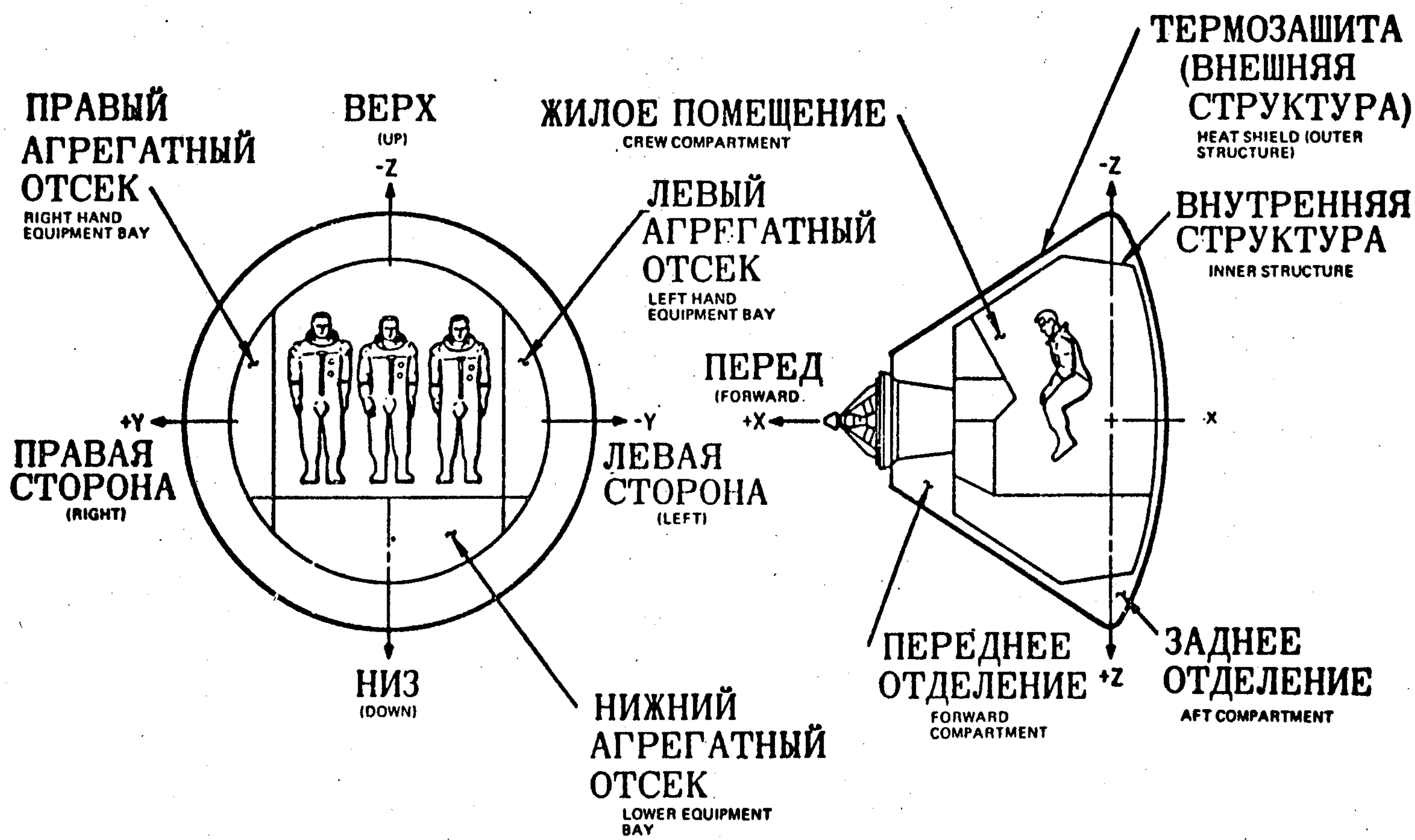
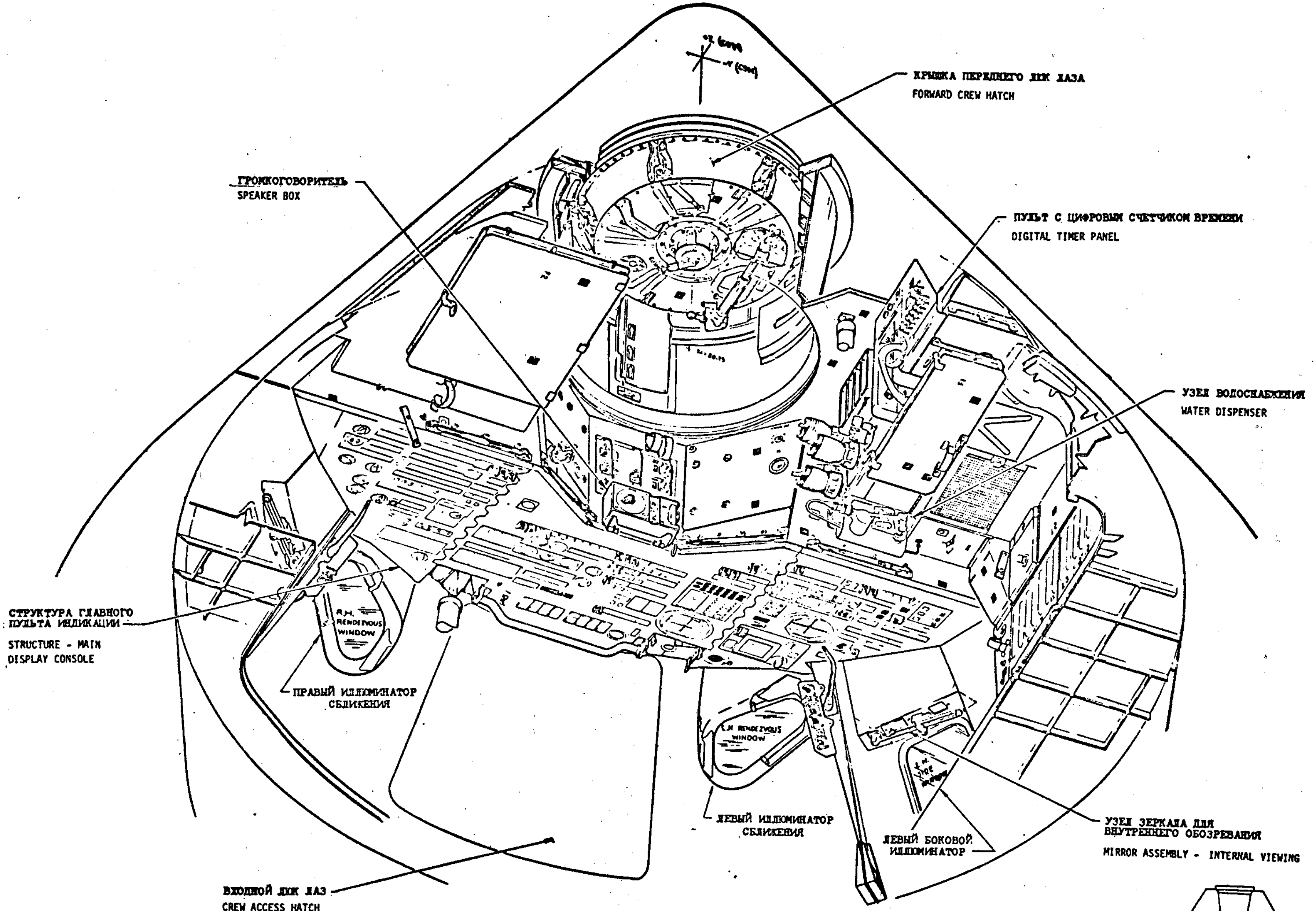


РИС 4-4 **ОРИЕНТАЦИЯ ВНУТРЕННИХ ОТСЕКОВ КОМАНДНОГО МОДУЛЯ**

FIGURE 4-4 COMMAND MODULE COMPARTMENT ORIENTATION



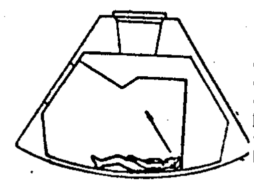


РИС 4-5 ЖИЛОЙ ОТСЕК-ПОКАЗАНЫ ГЛАВНЫЙ ПУЛЬТ ИНДИКАЦИИ И ТОННЕЛЬ ДЛЯ ПЕРЕХОДА ЭКИПАЖА

FIGURE 4-5 CREW COMPARTMENT - LOOKING FORWARD AT MAIN DISPLAY CONSOLE AND CREW TRANSFER TUNNEL

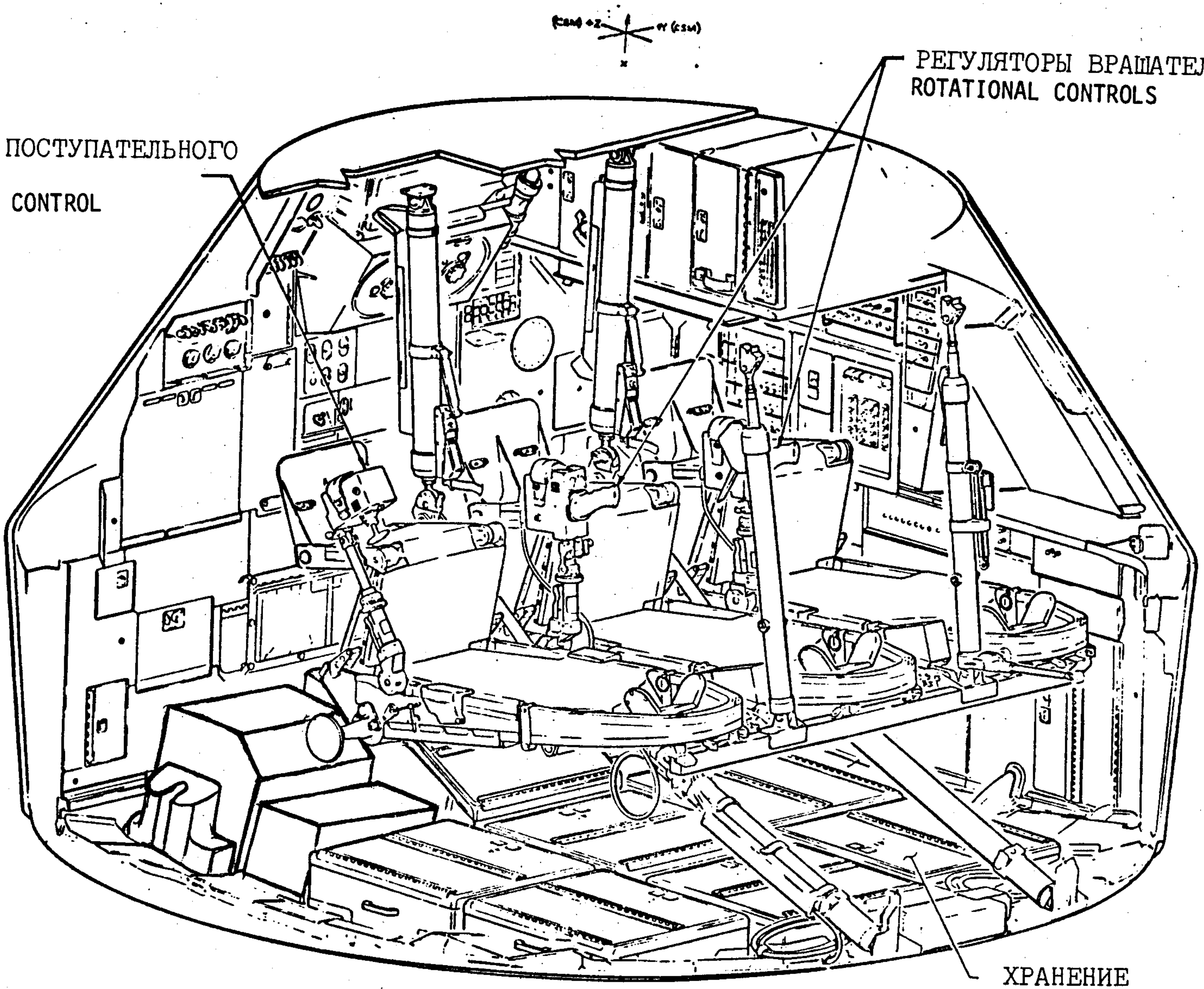


РИС 4-6 ЖИЛОЙ ОТСЕК - ПОКАЗАНЫ СКЛАДНЫЕ КРЕСЛА ЭКИПАЖА

FIGURE 4-6 CREW COMPARTMENT - SHOWING FOLDABLE CREW COUCHES

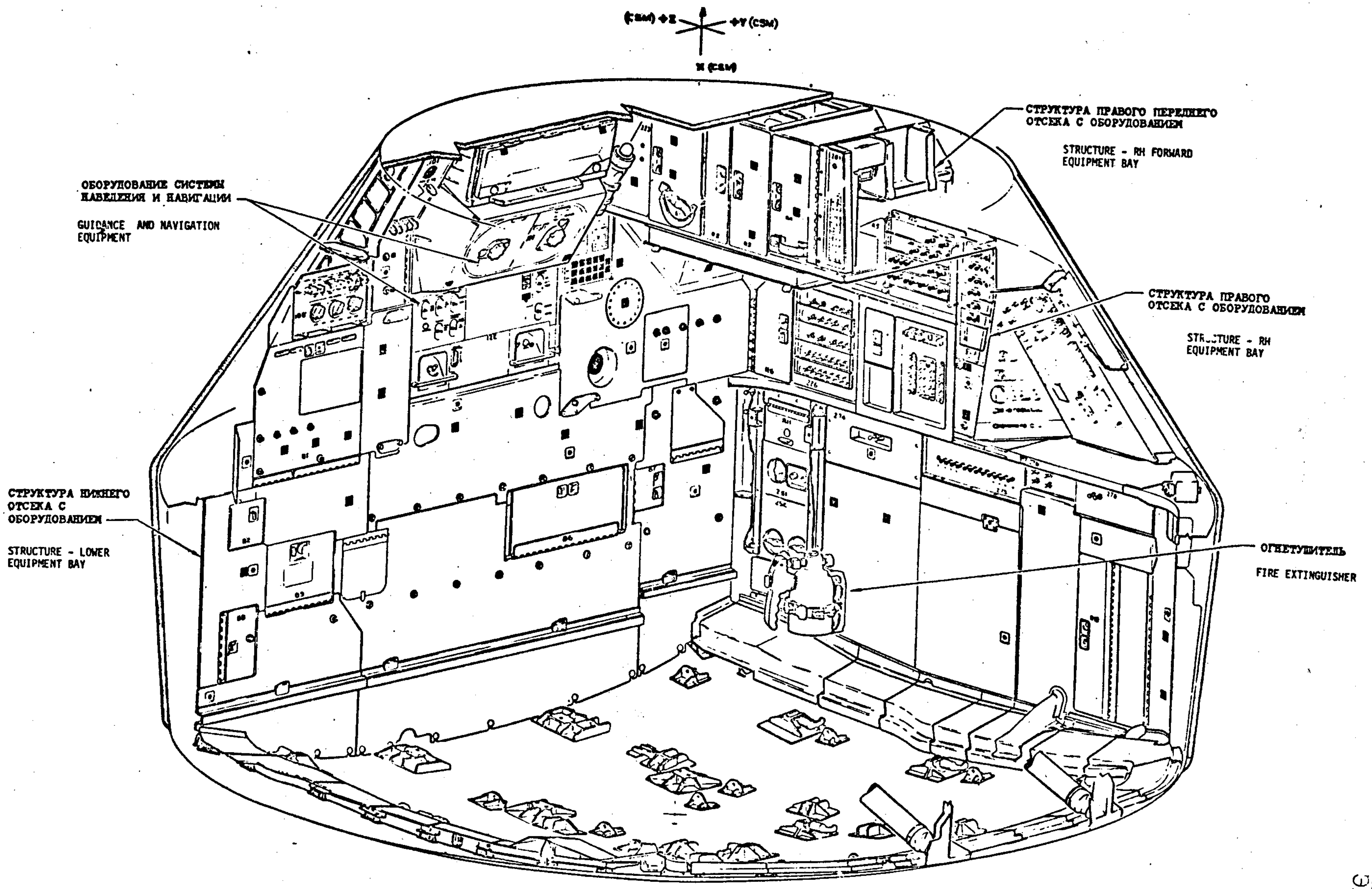


РИС 4-7 ЖИЛОЙ ОТСЕК-ПОКАЗАНЫ НИЖНИЙ И ПРАВЫЙ ОТСЕКИ С ОБОРУДОВАНИЕМ

FIGURE 4-7 CREW COMPARTMENT - LOWER EQUIPMENT BAY AND RIGHT HAND EQUIPMENT BAY

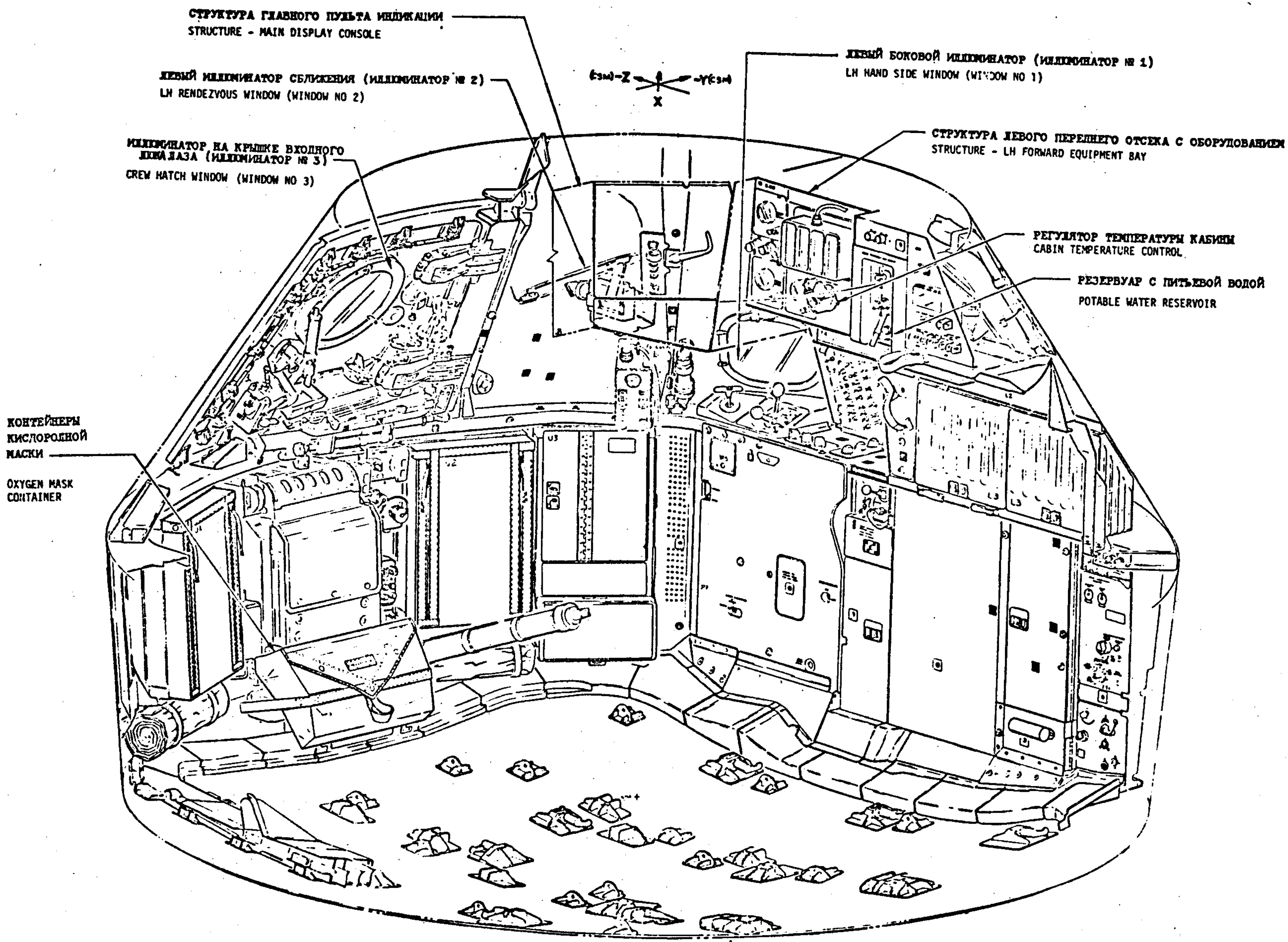


РИС 4-8 ЖИЛОЙ ОТСЕК-ПОКАЗАНЫ ЛЕВЫЙ ОТСЕК С ОБОРУДОВАНИЕМ И ВХОДНОЙ ЛЮК ЛАЗ
FIGURE 4-8 LEFT HAND EQUIPMENT BAY AND CREW HATCH AREA

РАЗМЕЩЕНИЕ ОБОРУДОВАНИЯ ЭПАС
ОБОРУДОВАНИЕ В КМ
ASTP STOWAGE
CM INFLIGHT STOWAGE

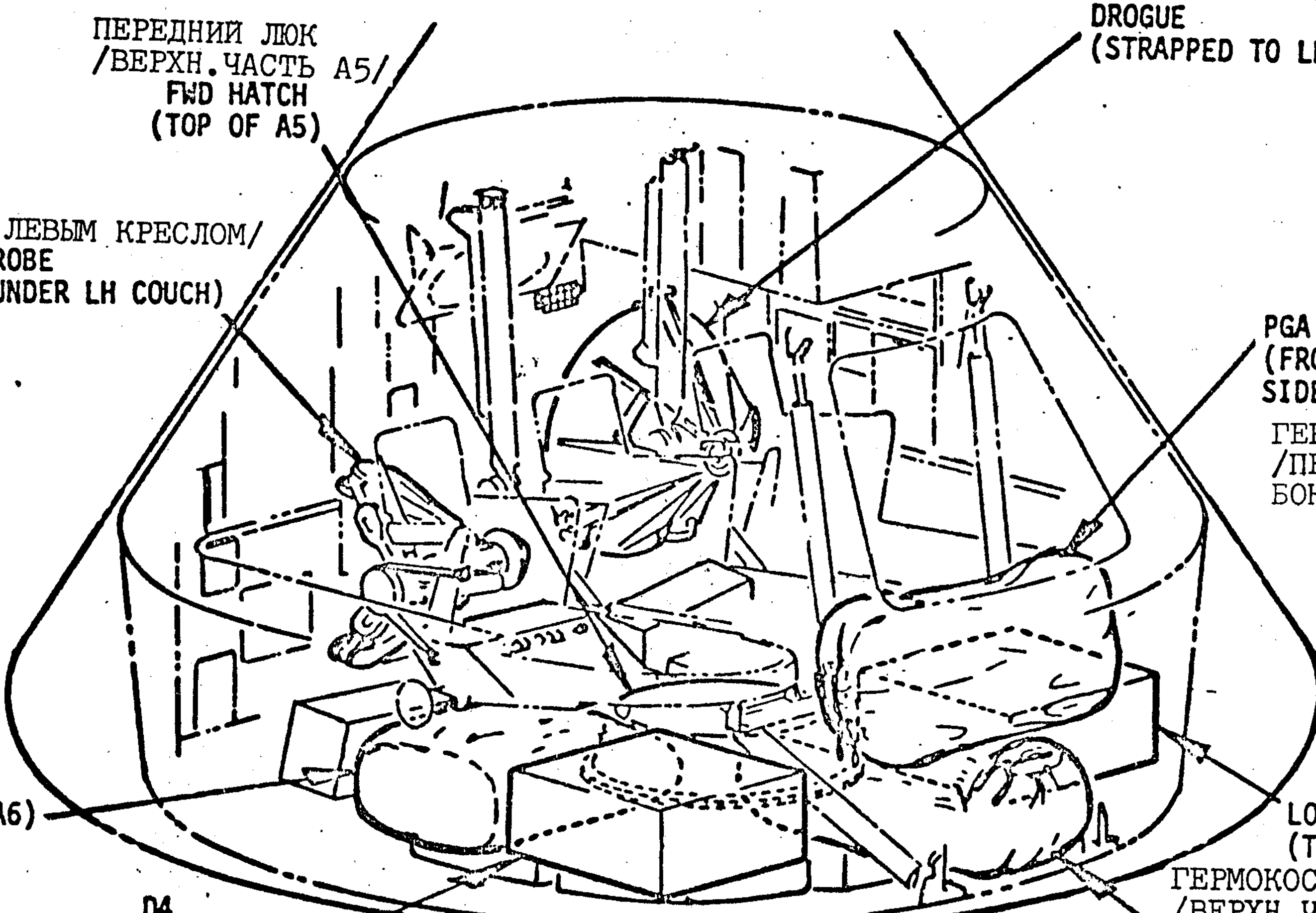


РИС 4-9 РАЗМЕЩЕНИЕ ОБОРУДОВАНИЯ ЭПАС В КМ
FIGURE 4-9 ASTP STOWAGE CM INFLIGHT STOWAGE

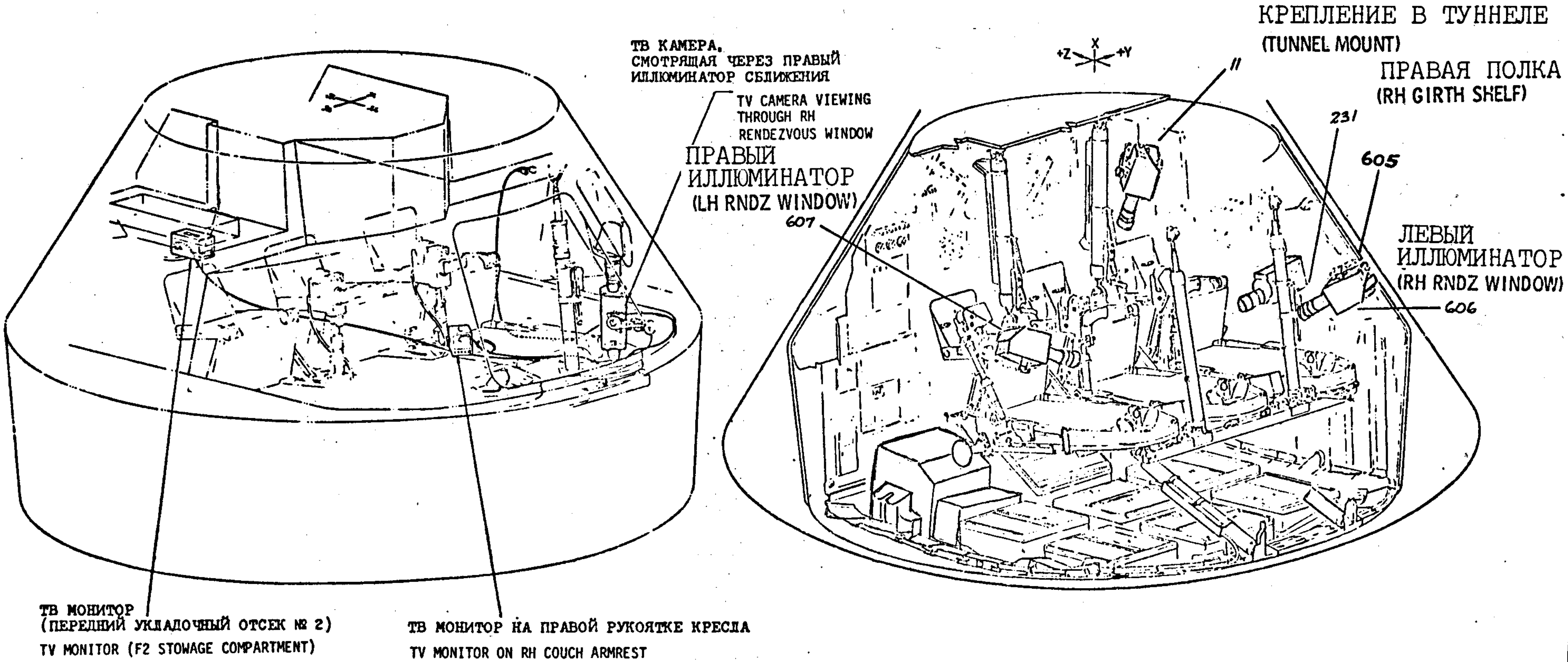


РИС 4-10 МЕСТОПОЛОЖЕНИЕ ТВ КАМЕР И ТВ МОНИТОРОВ В КМ

FIGURE 4-10 COMMAND MODULE TV CAMERA AND MONITOR LOCATIONS

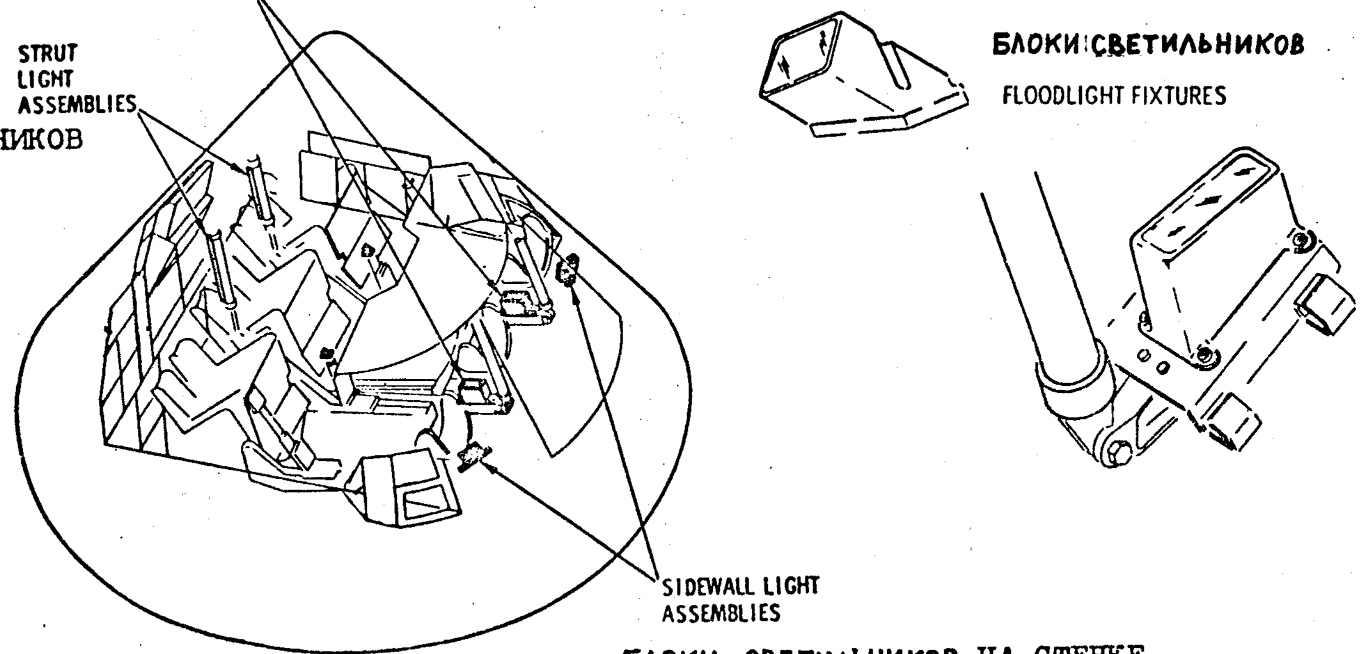


РИС 4-11 МЕСТОПОЛОЖЕНИЕ СВЕТИЛЬНИКОВ В КМ

FIGURE 4-11 COMMAND MODULE FLOODLIGHT LOCATIONS

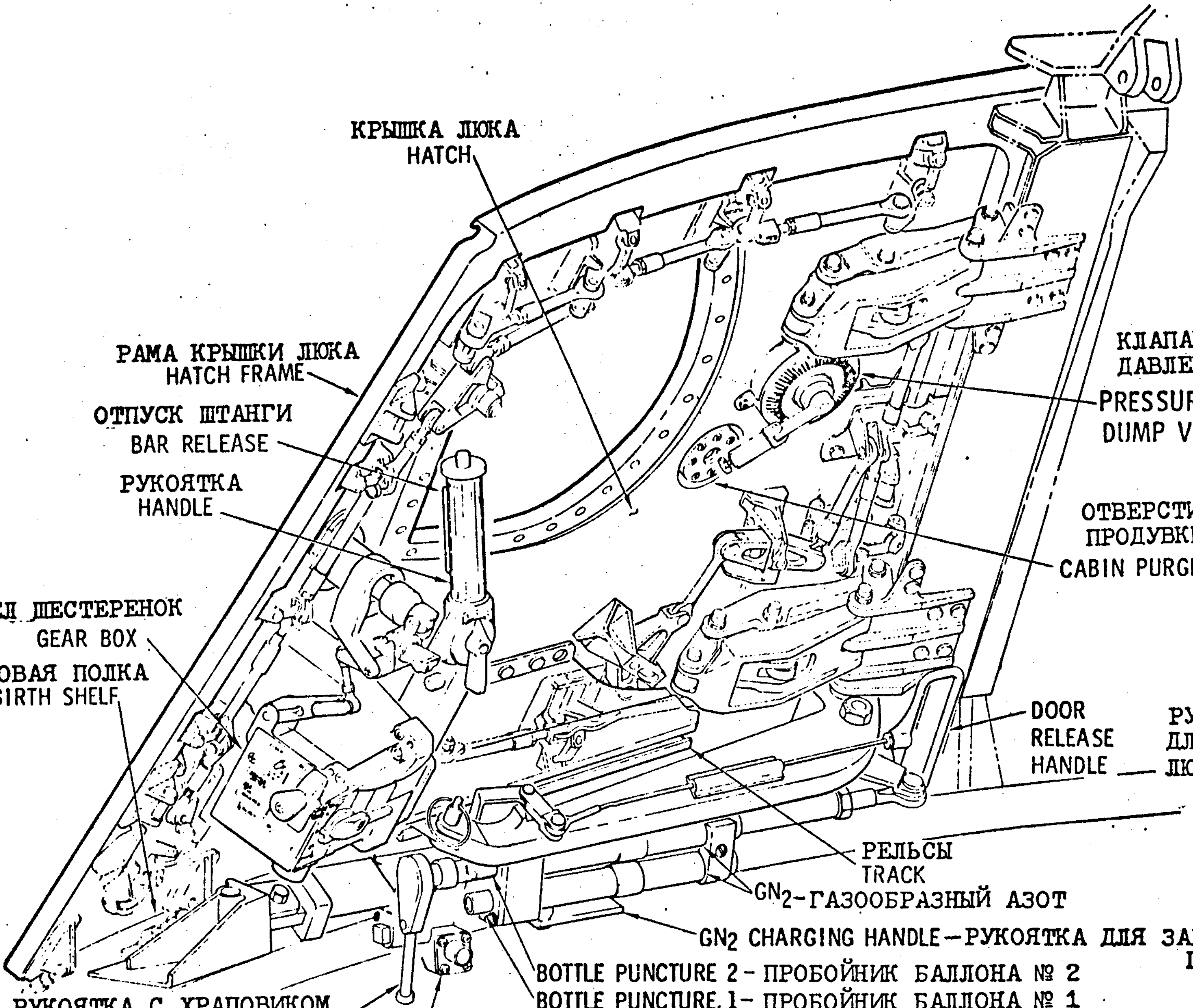


РИС 4-12 БОКОВОЙ ЛЮК ЛАЗ КМ

FIGURE 4-12 COMMAND MODULE SIDE HATCH

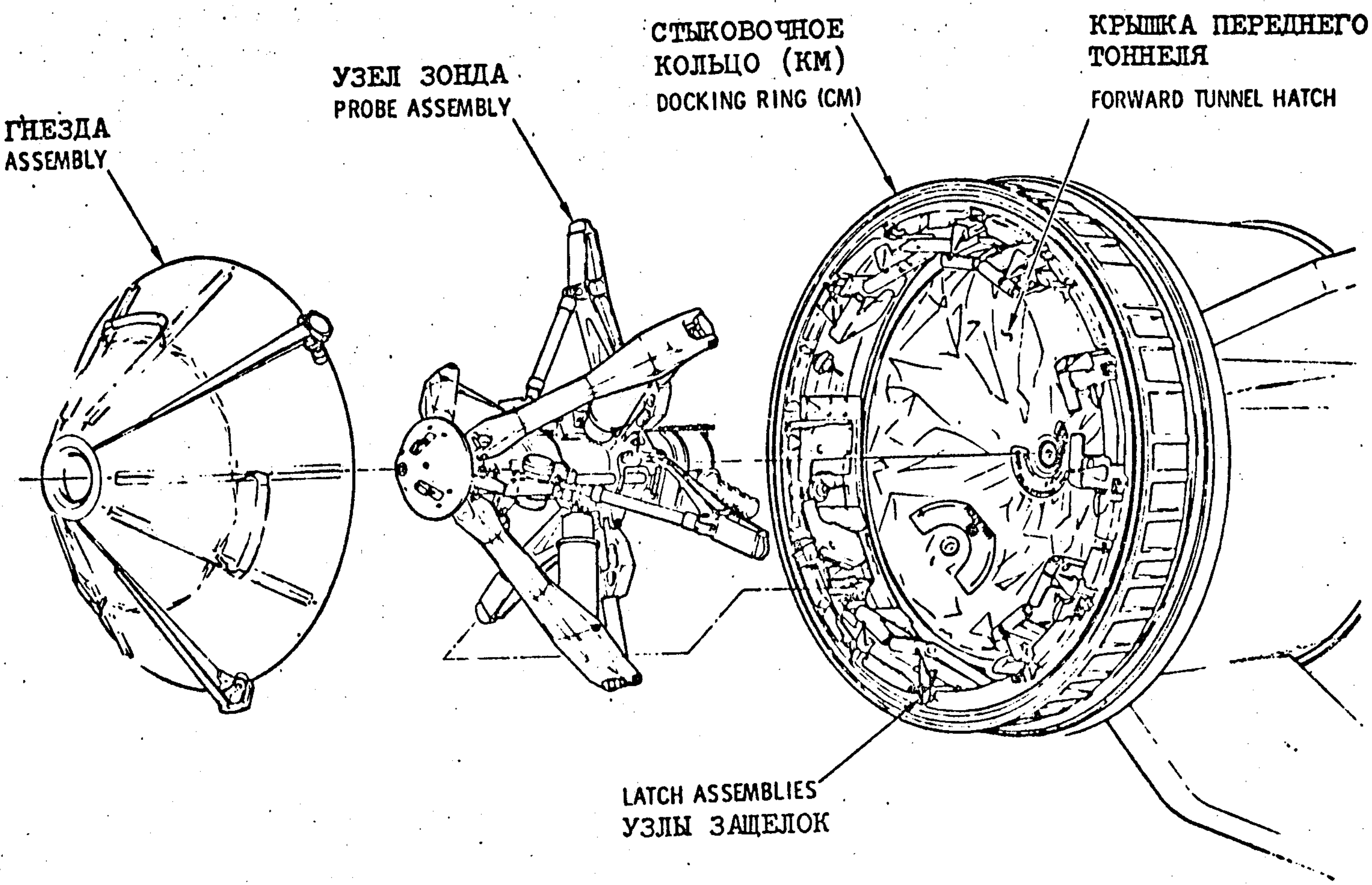
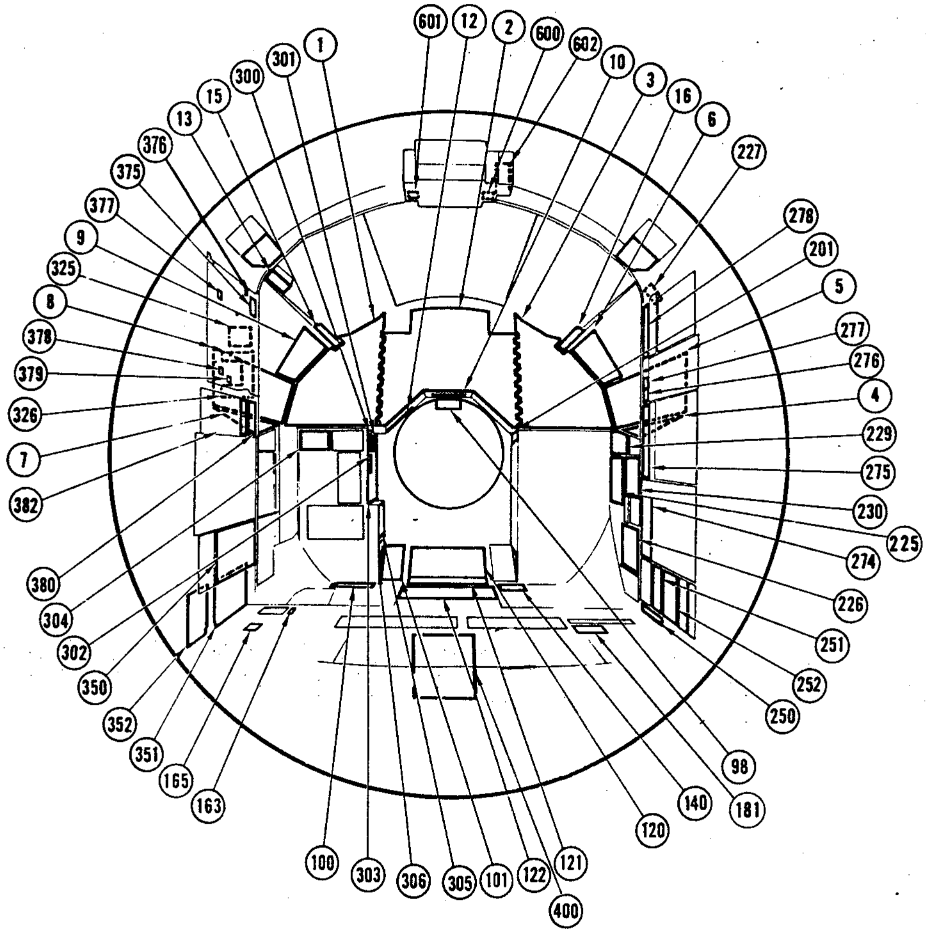


РИС 4-13 СТЫКОВОЧНОЕ УСТРОЙСТВО КСМ

FIGURE 4-13 CSM DOCKING SYSTEM



РАСПОЛОЖЕНИЕ ПАНЕЛЕЙ
PANEL LOCATIONS

РИС 4-14 ПУЛЬТЫ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 1 ИЗ 15

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 1 OF 15)

ГЛАВНЫЙ ПУЛЬТ ИНДИКАЦИИ
MAIN DISPLAY CONSOLE

ПАНЕЛЬ 1

РЕГУЛЯТОРЫ СУС
РЕГУЛЯТОРЫ СМД
МОНИТОРЫ РН
СИСТЕМА КОНТРОЛЯ ВХОДА В АТМОСФЕРУ
ВЫСОТОМЕР
УКАЗАТЕЛЬ ПОЛОЖЕНИЯ

PANEL 1

SCS CONTROLS
SPS CONTROLS
LV MONITOR
EMS
ALTIMETER
ATTITUDE INDICATOR

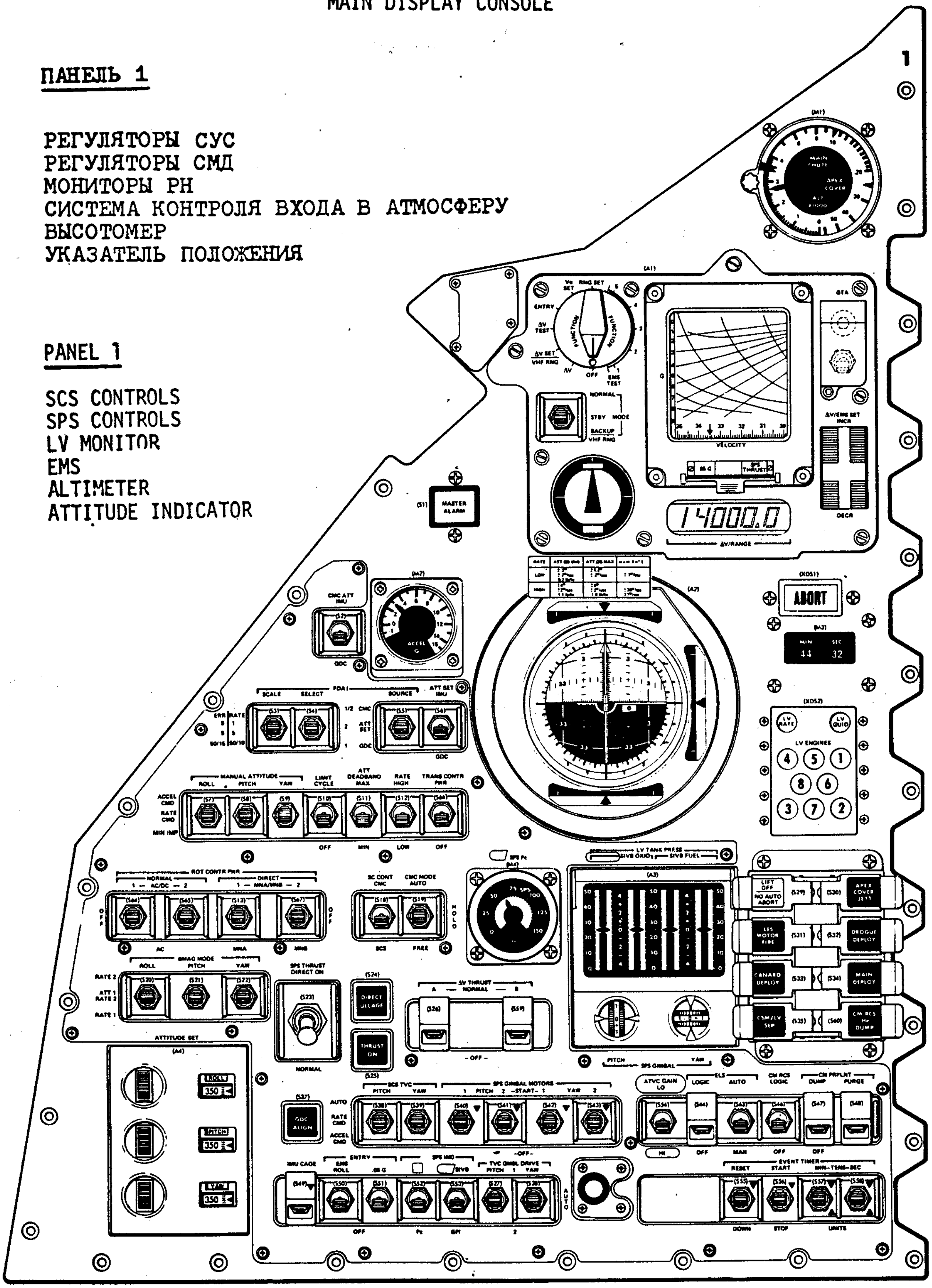
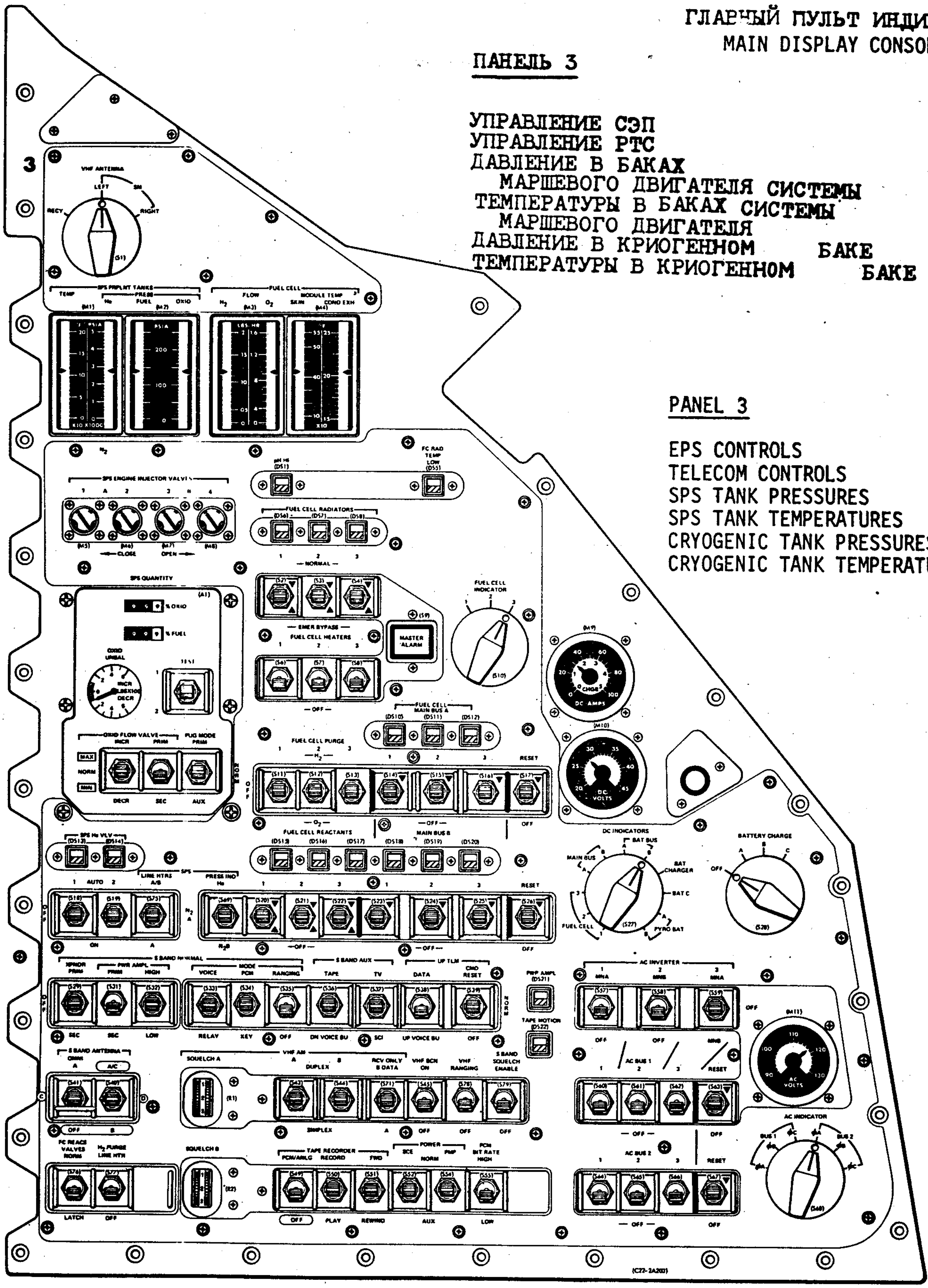


РИС 4-14 ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 2 ИЗ 15

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 2 OF 15)

ГЛАВНЫЙ ПУЛЬТ ИНДИКАЦИИ
MAIN DISPLAY CONSOLE



ПАНЕЛЬ 3

УПРАВЛЕНИЕ СЭП
УПРАВЛЕНИЕ РТС
ДАВЛЕНИЕ В БАКАХ МАРШЕВОГО ДВИГАТЕЛЯ СИСТЕМЫ
ТЕМПЕРАТУРЫ В БАКАХ СИСТЕМЫ МАРШЕВОГО ДВИГАТЕЛЯ
ДАВЛЕНИЕ В КРИОГЕННОМ БАКЕ
ТЕМПЕРАТУРЫ В КРИОГЕННОМ БАКЕ

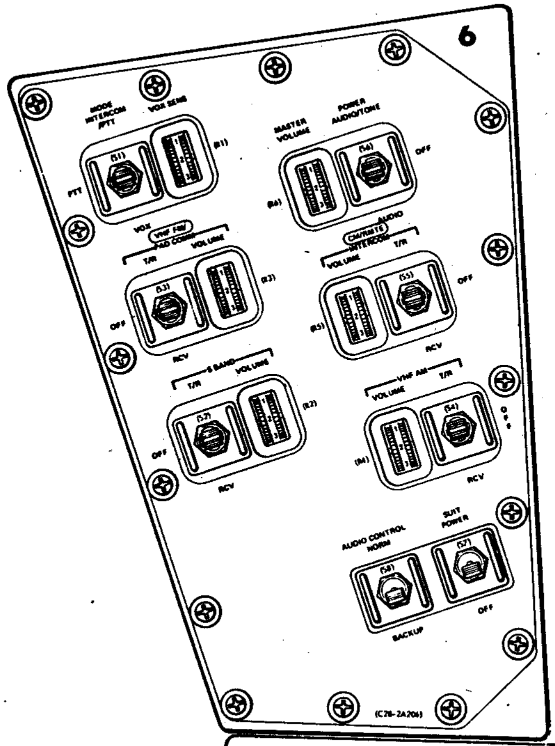
PANEL 3

EPS CONTROLS
TELECOM CONTROLS
SPS TANK PRESSURES
SPS TANK TEMPERATURES
CRYOGENIC TANK PRESSURES
CRYOGENIC TANK TEMPERATURES

РИС 4-14 ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 4 ИЗ 15

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 4 OF 15)

ГЛАВНЫЙ ПУЛЬТ ИНДИКАЦИИ
MAIN DISPLAY CONSOLE



ПАНЕЛЬ 6

УПРАВЛЕНИЕ РТС

PANEL 6

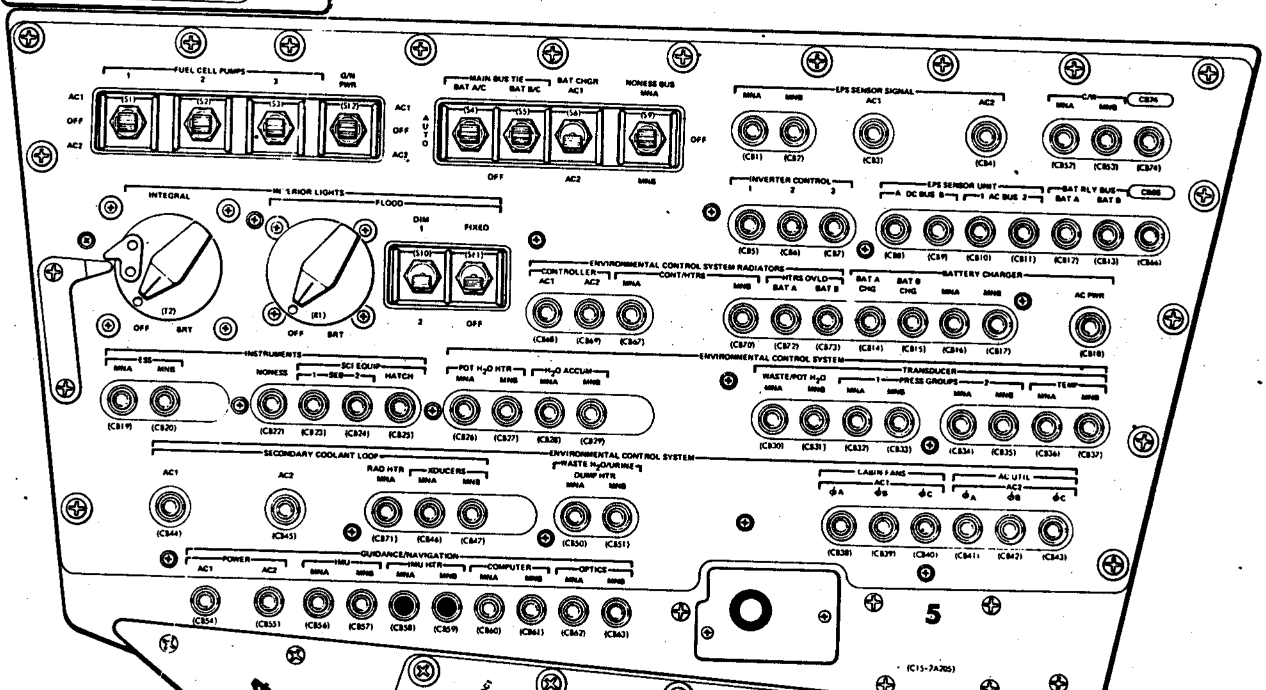
TELECOM CONTROLS

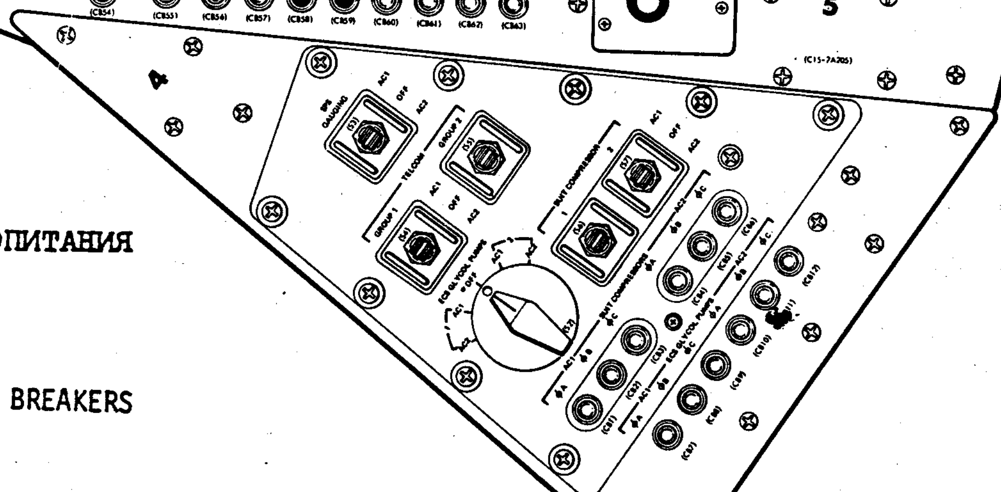
ПАНЕЛЬ 5

ОСВЕЩЕНИЕ
УПРАВЛЕНИЕ
АЗЦ ЭЛЕКТРОПИТАНИЯ

PANEL 5

LIGHTING CONTROLS
POWER CIRCUIT BREAKERS





ПАНЕЛЬ 4

АЗЦ ЭЛЕКТРОПИТАНИЯ

PANEL 4

POWER CIRCUIT BREAKERS

РИС 4-14 ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 5 ИЗ 15

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 5 OF 15)

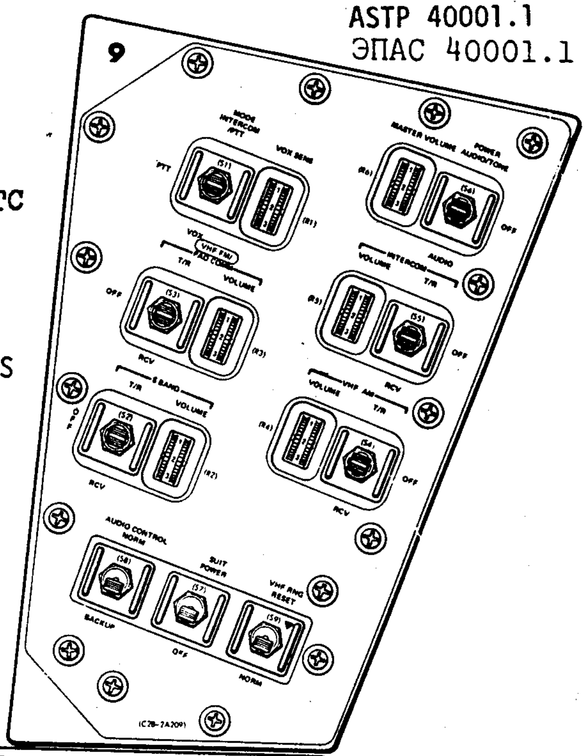
ГЛАВНЫЙ ПУЛЬТ ИНДИКАЦИИ
MAIN DISPLAY CONSOLE

ПАНЕЛЬ 9

УПРАВЛЕНИЕ РТС

PANEL 9

TELECOM CONTROLS

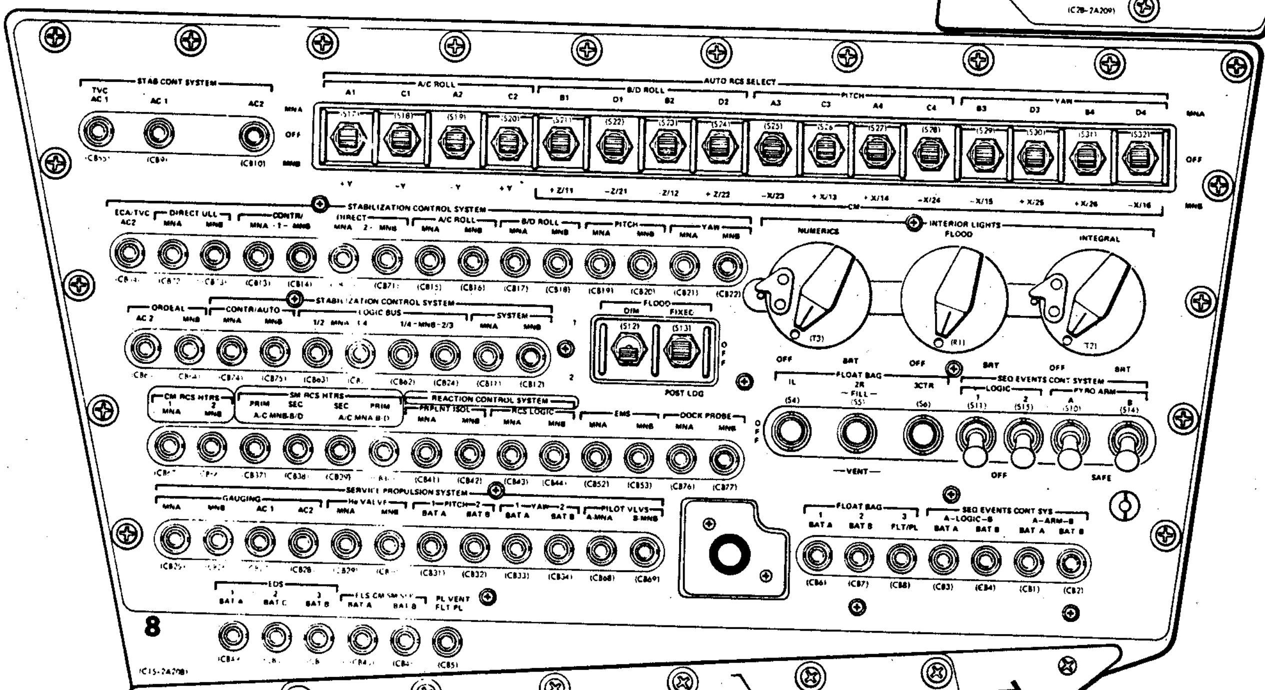


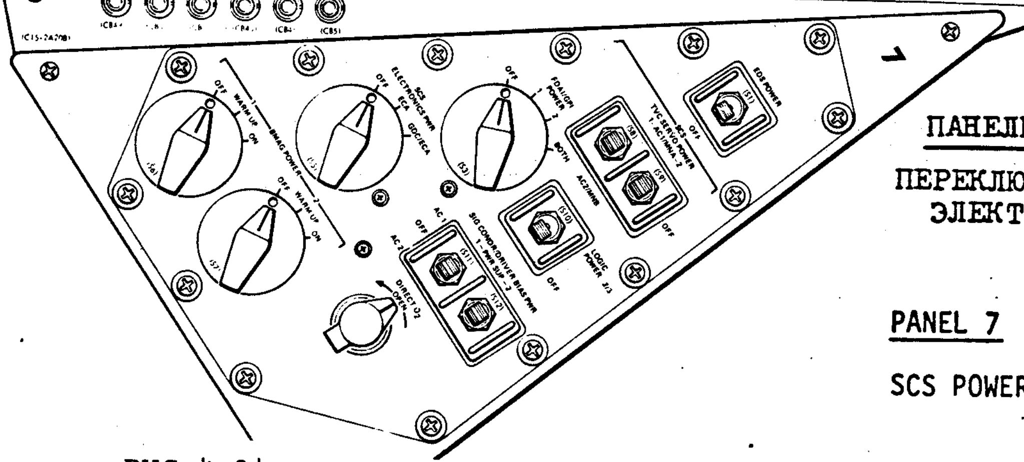
ПАНЕЛЬ 8

УПРАВЛЕНИЕ ОСВЕЩЕНИЕМ
АЗЦ ЭЛЕКТРОПИТАНИЯ

PANEL 8

LIGHTING CONTROLS
POWER CIRCUIT BREAKERS





ПАНЕЛЬ 7

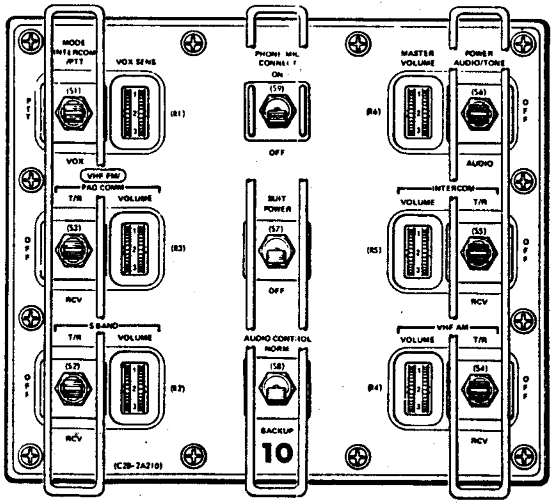
ПЕРЕКЛЮЧАТЕЛИ
ЭЛЕКТРОПИТАНИЯ СУС

PANEL 7

SCS POWER SWITCHES

РИС 4-14 ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 6 ИЗ 15

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 6 OF 15)

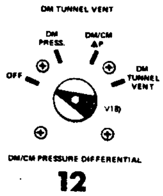


ПАНЕЛЬ 10

УПРАВЛЕНИЕ РТС

PANEL 10

TELECOM CONTROLS

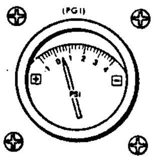


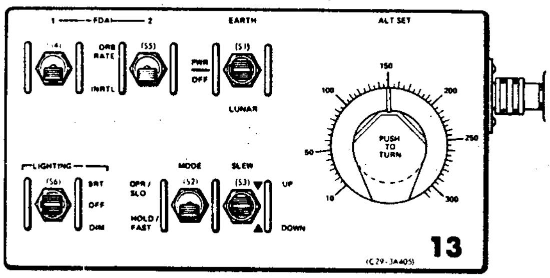
ПАНЕЛЬ 12

ОТДУШИНА ТОННЕЛЯ СМ

PANEL 12

DM TUNNEL VENT



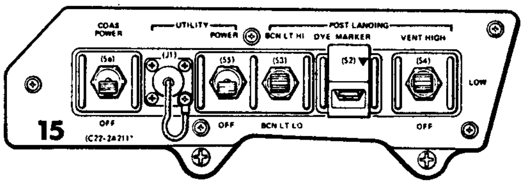


ПАНЕЛЬ 13

УПРАВЛЕНИЕ ОРБИТАЛЬНОЙ СКОРОСТЬЮ

PANEL 13

ORBITAL RATE CONTROL



ПАНЕЛЬ 15

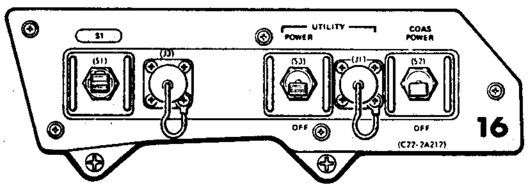
УПРАВЛЕНИЕ СИСТЕМАМИ ПОСЛЕПРИЗЕМЛЕНИЯ

ПИТАНИЕ ОБЩЕГО НАЗНАЧЕНИЯ

PANEL 15

POSTLANDING CONTROLS

UTILITY POWER OUTLET



ПАНЕЛЬ 16

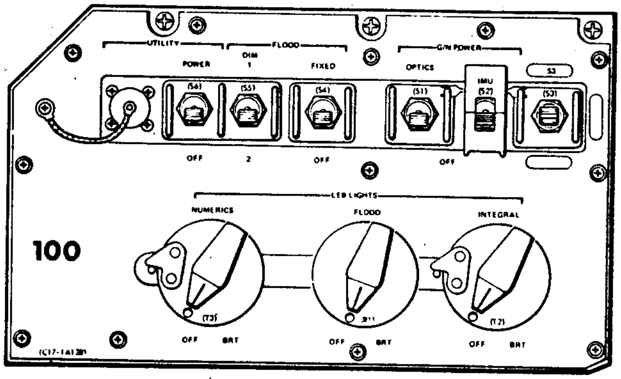
ПИТАНИЕ ОБЩЕГО НАЗНАЧЕНИЯ

PANEL 16

UTILITY POWER OUTLET

РИС 4-14 ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 7 ИЗ 15

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 7 OF 15)

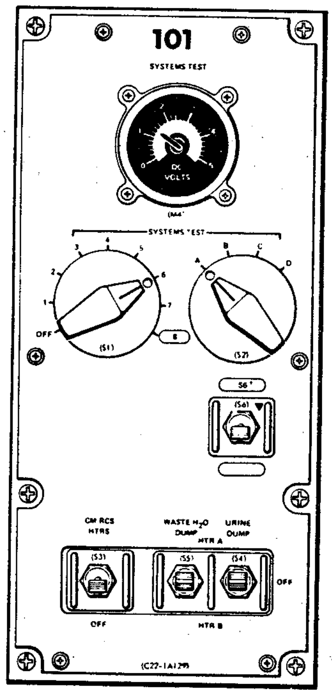


ПАНЕЛЬ 100

УПРАВЛЕНИЕ ОСВЕЩЕНИЕМ
ПИТАНИЕ ОБЩЕГО НАЗНАЧЕНИЯ
ПЕРЕКЛЮЧАТЕЛЬ ПИТАНИЯ СНН

PANEL 100

LIGHTING CONTROLS
UTILITY POWER OUTLET
G & N POWER SWITCHES



ПАНЕЛЬ 101

УКАЗАТЕЛЬ ПРОВЕРКИ СИСТЕМ
УПРАВЛЕНИЕ СБРОСА ВОДЫ

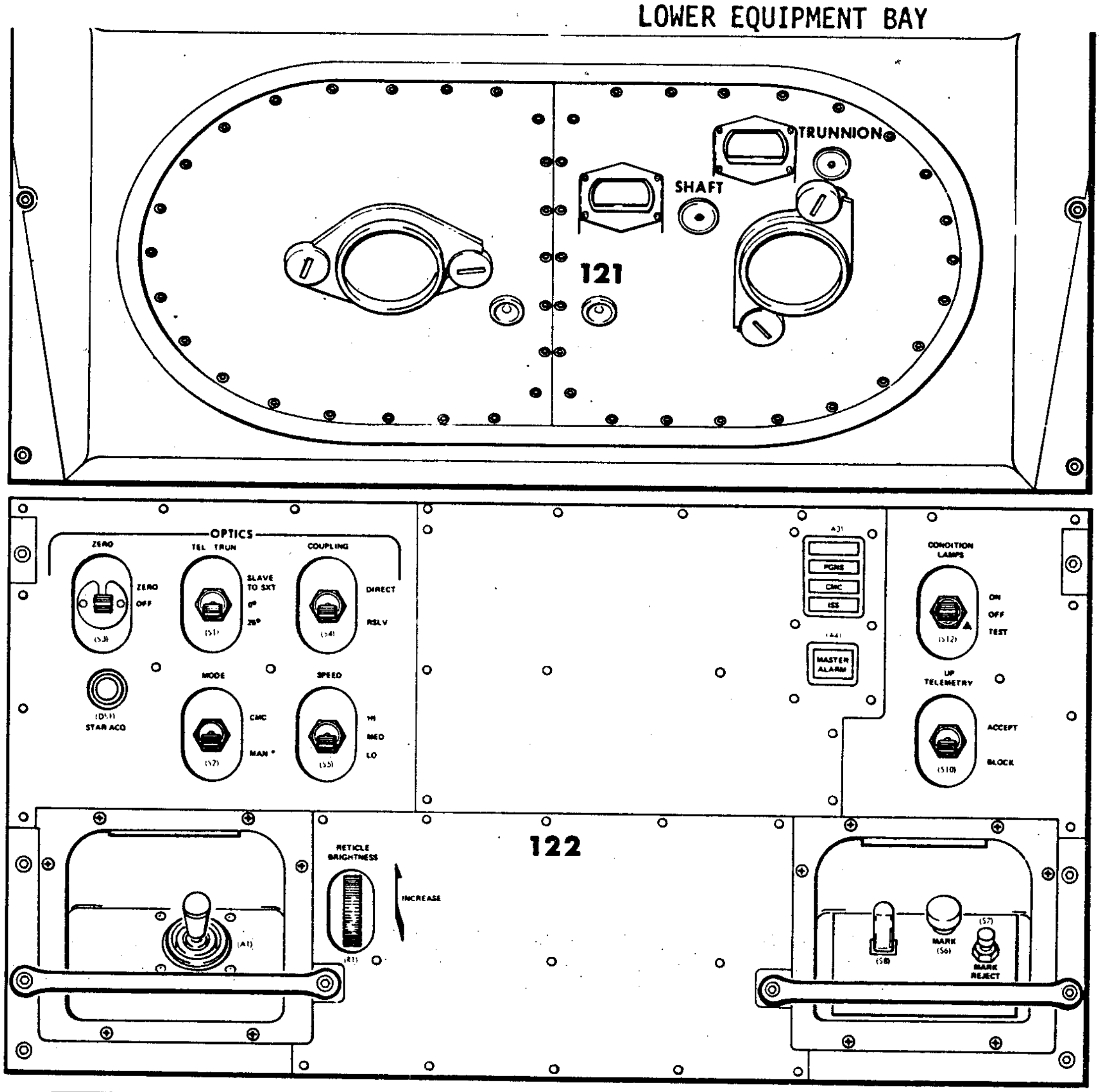
PANEL 101

SYSTEMS TEST METER
WATER DUMP CONTROLS

РИС 4-14 **ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 8 ИЗ 15**

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 8 OF 15)

НИЖНИЙ ОТСЕК ДЛЯ ОБОРУДОВАНИЯ
LOWER EQUIPMENT BAY

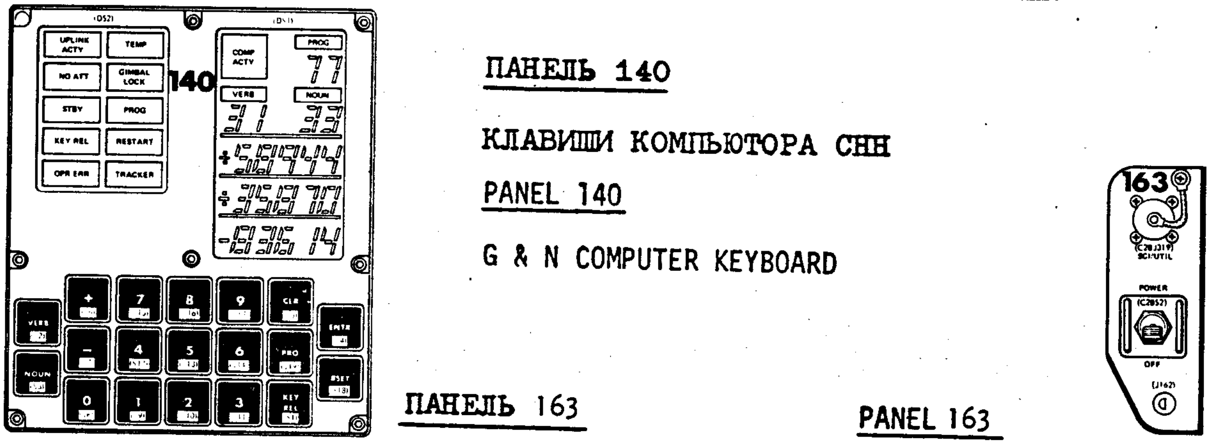


ПАНЕЛЬ 121
ПАНЕЛЬ 122

ОПТИКА И УПРАВЛЕНИЕ СНН

PANEL 121
PANEL 122

G & N OPTICS AND CONTROLS



ПАНЕЛЬ 140

КЛАВИШИ КОМПЬЮТОРА СНН

PANEL 140

G & N COMPUTER KEYBOARD

ПАНЕЛЬ 163

ПИТАНИЕ НАУЧНЫХ ЭКСПЕРИМЕНТОВ

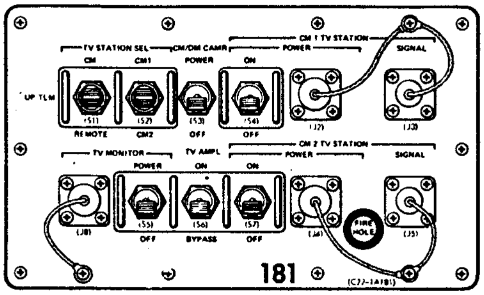
PANEL 163

SCIENTIFIC EXPERIMENT POWER OUTLET

РИС 4-14 **ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 9 ИЗ 15**

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 9 OF 15)

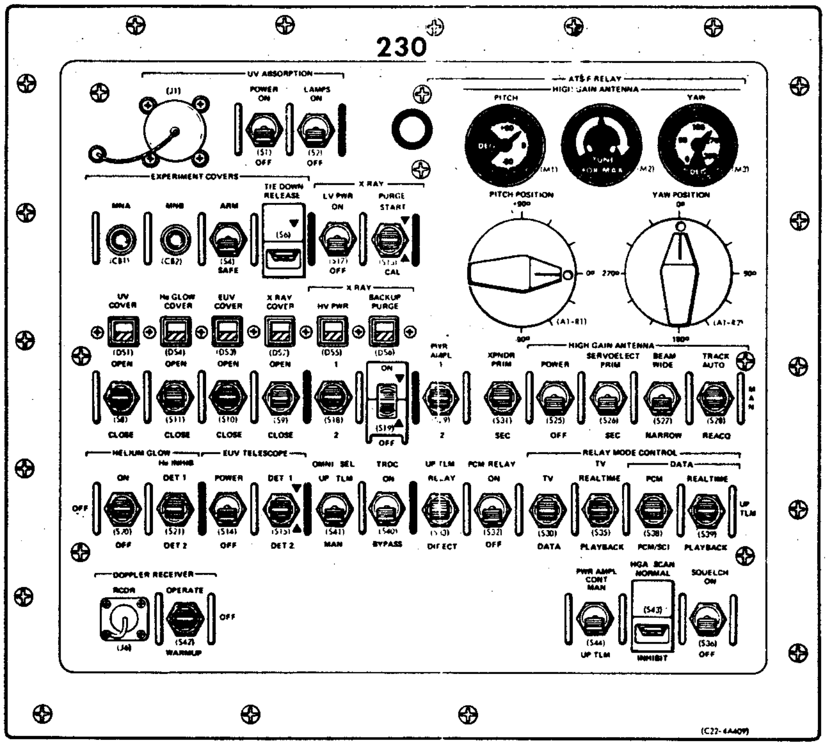
НИЖНИЙ ОТСЕК ДЛЯ ОБОРУДОВАНИЯ
LOWER EQUIPMENT BAY



PANEL 181
TV POWER AND SIGNAL OUTLETS

ПАНЕЛЬ 181
ВЫВОДЫ СИГНАЛЬНОЙ СИСТЕМЫ
И ТВ ПИТАНИЯ

ПРАВЫЙ ОТСЕК ДЛЯ ОБОРУДОВАНИЯ
RIGHT HAND EQUIPMENT BAY



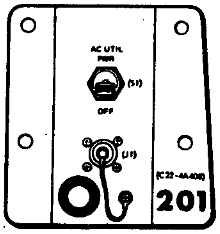
PANEL 230
ATS-6 SATELLITE COMMUNICATION RELAY AND EXPERIMENT CONTROLS

ПАНЕЛЬ 230
Управление связью со спутником ATS -6 и экспериментами

РИС 4-14 **ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 9А ИЗ 15**

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 9A OF 15)

ПРАВЫЙ ОТСЕК ДЛЯ ОБОРУДОВАНИЯ
RIGHT HAND EQUIPMENT BAY

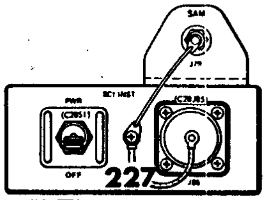


ПАНЕЛЬ 201

ПИТАНИЕ ОБЩЕГО НАЗНАЧЕНИЯ ПЕРЕМЕННЫМ ТОКОМ

PANEL 201

AC UTILITY POWER OUTLET

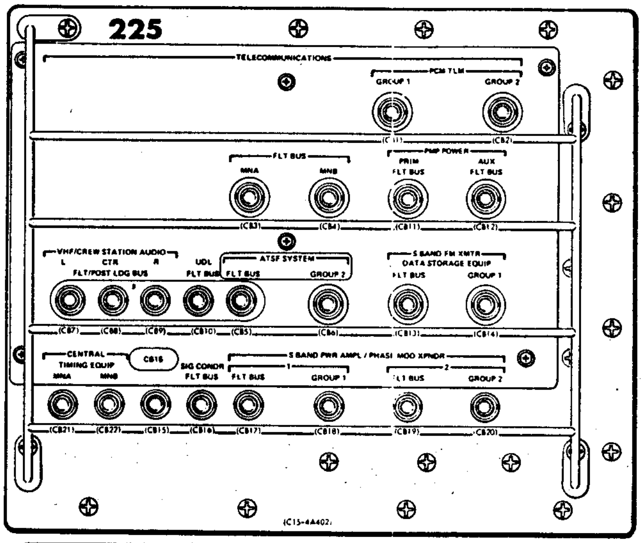


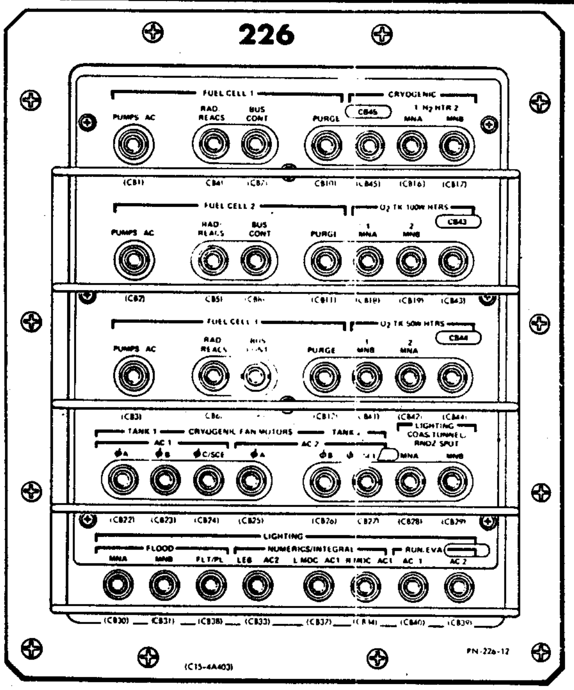
ПАНЕЛЬ 227

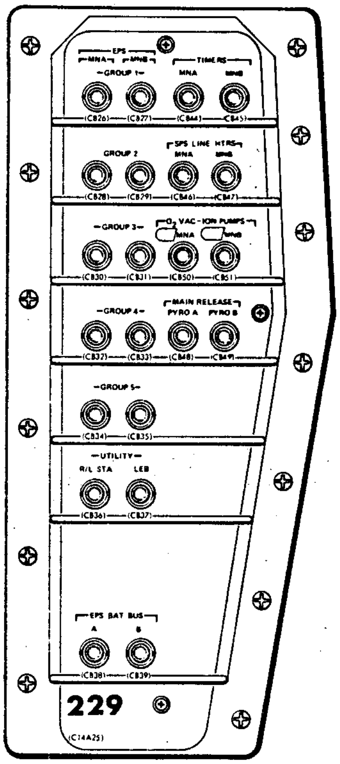
ПИТАНИЕ НАУЧНЫХ ЭКСПЕРИМЕНТОВ

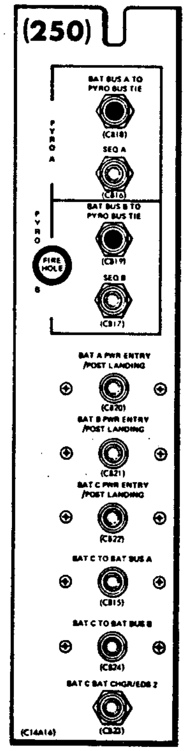
PANEL 227

UTILITY POWER OUTLET









**ПАНЕЛЬ 225
ПАНЕЛЬ 226
ПАНЕЛЬ 229
ПАНЕЛЬ 250**

АЗЦ ЭЛЕКТРОПИТАНИЯ

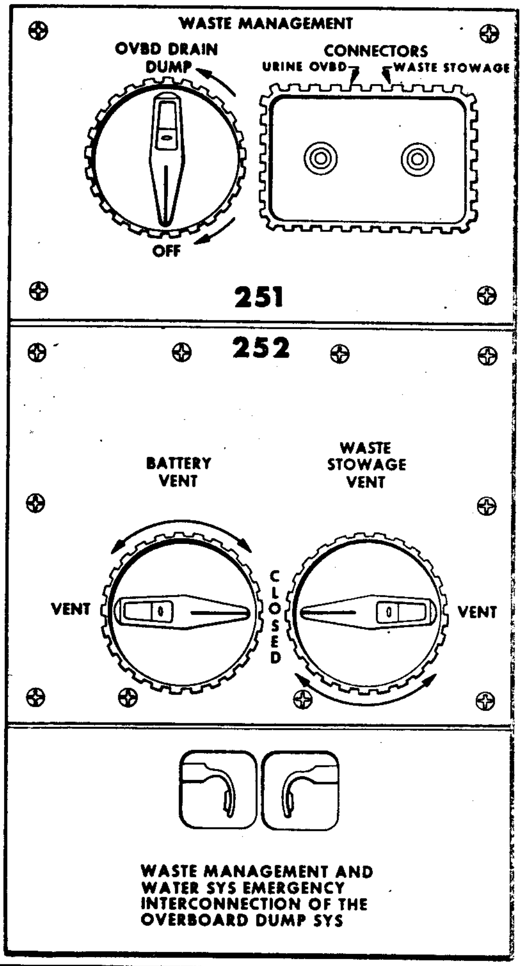
**PANEL 225
PANEL 226
PANEL 229
PANEL 250**

POWER CIRCUIT BREAKERS

РИС 4-14 ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 10 ИЗ 15

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 10 OF 15)

ПРАВЫЙ ОТСЕК ДЛЯ ОБОРУДОВАНИЯ
RIGHT HAND EQUIPMENT BAY

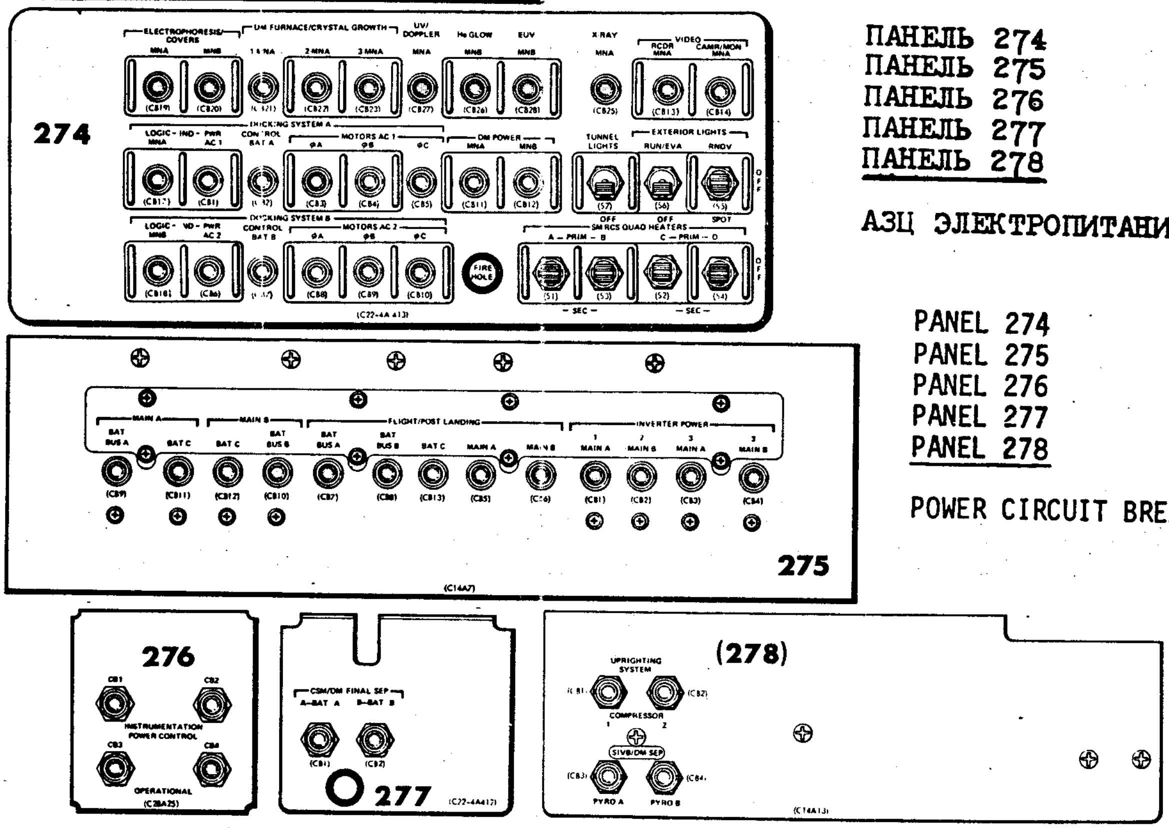


ПАНЕЛЬ 251
ПАНЕЛЬ 252

УПРАВЛЕНИЕ СИСТЕМОЙ СБРОСА.

PANEL 251
PANEL 252

WASTE MANAGEMENT CONTROLS



ПАНЕЛЬ 274
ПАНЕЛЬ 275
ПАНЕЛЬ 276
ПАНЕЛЬ 277
ПАНЕЛЬ 278

АЗЦ ЭЛЕКТРОПИТАНИЯ

PANEL 274
PANEL 275
PANEL 276
PANEL 277
PANEL 278

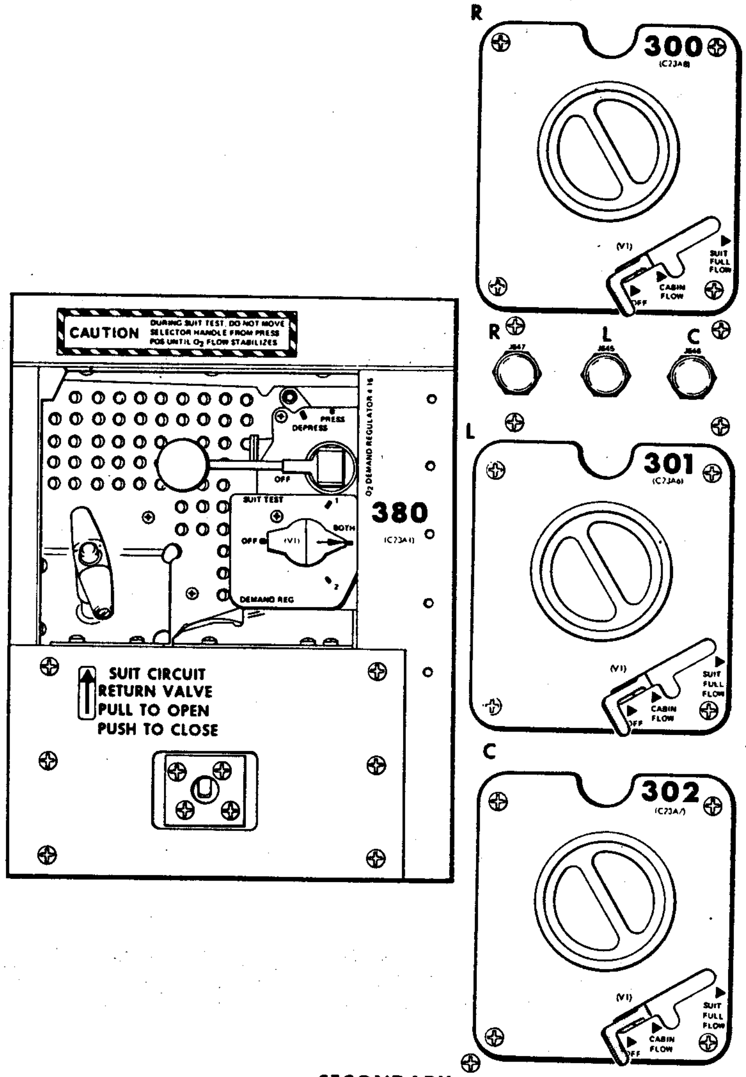
POWER CIRCUIT BREAKERS

РИС 4-14 **ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111** **ЛИСТ 11 ИЗ 15**

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 11 OF 15)

LEFT HAND EQUIPMENT BAY

ЛЕВЫЙ ОТСЕК ДЛЯ ОБОРУДОВАНИЯ

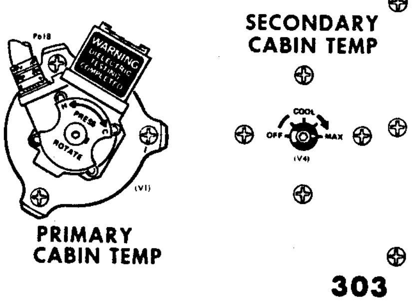


ПАНЕЛЬ 300
ПАНЕЛЬ 301
ПАНЕЛЬ 302
ПАНЕЛЬ 380

УПРАВЛЕНИЕ СОЖ В СКАФАНДРЕ

PANEL 300
PANEL 301
PANEL 302
PANEL 380

SUIT CIRCUIT CONTROLS

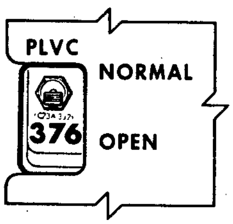


ПАНЕЛЬ 303

РЕГУЛЯТОРЫ
ТЕМПЕРАТУРЫ В КМ

PANEL 303

CM TEMPERATURE CONTROLS



ПАНЕЛЬ 376

ОТДУШИНА
ПОСЛЕПРИЗЕМЛЕНИЯ

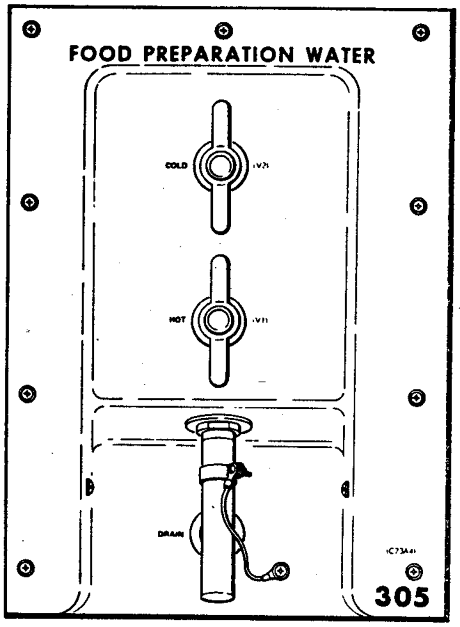
PANEL 376

POSTLANDING VENT

РИС 4-14 ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 12 ИЗ 15

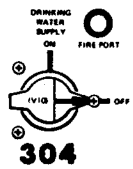
FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 12 OF 15)

ЛЕВЫЙ ОТСЕК ДЛЯ ОБОРУДОВАНИЯ
LEFT HAND EQUIPMENT BAY



ПАНЕЛЬ 304

РЕГУЛЯТОР ПИТЬЕВОЙ ВОДЫ



PANEL 304

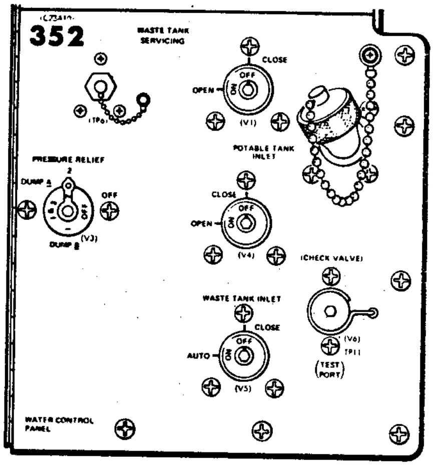
DRINKING WATER CONTROL

ПАНЕЛЬ 305

СНАБЖЕНИЕ ГОРЯЧЕЙ И ХОЛОДНОЙ ВОДОЙ

PANEL 305

HOT AND COLD WATER SUPPLY

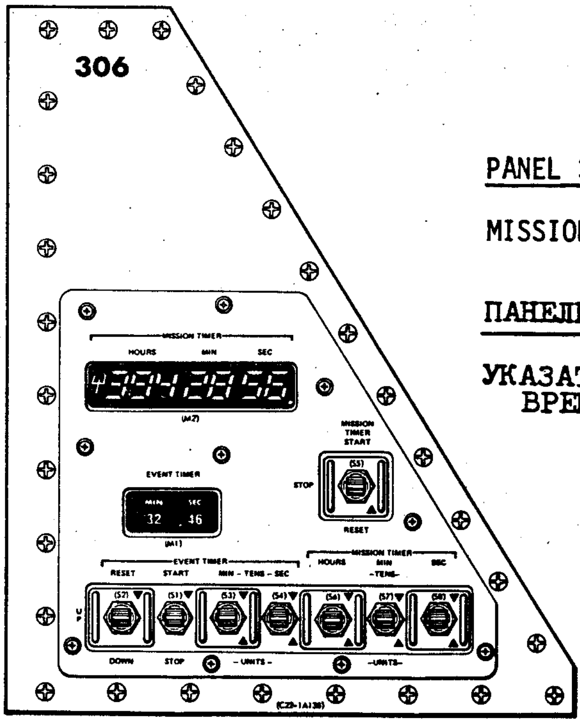


ПАНЕЛЬ 352

УПРАВЛЕНИЕ БАКАМИ ВОДОСНАБЖЕНИЯ

PANEL 352

WATER TANK CONTROLS



PANEL 306

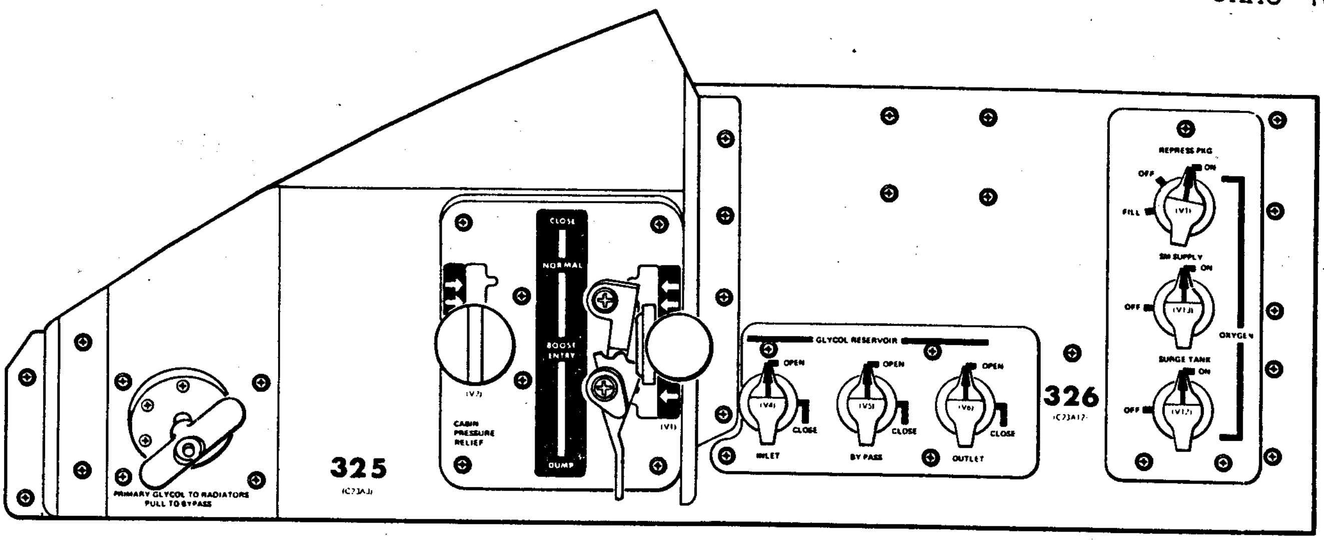
MISSION TIMER

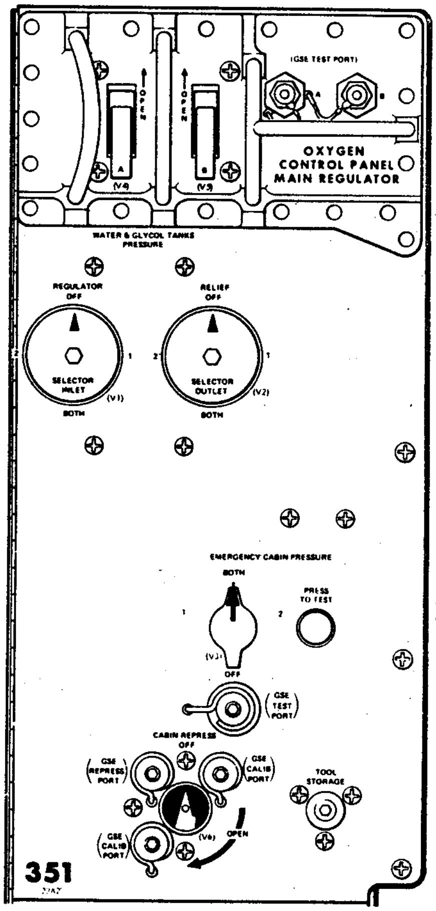
ПАНЕЛЬ 306

УКАЗАТЕЛЬ ВРЕМЕНИ ПОЛЕТА

РИС 4-14 **ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 13 ИЗ 15**

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 13 OF 15)





ПАНЕЛЬ 325

ОБХОД РАДИАТОРА
КЛАПАН СБРОСА
ДАВЛЕНИЯ В КМ

PANEL 325

RADIATOR BYPASS
CM PRESSURE RELIEF VALVE

ПАНЕЛЬ 326

УПРАВЛЕНИЕ
КИСЛОРОДОМ
УПРАВЛЕНИЕ
ОХЛАЖДЕНИЕМ

PANEL 326

COOLANT CONTROLS
OXYGEN CONTROLS

ПАНЕЛЬ 351

УПРАВЛЕНИЕ
КИСЛОРОДОМ

PANEL 351

OXYGEN CONTROLS

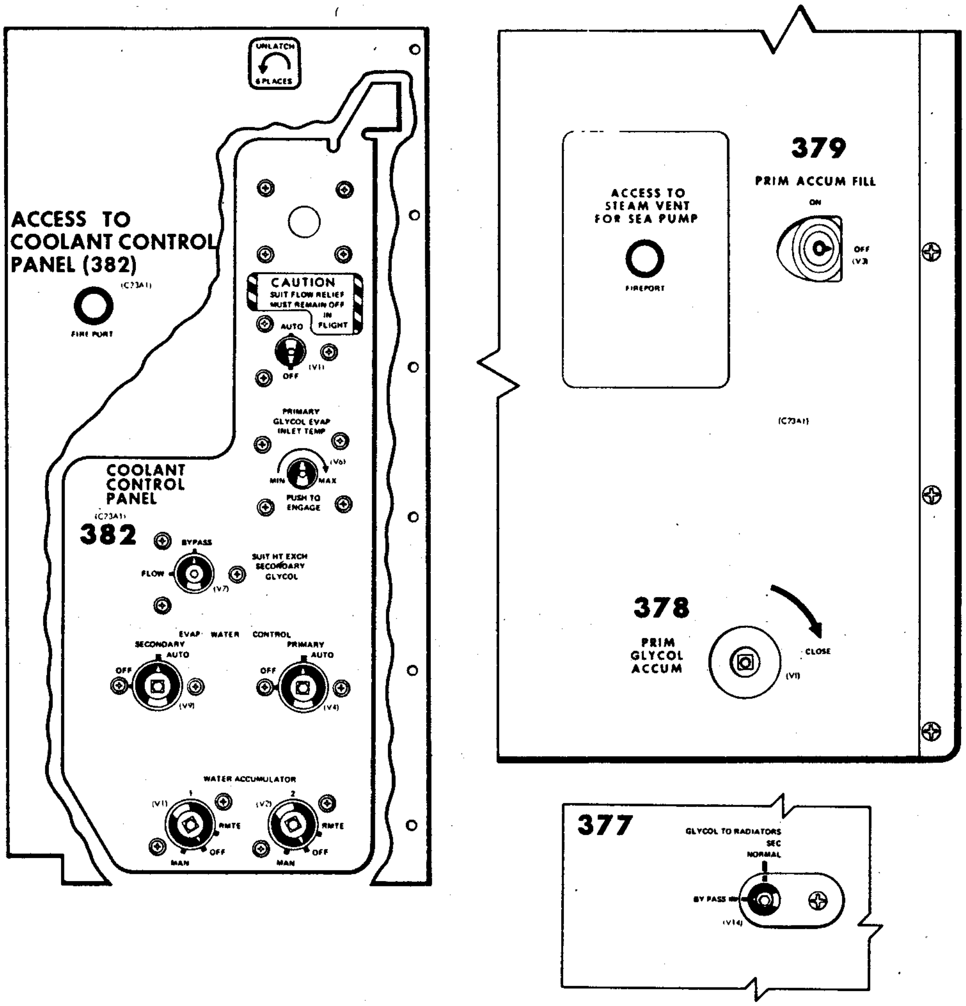
РИС 4-14 ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 14 ИЗ 15

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 14 OF 15)

ЛЕВЫЙ ОТСЕК ДЛЯ ОБОРУДОВАНИЯ
LEFT HAND EQUIPMENT BAY

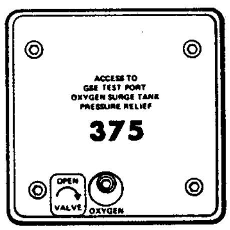
ПАНЕЛЬ 377	PANEL 377
ПАНЕЛЬ 378	PANEL 378
ПАНЕЛЬ 379	PANEL 379
ПАНЕЛЬ 382	PANEL 382

УПРАВЛЕНИЕ ОХЛАЖДЕНИЕМ — COOLANT CONTROLS



ПАНЕЛЬ 375

стравливание давления из баллона с O_2



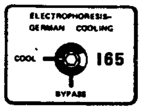
PANEL 375

OXYGEN SURGE TANK PRESSURE RELIEF

РИС 4-14 **ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 14А ИЗ 15**

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 14 A OF 15)

НИЖНИЙ ОТСЕК ДЛЯ ОБОРУДОВАНИЯ
LOWER EQUIPMENT BAY

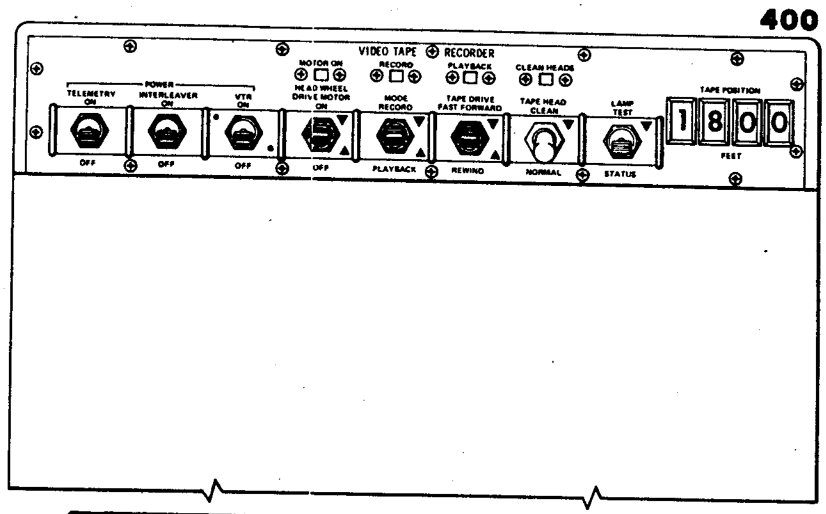


ПАНЕЛЬ I65

PANEL 165

EXPERIMENT COOLING CONTROL

управление системой охлаждения для эксперимента



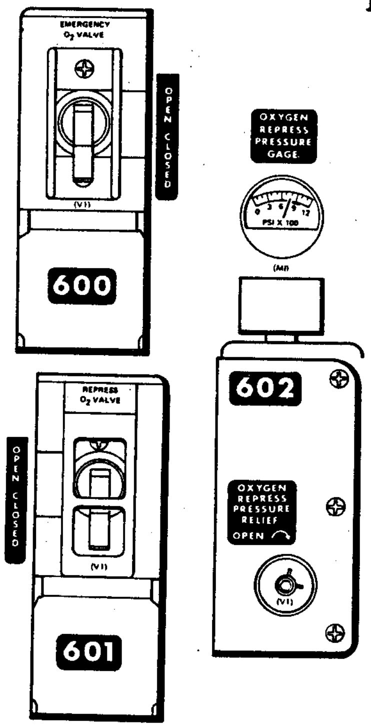
ПАНЕЛЬ 400

УПРАВЛЕНИЕ ВИДЕО ЛЕНТОЧНЫМ МАГНИТОФОНОМ

PANEL 400

VIDEO TAPE RECORDER

ВЕРХНИЙ ОТСЕК ДЛЯ ОБОРУДОВАНИЯ
UPPER EQUIPMENT BAY



ПАНЕЛЬ 600
ПАНЕЛЬ 601
ПАНЕЛЬ 602

УПРАВЛЕНИЕ НАДДУВОМ СМ

PANEL 600
PANEL 601
PANEL 602

DM PRESSURIZATION CONTROLS

РИС 4-14 **ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 15 ИЗ 15**

FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 15 OF 15)

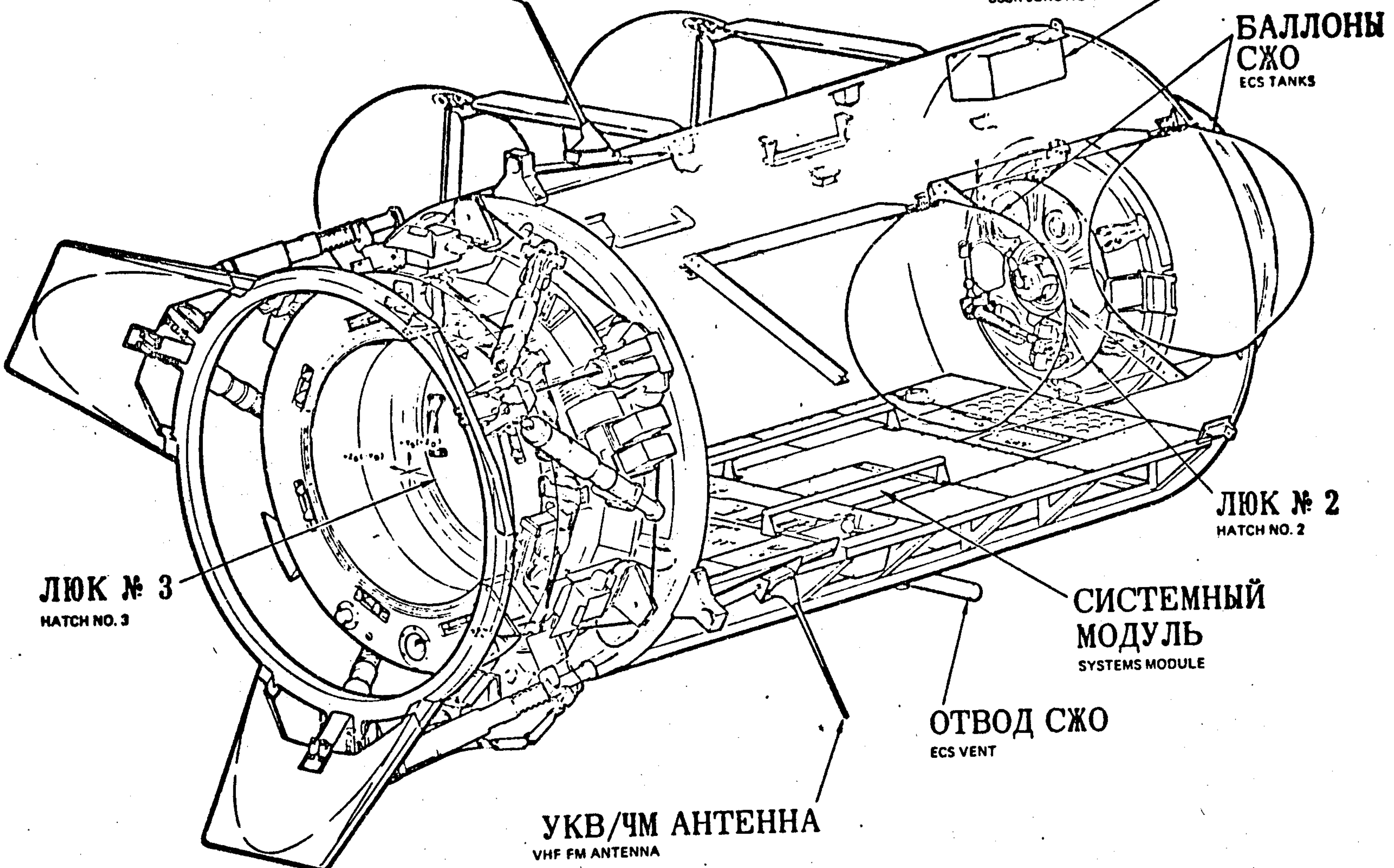


РИС 4-15 КОНФИГУРАЦИЯ СТЫКОВОЧНОГО МОДУЛЯ

FIGURE 4-15 DOCKING MODULE CONFIGURATION

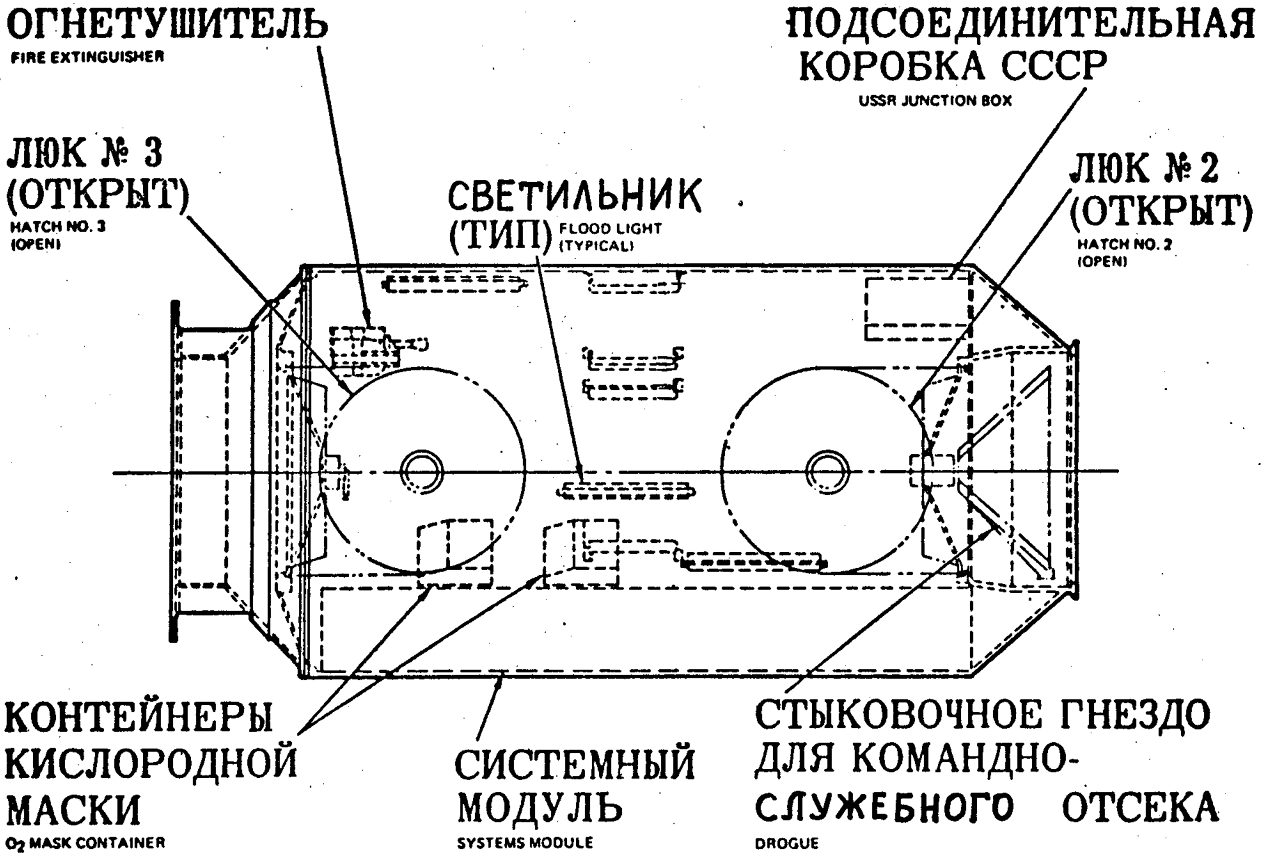


РИС 4-16 СТЫКОВОЧНЫЙ МОДУЛЬ-ВНУТРЕННЯЯ КОМПОНОВКА

FIGURE 4-16 DM INTERNAL CONFIGURATION

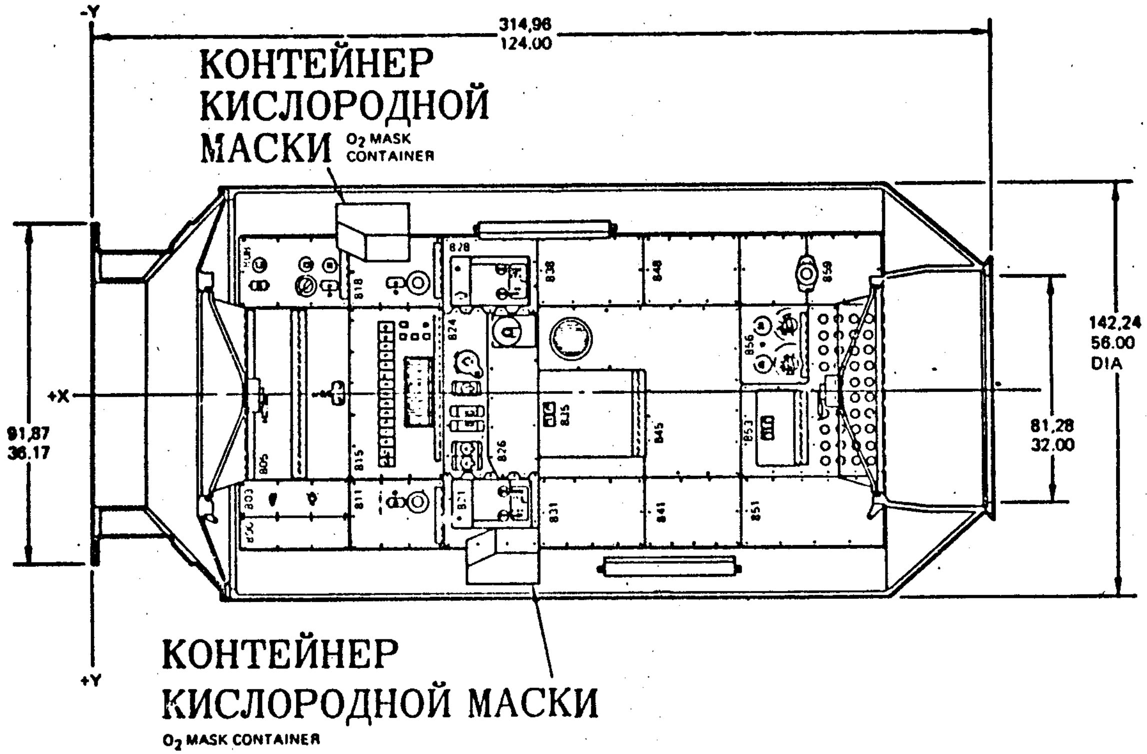
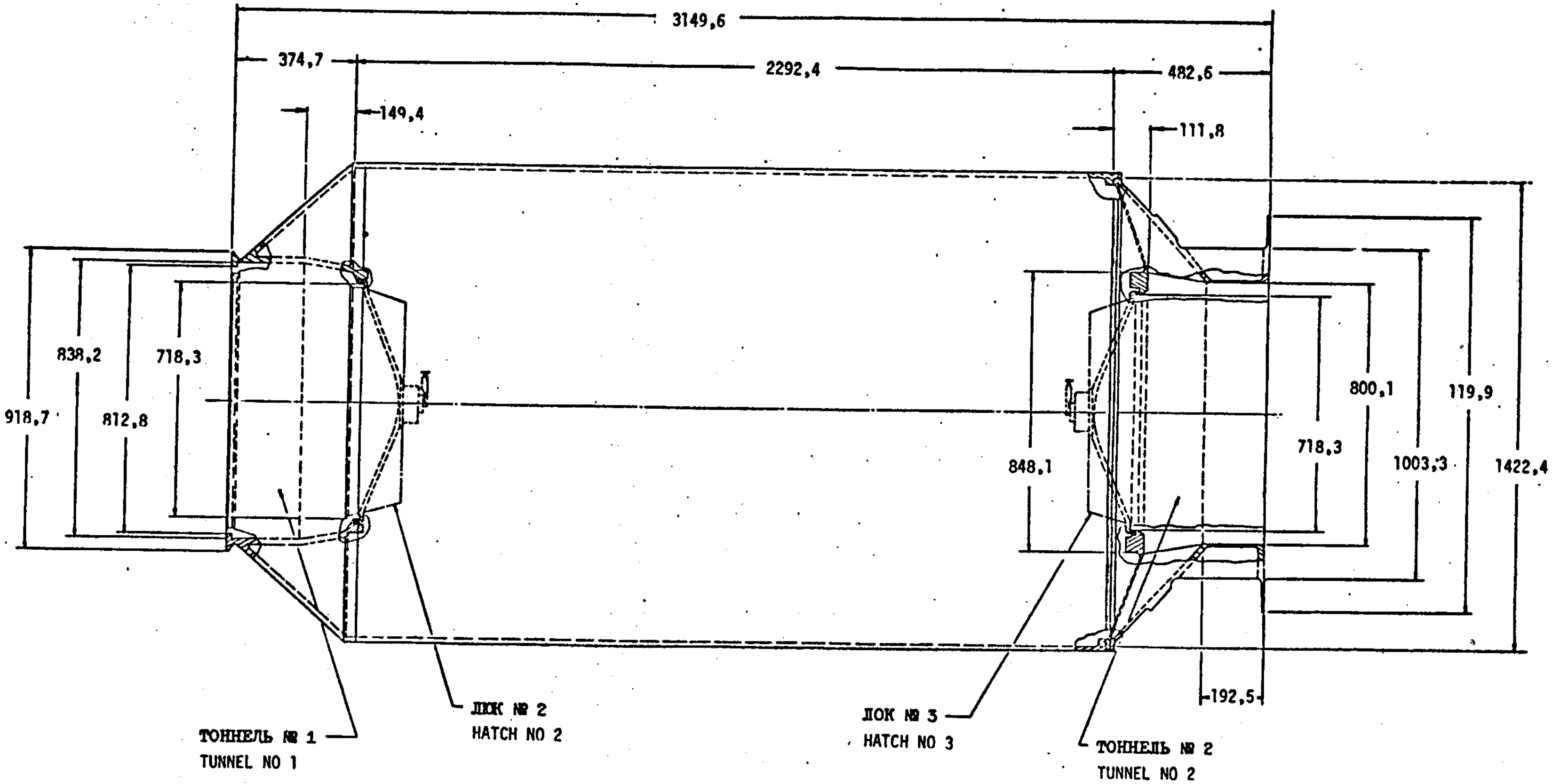


РИС 4-17 **СТЫКОВОЧНЫЙ МОДУЛЬ-ВНУТРЕННЯЯ КОМПОНОВКА**

FIGURE 4-17 DM INTERNAL CONFIGURATION



ПРИМЕЧАНИЕ: ВСЕ РАЗМЕРЫ В МИЛЛИМЕТРАХ

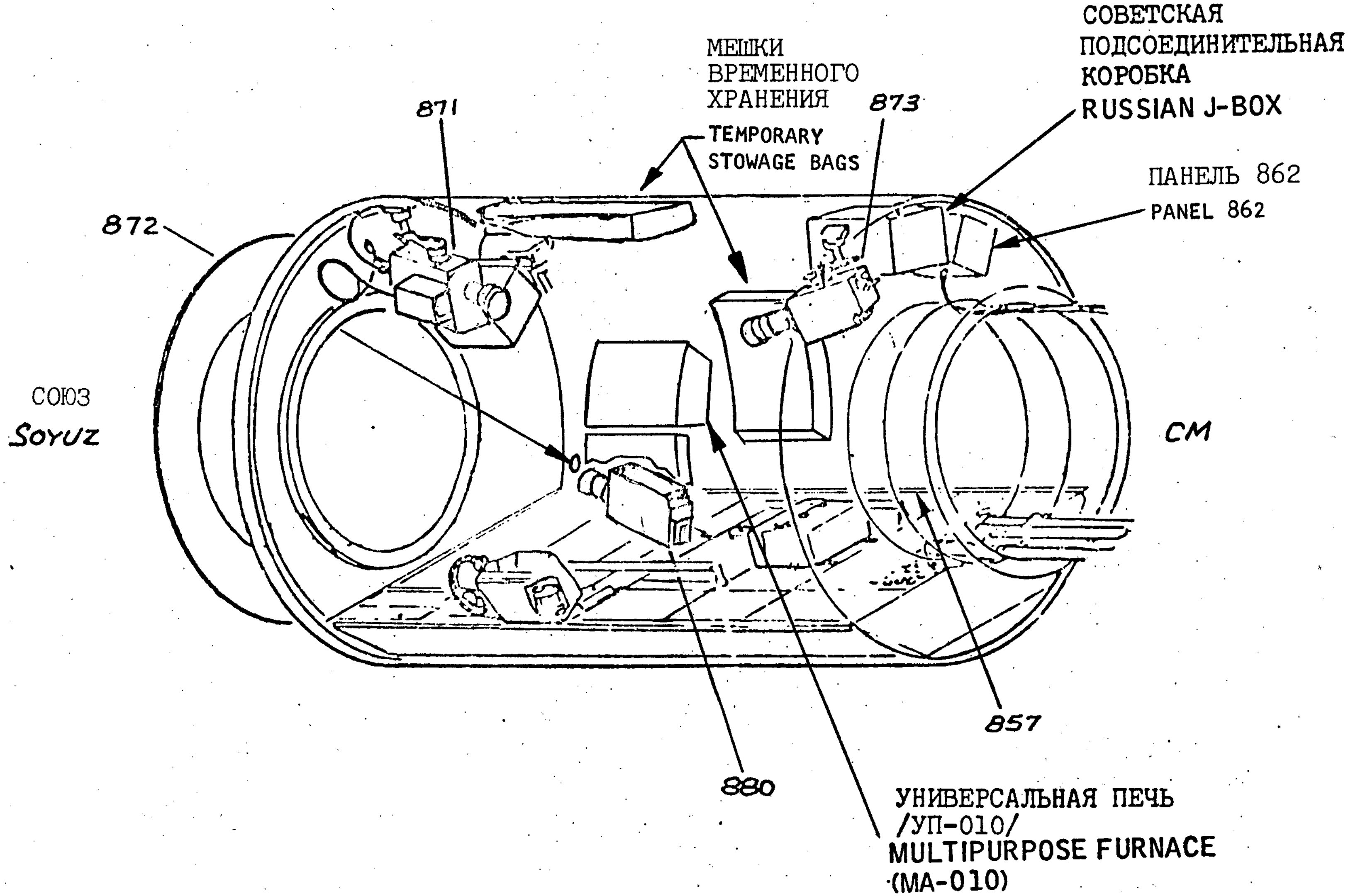
NOTE: ALL DIMENSIONS IN MM

РИС 4-18 СТЫКОВОЧНЫЙ МОДУЛЬ, ОБЩИЕ РАЗМЕРЫ

FIGURE 4-18 DOCKING MODULE, OVERALL DIMENSIONS

РИС 4-20 СТЫКОВОЧНЫЙ МОДУЛЬ МЕСТОПОЛОЖЕНИЕ ТВ КАМЕР

FIGURE 4-20 **DOCKING MODULE TV CAMERA LOCATIONS**



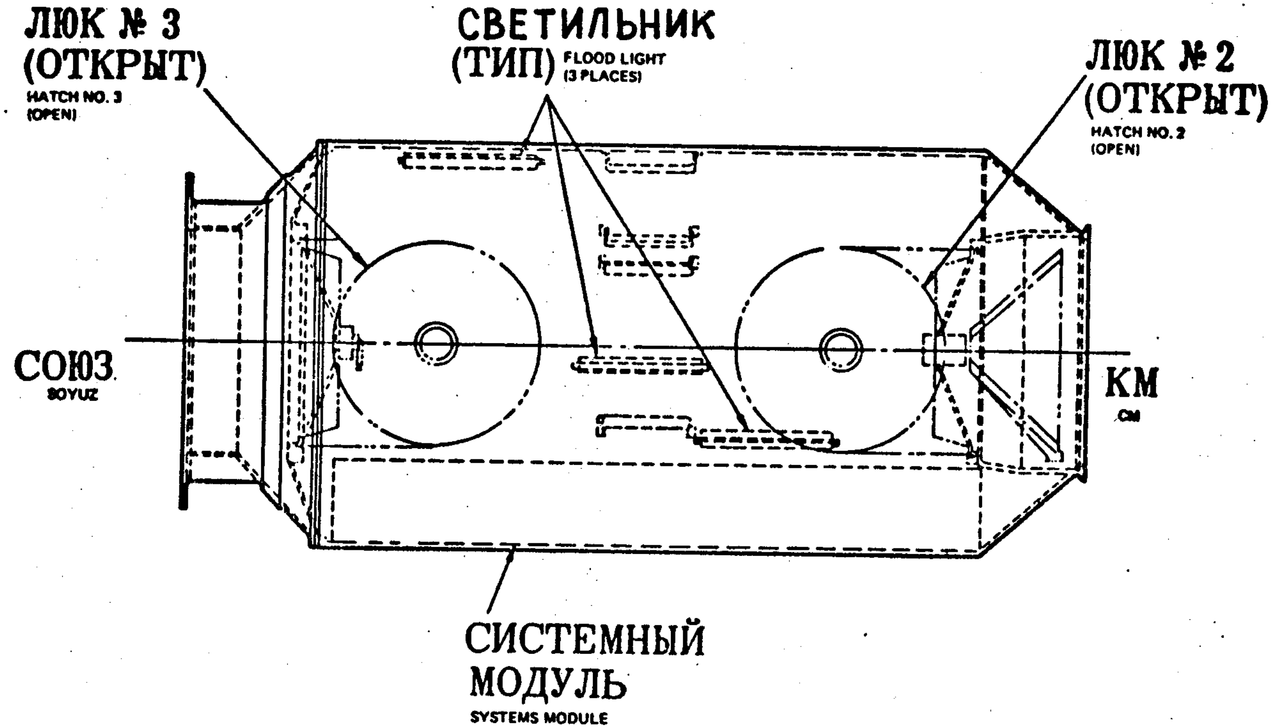
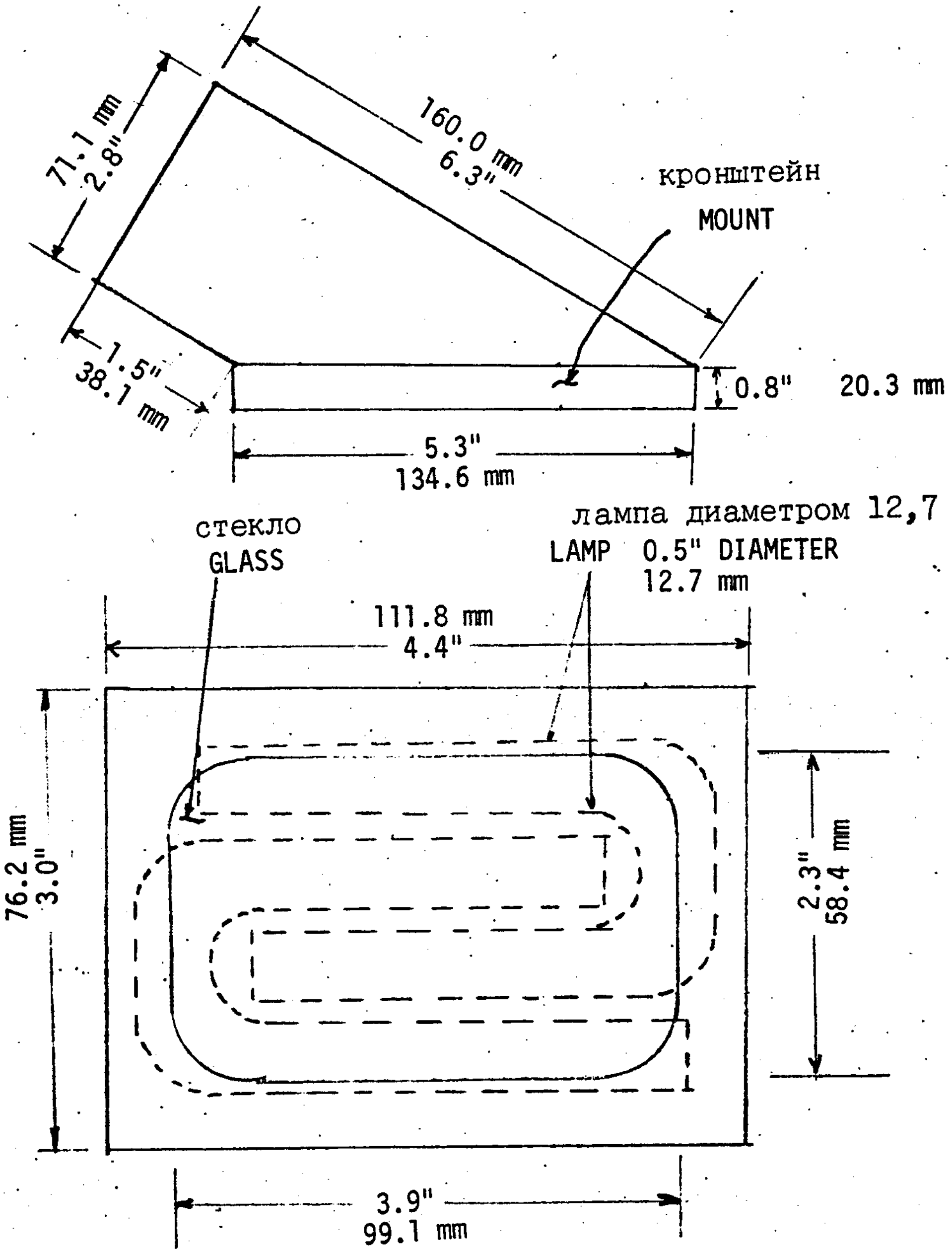


РИС 4-21 **СТЫКОВОЧНЫЙ МОДУЛЬ РАСПОЛОЖЕНИЕ СВЕТИЛЬНИКОВ.**

FIGURE 4-21 DOCKING MODULE FLOODLIGHT ARRANGEMENT

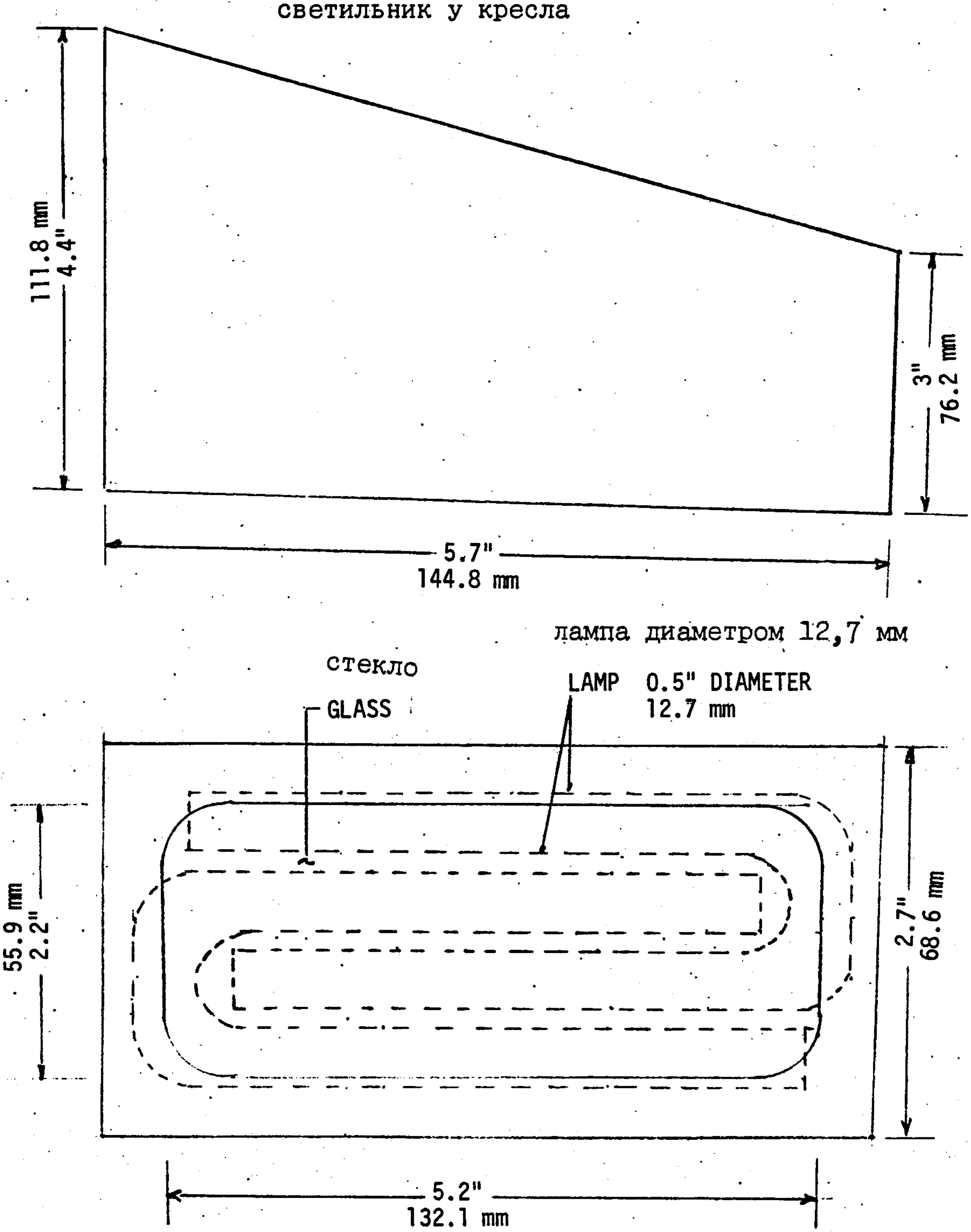
SIDEWALL LIGHT
светильник у боковой стены



ширина луча половинной мощности
HALF-POWER BEAM WIDTH:
100° WIDTH ширина 100°
100° LENGTH длина 100°

РИС 4-22
Figure 4-22

COUCH LIGHT
светильник у кресла



HALF-POWER BEAM WIDTH:

100° WIDTH
100° LENGTH

ширина луча половинной мощности

ширина 100°

длина 100°

РИС 4-23 Figure 4-23

COUCH STRUT LIGHT
светильник на стойке кресла

HALF-POWER BEAM WIDTH: ширина луча половинной мощности
120° WIDTH ширина 120°
110° LENGTH длина 110°

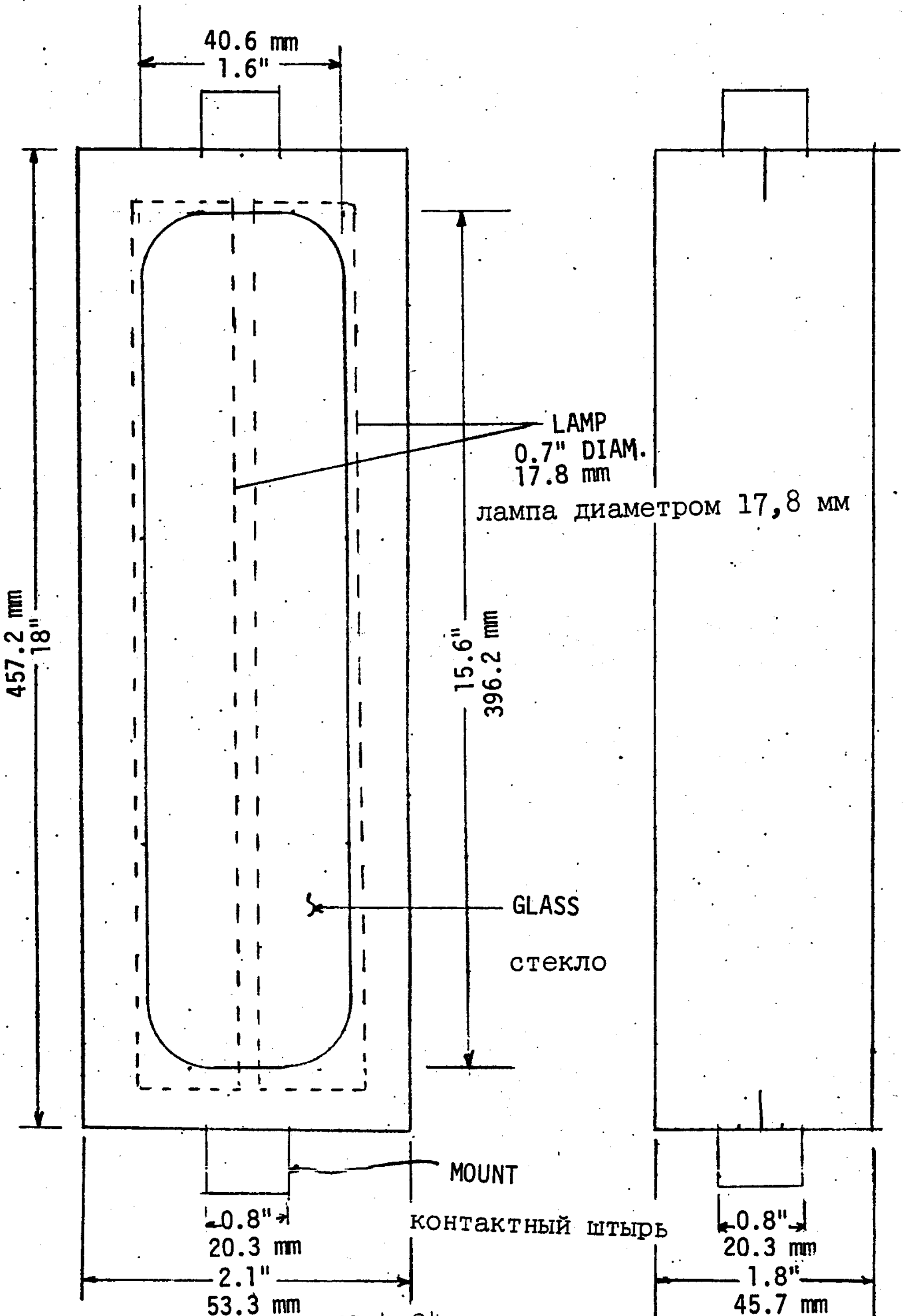
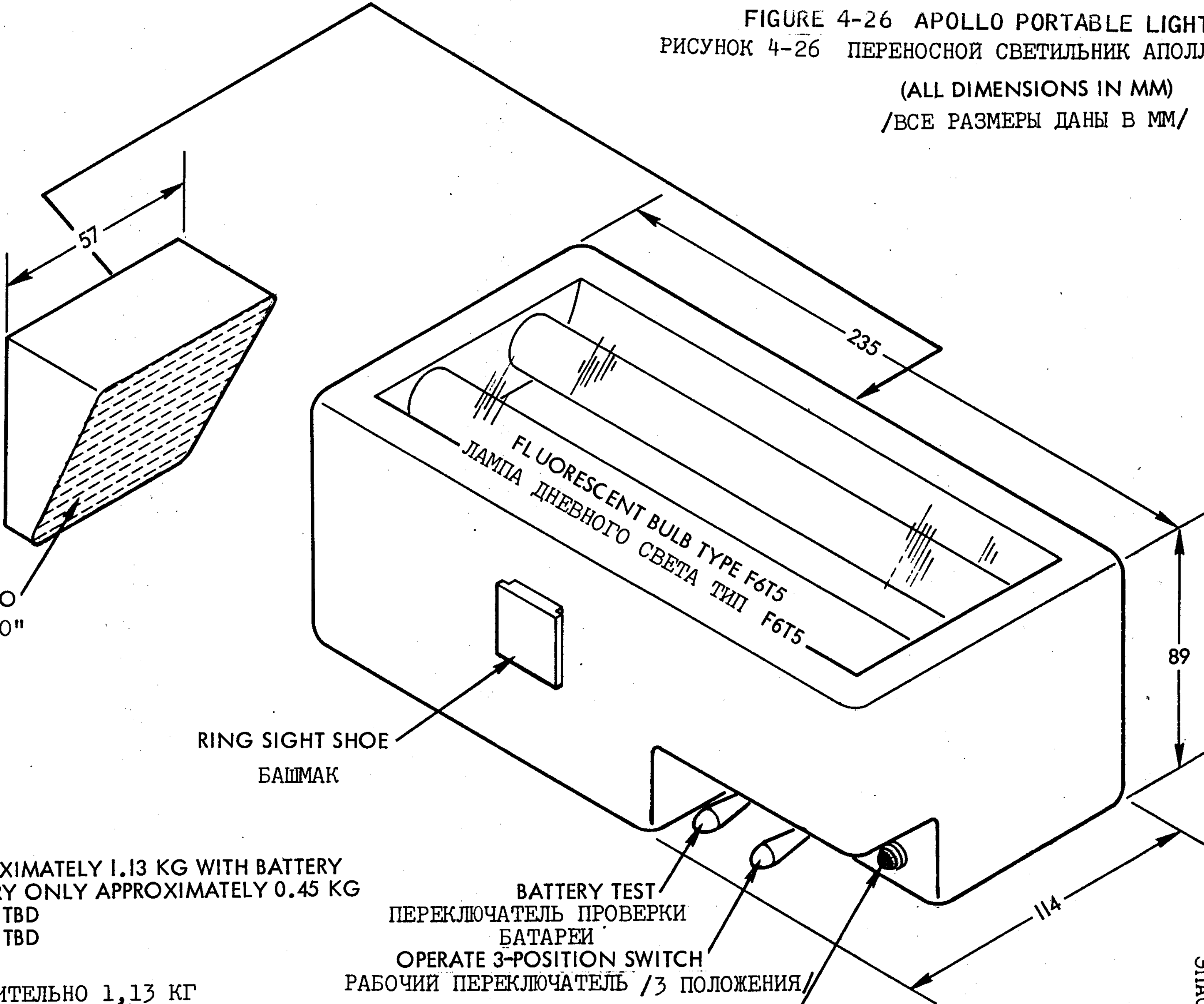


РИС 4-24
Figure 4-24

FIGURE 4-26 APOLLO PORTABLE LIGHT
РИСУНОК 4-26 ПЕРЕНОСНОЙ СВЕТИЛЬНИК АПОЛЛОНА

(ALL DIMENSIONS IN MM)
/ВСЕ РАЗМЕРЫ ДАНЫ В ММ/



WEIGHT: APPROXIMATELY 1.13 KG WITH BATTERY
BATTERY ONLY APPROXIMATELY 0.45 KG
LIGHT OUTPUT: TBD
LIGHT ANGLES: TBD

ВЕС: ПРИБЛИЗИТЕЛЬНО 1,13 КГ
ВКЛЮЧАЯ БАТАРЕЮ
ВЕС БАТАРЕИ-ОКОЛО 0,45 КГ
СВЕТОВАЯ ОТДАЧА: ПО
УГОЛ СВЕТА: ПО

NASA TECHNICAL TRANSLATION

A BRIEF DESCRIPTION OF THE RADAR APPROACH EQUIPMENT OF THE SOYUZ-TYPE SPACECRAFT

Translation of "Kratkoye opisaniye radioapparatury sblizheniya kosmicheskikh korabley tipa Soyuz."

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. 20546 NOVEMBER 1970

A BRIEF DESCRIPTION OF THE RADAR APPROACH EQUIPMENT OF THE SOYUZ-TYPE SPACECRAFT

ABSTRACT: Radar approach equipment of Soyuz-type spacecraft is described and presented in computational form.

Radar equipment is used to measure the parameters of the relative movement of the Soyuz spacecraft, and provides /1*

mutual search and detection of the spacecraft;

measurement of the angular position of the sighting line relative to the coordinate system for the body of the spacecraft;

measurement of the relative distance between the spacecraft;

measurement of the radial component of the the relative speed of the spacecraft;

measurement of the angular velocity of the movement of the sighting line in an inertial coordinate system;

measurement of the mutual roll angle between the spacecraft.

These functions are provided for by the equipment on both linked spacecraft: on the "active" spacecraft, where delivery of all the compiled information is carried out, there is an interrogator device, and on the "passive" spacecraft, there is a responder which in addition to retranslating the signals in the approach zone, also measures the angular coordinates of the sighting line in order to orient the "passive" spacecraft.

The operation of the electronic linkup system is completely automatic, i.e., not connected with any ground electronic or other type of instruments. The initial conditions for the operation of the system at a relative distance /2 and relative velocity are determined by the accuracy of the orbit of the linked spacecraft when their attitude with respect to the sighting line is arbitrary.

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* Numbers in the margin indicate pagination in the foreign text.

These initial conditions are provided for by means of a corresponding orbit correction using ordinary navigational equipment.

It is also essential that the system be designed so that its operation does not require preliminary target destination for the mutual angular position of the spacecraft. When a system is constructed in this way, it is more universal in the sense that it can be used in different types of spacecraft and that different ballistic systems of detection and long-range approach.

MUTUAL SEARCH

The mutual search and detection channel includes two transmitting antennas mounted on the "passive" spacecraft and which provide omnidirectional scanning of the whole of space. In this case, the transmitting device of the responder operates in a noncoherent regime with continuous scanning.

The signals from the responder ("beacon"), i.e., the "passive" spacecraft are picked up by the antenna system of the "active" spacecraft which is also made up of two antennas which circularly sca... the whole of space. The receiving device of the "active" spacecraft also emits control signals as it turns with respect to the sighting line. As the "active" spacecraft turns, the "passive" spacecraft remains stabilized in the inertial coordinate system.

The sequence of the mutual orientation of the spacecraft assumed for the system is shown in Figure 1.

Lock-on of the "target", i.e., "passive" spacecraft occurs when the "active" spacecraft completes its revolution by the narrow beam antenna system of the homing attachment, and further orientation of the "active" spacecraft relative to the sighting line is carried out by the information received from the angle gauges, located in the Cardan suspension of the homing attachment. The interrogator signal is transmitted by this same narrow beam antenna system and is picked up by the antennas of the circular scanner of the "passive" spacecraft. These antennas as well as the equipment for generating the orientation control signals on both spacecraft are analog type.

After the "passive" spacecraft completes its revolution relative to the sighting line, its responder is switched to the coherent-fractional retranslation zone for the interrogator signal through the narrow beam antenna which is rigidly connected to the body of the spacecraft. From this point, all the information necessary for the approach is fed into the control system of the "active" spacecraft.

MEASUREMENT OF THE MUTUAL DISTANCE AND RADIAL SPEED

Figure 2 gives a functional diagram of the gauge for the relative distance between the spacecraft ρ and the rate of measurement $\dot{\rho}$. The device uses /4 the phase method of measuring distance, whereby, information on the relative distance yields the magnitude of the phase lag of the continuous answer signal with respect to the phase of the interrogator signal emitted by the transmitter of the "active" spacecraft. The interrogator includes a modulation frequency shaper for the distance, a modulator, a transmitter, and a receiver which separates the continuous answer signal, and a phase meter which produces a constant voltage proportional to the measured distance value. The type of modulation is amplitude modulation with continuous emission. Decoupling the transmitter from the receiver is accomplished by a corresponding frequency shift.

The responder separates the constant modulation frequency and transfers it to a new carrier. Modulation here is also of the amplitude type (see diagram of responder also inserted in Figure 2). In order to eliminate ambiguity to obtain the necessary measurement accuracy over short distances, there are several interchangeable distance scales on board the vehicle which correspond to the amount of modulation frequencies. The magnitudes of the initial phase lags in the responder, interrogator, and the feed lines from the tranoceiver to the antennas are fixed and allowed for in the phase meter.

The method described enables measurement of the distance until the spacecraft is mechanically coupled.

In order to measure the magnitude of $\dot{\rho}$, the same signal is used as is used for retranslation of the distance signals as seen in Figure 2.

The method of measurement is based on determination of the Doppler displacements of the frequency carrier for the coherent-fractional retranslation of the interrogator signal. This method enables us to measure $\dot{\rho}$ with an accuracy which guarantees normal operation of the docking unit. /5

MEASUREMENT OF THE ANGULAR COORDINATES

As has already been mentioned, the interrogator system includes a homing unit which automatically tracks the "passive" spacecraft, or more precisely, the antenna-retranslator mounted on it. In order to increase the measurement accuracy of the angular velocity of the shift of the sighting line, the antenna of the homing unit is mounted on a gyrostabilized platform which eliminates the effect of stabilization fluctuations of the target about its center of mass.

The Cardan suspension in which the gyrostabilized platform with antenna is located, has the following angles of roll:

in the pitching plane

to the side of the docking unit - 10 degrees,

to the side of the cruising engine -190 degrees;

in the perpendicular plane (internal frame of the Cardan suspension) ± 10 degrees.

The functional diagram of the angular measurement channel is given in Figure 3 which shows the receiver which separates the error signal, resolved into two orthogonal components of pitch and yaw.

The error signals obtained in this manner are fed into the controls of the gyrostabilized platform; in addition, these same signals are fed into the approach control system, since in the established zone, they are proportional to the angular speeds of the movement of the sighting line ω_ζ and ω_η. In order to decrease the effect of reflections from the body of the spacecraft on the measurement of the angular speeds, special reflector plates were provided and mounted on the body of the spacecraft, and by means of which there was a considerable reduction in the reflected signals at the antenna of the homing unit. The receiver of the angular measurement channel also includes a shaping diagram for the error signal with respect to the roll which is also /6 fed into the control system in the docking zone. The input cascades and the first intermediate frequency amplifer of the receiver are joint, both for the goniometric channel as well as for the ρ and $\dot{\rho}$ measurement channel.

SPECIAL FEATURES OF THE RADAR SYSTEM OVER SHORT DISTANCES

When the method of coherent-fractional retranslation of the interrogator signal is used, the operation of the ρ and $\dot{\rho}$ gauges in the docking zone does not differ in principle from its operation over great distances. As regards the function of the goniometric channel, it is necessary to take into account several special structural features for short distance values. It would be appropriate here to define "short distances" as those distances between the spacecraft which are commensurate with the geometric dimensions of the spacecraft themselves.

Figure 4 shows a conventional diagram of the arrangement of the antennas /7 of the electronic docking system on both spacecraft. At large distances (up to the docking zone) the connecting line is formed as follows: the signal from the interrogator is transmitted from the antenna of the homing unit on the "active" spacecraft, is fixed by the circular sweep antenna of the anterior hemisphere of the "passive" spacecraft, is retranslated by the narrow beam antenna rigidly fastened to the body of the "passive" spacecraft and fixed by the antenna of the homing unit.

From Figure 4, we can see that when the distance is reduced, the "passive" spacecraft will orient itself along the sighting line with an angular error which is conditioned by the increasing movement of the sighting line from the longitudinal axis of the spacecraft. This error is eliminated by installing a supplementary antenna on the "active" spacecraft, located at the "reflecting" point of the circular sweep direction-finding antenna of the "passive" spacecraft. The interrogator signal is transmitted over this antenna in the docking zone.

Measurement of the angular coordinates in this arrangement is possible until the spacecraft makes mechanical contact, since in this case, there is still some distance between the corresponding antennas of the spacecraft so that the alignment diagrams retain their shape.

STAGES OF MUTUAL ORIENTATION

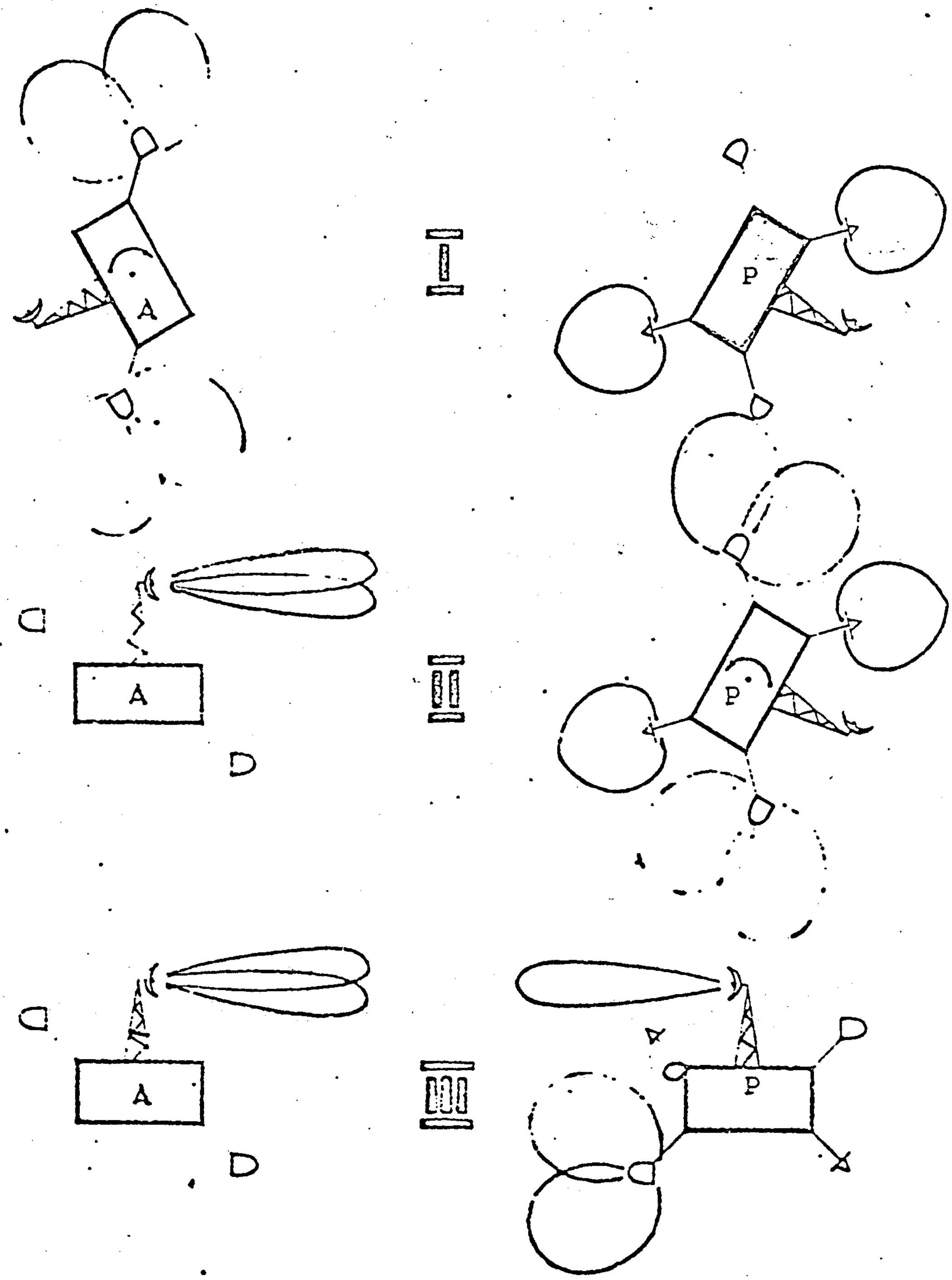


Figure 1

R and Ṙ MEASUREMENT

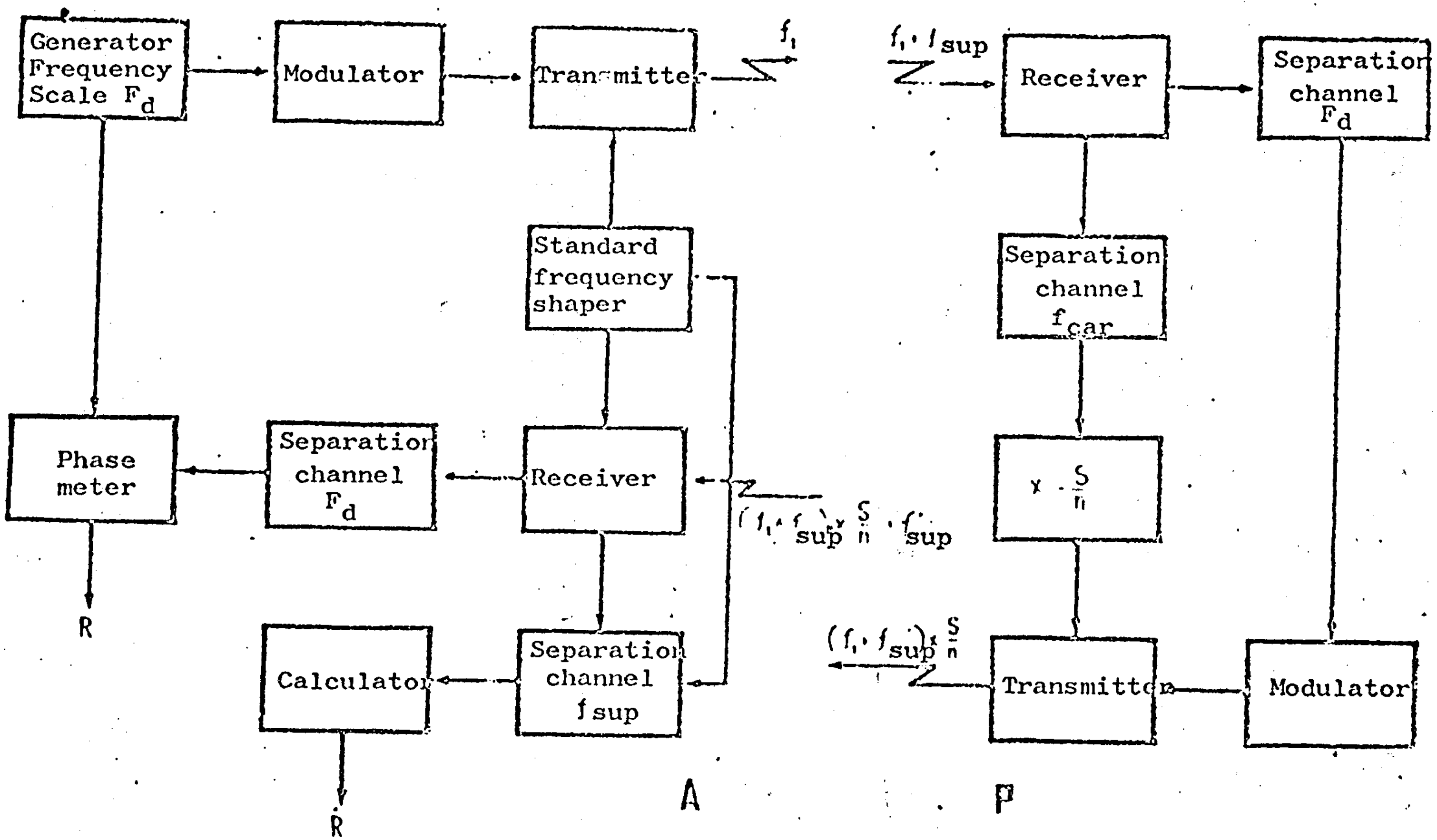


Figure 2.

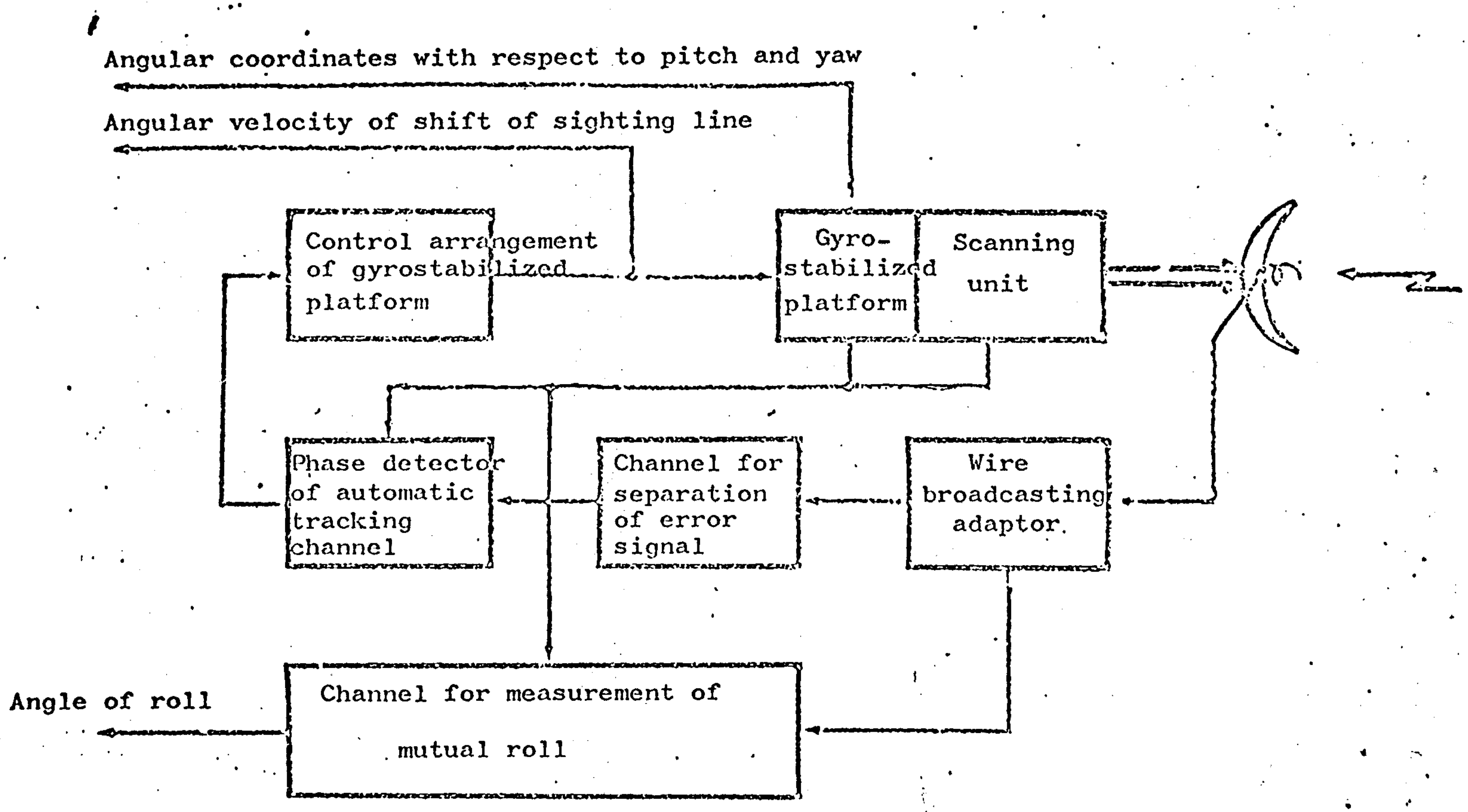

Angular coordinates with respect to pitch and yaw
Angular velocity of shift of sighting line
Control arrangement of gyrostabilized platform
Gyro-stabilized platform
Scanning unit
Phase detector of automatic tracking channel
Channel for separation of error signal
Wire broadcasting adaptor.
Angle of roll
Channel for measurement of mutual roll

Figure 3.

DIAGRAM OF THE POSITION OF THE ANTENNA ASSEMBLIES

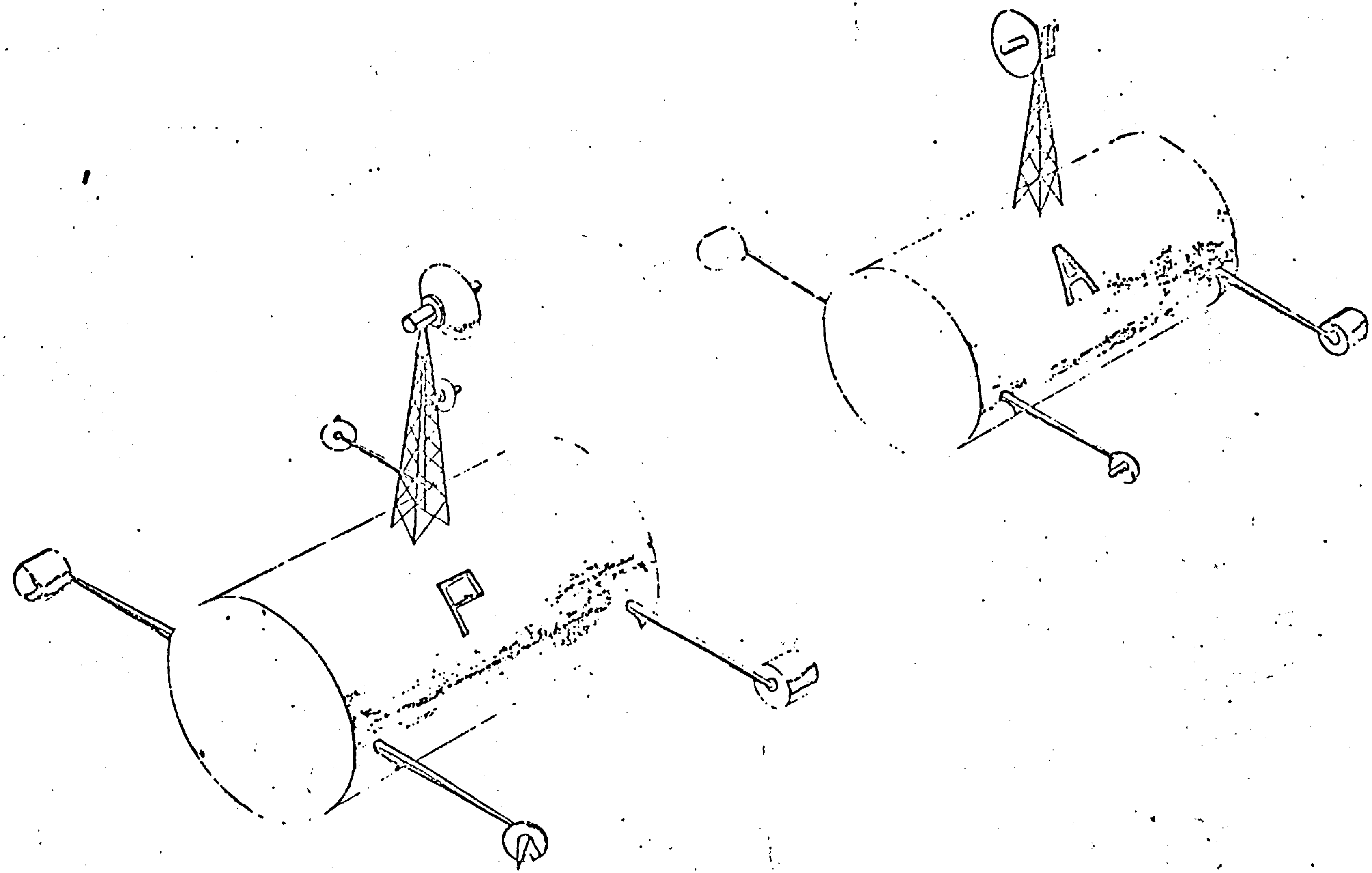
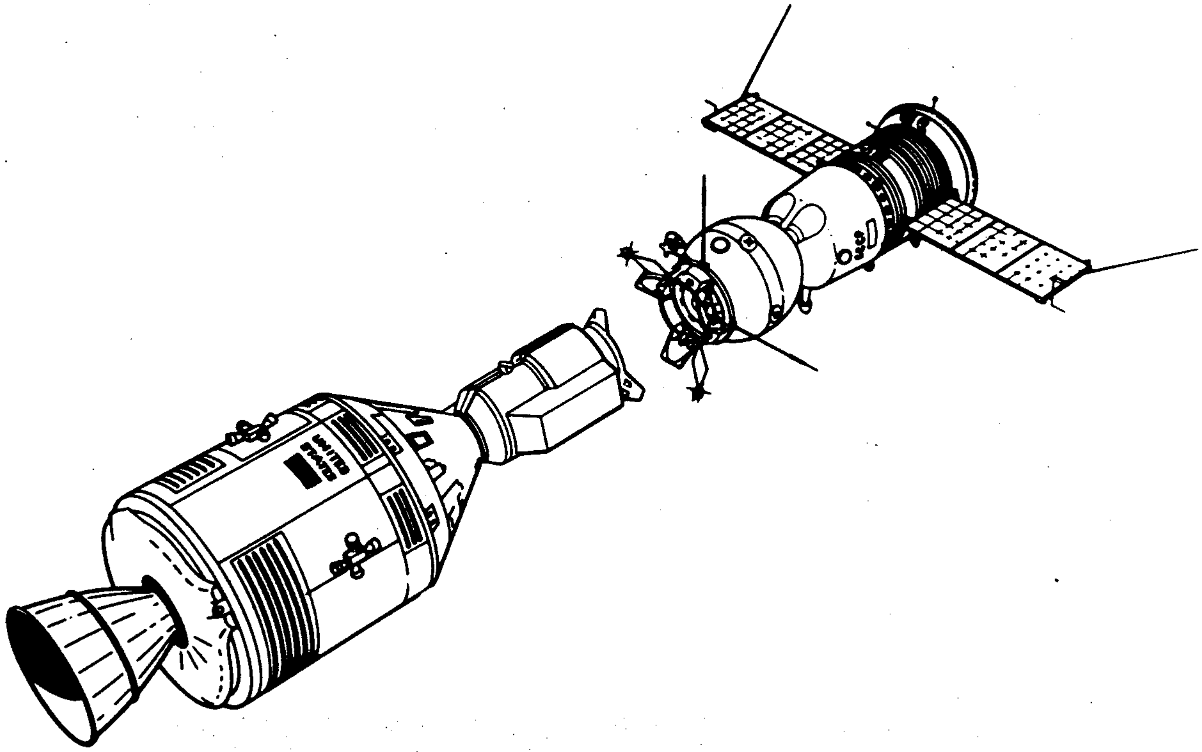


Fig. 4

ASTP 20202
APRIL 30, 1974

APOLLO SOYUZ TEST PROJECT



SAFETY ASSESSMENT REPORT FOR SOYUZ PROPULSION AND CONTROL SYSTEMS

USA - USSR

ORIGINAL	USA		R. Lavroff	H. E. Smith	G. S. Lunney 5/3/74
ОРИГИНАЛ	СССР	O. Babkov	E. Safonova	V. Legostayev	K. Bushuyev
REISSUE NO.	COUNTRY	PREPARED	TRANSLATION VERIFIED	WORKING GROUP CHAIRMAN	DIRECTOR
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TITLE

SAFETY ASSESSMENT REPORT FOR SOYUZ PROPULSION AND CONTROL SYSTEMS

ЗАГЛАВИЕ

ОТЧЕТ ПО ОЦЕНКЕ БЕХОПАСНОСТИ СИСТЕМЫ ОРИЕНТАЦИИ И УПРАВЛЕНИЯ ДВИЖЕНИЕМ КОРАБЛЯ "СОЮЗ"

APOLLO/SOYUZ
"АПОЛЛОН-СОЮЗ"
TEST PROJECT
ЭКСПЕРИМЕНТАЛЬНЫЙ ПОЛЕТ

SCALE
МАСШТАБ

DOC. NO.
№ ДОКУМЕНТА

SHEET 1 OF 54
ЛИСТ ___ ИЗ ___

REVISION LOG

REVISION NUMBER	CHANGE SUMMARY NO.	DESCRIPTION OF CHANGE	COUNTRY	DATE APPROVED

JSC Form 193 (Dec 73)

CONTENTS

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LIST OF FIGURES

LIST OF ABBREVIATIONS

BVDPO	The control assembly of the docking and orientation engines
BDUS	The sensor unit of angular rates
BKID	Ionic sensors switching unit
BS	The stabilization assembly
BTsI	The digital display unit
DO	Orientation engines (1 kg)
DKD	Backup corrective engine
DPO	Docking and orientation engines (10 kg)
ID	Ionic sensor
IKV	Infrared vertical sensor
IKP	Program monitoring display
IRO	Manual pulse orientation
IU	Integrating accelerometer
K	Roll
T	Pitch
R	Yaw
KSU	Command signal device
KEI	Combined electronic instrument
KLP	Switching-logic instrument
PVU	Program timing device
PD	Instrument panel
PK	Cosmonaut Control Panel
RO	Manual orientation
RUL	Left control knob (translation hand controller)

RUP	Right control knob (rotational hand controller)
SD	Sun sensor
SIO	Docking and orientation engine system
SKD	Main corrective engine
SKDU	Main and backup corrective engine system (SKD and DKD)
SOUD	Attitude and motion control system
SUS	Control system for descent
TE	Shade gauge
URD	Control thruster
ELS	Electroluminescent Indicator

INTRODUCTION

1.0 This report gives a brief description of the attitude and translation control system of the Soyuz spacecraft and its associated instruments. The following are represented:

1. A block diagram of the system.
2. Interfaces inside the system.
3. Attitude and translation control system modes.

The objective of this report is to provide the necessary information on the adequacy of the control system design to assure its flight safety.

2.0 THE PURPOSE AND CONSTITUENTS OF THE ATTITUDE AND TRANSLATION CONTROL SYSTEM OF THE SOYUZ SPACECRAFT

The attitude and translation control system (SOUD) is designed to perform the following functions:

1. The modes of attitude maneuvering and attitude hold of the Soyuz spacecraft.
2. The stabilization of the spacecraft when using the main and backup corrective engine system (SKDU).
3. Control during docking.

The SOUD hardware consists of command sensors, converters, switching logic instruments, attitude reference displays, and control knobs (hand controllers), the docking and orientation engine system, and the main and backup corrective engine system. The block diagram of the SOUD of the Soyuz spacecraft is given in Figure 1. Command sensors provide input information on attitude and angular rate in automatic modes. The output signals of these instruments are sent to the control assembly of the docking and orientation engines (BVDPO). In this assembly the signals from sensors are summed and are converted into the commands to the docking and orientation engines (SIO). Attitude control of the spacecraft is provided by the operation of the SIO control thrusters.

In manual control modes, the information on the spacecraft angular position is provided to the crew through the visual monitoring equipment, and the crew generates signals via the rotational and translational controllers (knobs) to the SIO control thrusters.

2.1 COMMAND SENSORS

2.1.1 Infrared Vertical Sensor

The infrared vertical sensor (IKV) is an optical electronic instrument, which measures the angular misalignment of the spacecraft $-OY_{C4}$ axis and the local vertical.

The IKV uses the earth's and earth atmosphere's infrared radiation and converts it into command signals along the pitch and roll channels.

The crew visually checks attitude by means of optical devices and if necessary switches on the mode of manual orientation from the PK and performs orbital attitude manually.

2.1.2 Ionic Sensor

The Ionic sensor (ID) is an electronic device, which measures the misalignment of the Soyuz spacecraft OX_{C4} axis from the orbital velocity vector. The ID uses the incident ion flow on the spacecraft and converts it into command signals along the pitch and yaw channels. Three ionic sensors are installed in the spacecraft: two along $+ X_{C4}$ axis and one along $- X_{C4}$ axis. The selection of an ionic sensor and its control switching are accomplished by a command from the ground or cosmonaut control panel (PK).

The sensor selected is tested in that SOUD mode using ionic sensors. The test results either confirm the selected sensor's operational readiness or provide for automatic switching to the other sensor.

During the flight in the docked configuration the ionic sensors are not used for control.

2.1.3 Sun Sensor

The sun sensor (SD) is an optical-electronic instrument, producing a signal of the solar attitude misalignment of the spacecraft $+OY_{C4}$ axis. The central zone of the sensor generates a signal indicating that the sun is within ±6° of the sensor line-of-sight axis. The crew monitors the attitude by means of the shade gauge If the sensor fails, solar orientation is performed manually.

2.1.4 Gyro System

The gyro system consists of two free gyros, each gyro with two gimbals. Both gyros are used simultaneously. The gyro system provides for selected inertial attitude hold of the spacecraft and performs attitude maneuvers about the roll and yaw axes from 0° to 360°. Attitude change maneuvers are performed consecutively about the roll and yaw axes.

The maximum allowable angular deviation of the spacecraft relative to the reference value about any axis (including the pitch axis) is ±8°.

During gyro system operation, attitude rate signals supplied by the angular rate sensor unit (BDUS) are used. The gyro system does not contain additional angular rate sensors. If the angular deflection with gyro system operation exceeds ±8°, an "emergency" signal is generated which automatically disables the SOUD. Gyro system functions are duplicated by the rate gyros in the angular rate integration mode (see 2.1.6).

2.1.5 Integrating Accelerometer

The integrating accelerometer measures the velocity increment projection onto the $-X_{C4}$ axis. It is used with main and backup corrective engine system (SKDU) operation. The preset velocity increment (settings) is fed into the integrating accelerometer prior to the engine firing. Upon achieving the preset incremental velocity, the engine is automatically shut off.

The integrating accelerometer is tripled and works by voting. The incremental velocities are displayed on the digital display unit (BTsI).

2.1.6 Sensor Unit of Angular Rates

The angular rate sensor unit (BDUS) is an electronic gyroscopic instrument, which contains three rate gyros and forms the signals, proportional to the projections of the spacecraft angular rate vector on the OX_{C4}, OY_{C4}, and OZ_{C4} axes. On command from the cosmonaut control panel (PK), the BDUS can be switched into a mode which, in addition to the rate signals, also forms signals proportional to the integral of the respective angular rates. In this mode, the BDUS provides the inertial or orbital attitude hold of the spacecraft and makes it possible to implement programmed maneuvers about the roll, pitch, and yaw axes. Also, it generates an "emergency" signal if the magnitude of the angular deviation of the spacecraft from the reference direction in any of the three axes exceeds ±6°. In this case, the subsequent activity is defined in Section 3.1.2.

Two BDUS systems are installed in the spacecraft; one in the instrument module and the other in the orbital module. During SOUD operation, one BDUS is operational and the other is powered off and on standby. It takes less than 1 minute for the BDUS to become operational. Switchover of the sets is performed by a command from the ground or from the PK. BDUS malfunctioning is identified by the loss of spacecraft attitude hold and a "emergency" light on the PK. The "emergency" signal is also telemetered to the ground station.

2.2 CONVERTERS AND SWITCHING LOGIC INSTRUMENTS

2.2.1 Control Assembly of the Docking and Orientation Engines

The control assembly of the docking and orientation engine (BVDPO) is an electronic device, located in the instrument module, which performs the summation of the signals of command sensors, amplifies them, and converts them into commands which fire the SIO control thrusters.

The BVDPO also switches the signals from command sensors and the hand controllers and forms the pulse train commands. For each of the X, Y, Z control axes in BVDPO there are three identical electronic units which generate "switch-on" commands of SIO thrusters by voting. These three units are powered by three independent buses through separate circuit breakers, switching off the corresponding bus in case of a current overload.

The firing of any DO thrusters (1 kg.) illuminates the light "DO thrusters" on the electroluminescent indicator (ELS) (fig 7) for the time of firing. Firing of any DPO thrusters illuminates the light "DPO thrusters" on the ELS for the time of firing.

Minimum pulses for deflection of the RUP are generated by a separate device in the BVDPO. This device is tripled and operates by voting. This device is powered from the same buses that are used for the above mentioned primary electronic units of the BVDPO.

2.2.2 Stabilization Assembly

The stabilization assembly (BS) is an electronic device, located in the instrument module of the spacecraft, which sums the signals from the gyro system and from the BDUS, amplifies them and forms control commands to the drivers of the backup corrective engine (DKD). The function of the DKD drivers is to provide linear control of special thrusters located near the SKDU and generating the spacecraft stabilization control torques.

2.2.3 Ionic Sensors Switching Unit

The ionic sensors switching unit (BKID) analyzes the condition of the active ionic sensor in control and if failures occur, switches to the backup ID.

2.2.4 Program Timing Device

To perform any SOUD mode (for example, orientation, attitude change maneuver, orbit correction), it is necessary to follow a particular operation sequence (on and off switching of equipment, preparatory operations such as warmup or gyro runup, initialization of attitude change maneuvers, SKDU on and off switching, etc.). All of these operations can be accomplished from the PK, if desired; however, to reduce the cosmonaut's work load, it is possible to perform a particular set of such sequences ("fixed programs") on command from the PK or the ground. These functions are performed by the program timing device (PVU).

The PVU is redundant in such a way that a single failure of any element does not cause any malfunction. The crew is also able to switch off the PVU by issuing a command through the command signal device (KSU) and issue all the necessary commands manually.

2.2.5 Switching Logic Instrument

The switching logic instrument (KLP) processes the commands, which enter through a radiocommunication line, from the PVU, and the PK and distributes them to the appropriate equipment. The KLP is redundant in such a way that a single failure of any element does not cause any malfunction.

2.3 VISUAL ORIENTATION INSTRUMENTS AND HAND CONTROLLERS

2.3.1 The Right Control Knob (Rotational Hand Controller)

The right control knob (RUP) makes it possible for crew to perform attitude maneuvers around any axis of the spacecraft in a proportional rate command mode and in a pulse mode. The RUP has three degrees of freedom (Figure 2), corresponding to the "roll", "yaw", and "pitch" (K, R, T) control channels. The control stick grip is returned by springs to the neutral position. This position is fixed. The characteristic of the output signal of the stick along each axis is piecewise-linear. The force on the stick is expressed by the same relationship. At the break point of the output curve, the force necessary to deflect the stick increases, acting as a "soft detent". Furthermore, at full displacement of the stick along each axis there are contacts. In the pulse control mode the closing of the end contacts generates a single SIO thruster pulse of a fixed time interval.

The signal, from the stick in the "soft detent" position, corresponds to a rate command of 0.5 degrees/second in the pitch and roll axes, and 1 degrees/second in the yaw axis. The rate achieved by the spacecraft with hard detent position of the stick is 3 degrees/second in all three control channels. Power to the RUP is applied by calling the manual orientation control mode on the PK.

The Right Control knob (RUP) can be used in two operational modes - for orientation and for manual approach. In the mode of manual approach, in contrast to Figure 2, the roll and yaw channels are interchanged due to the 90° rotation of the periscope head. This RUP switching is automatic with on and off switching of the SOUD "manual approach" mode.

In the modes when the RUP is not used, it is powered down and does not generate any signals to the control system.

2.3.2 The Left Control Knob (Translational Hand Controller)

The left control knob (RUL) controls the translation of the spacecraft's center of mass. It permits the crew to perform translations of the spacecraft along the Y_{C4} and Z_{C4} axes. The toggle switch on the RUL commands thrusters on and off to provide translation along the $\pm X_{C4}$ axis. RUL contacts close at the end of

RUL travel. In the modes when the RUL is not used, it is powered down and does not generate any signals to the control system.

2.3.3 Sighting Device (Periscope)

The sighting device is an optical device, arranged in the descent vehicle, for viewing the earth and/or for viewing the other spacecraft during docking. The sighting device has central and peripheral fields of vision. The central field provides a view in the direction of the optical axis of the instrument with a field of view of ±7.5°. The peripheral field makes it possible to view objects, arranged in a zone from 71° to 84° from the axis of the instrument. The images of the central and peripheral optical systems are projected onto a common screen (Figure 3). The sighting device is equipped with a rotary periscopical head. During the docking of the spacecraft it is possible to rotate the central optical system through an angle of 90° so that the line-of-sight axis would coincide with the longitudinal axis of the spacecraft. This rotation is performed by command from the KSU. With the sighting device, the crew can orient the spacecraft $-OY_{C4}$ axis along the local vertical, and the OX_{C4} axis along the desired course angle. Orientation to the local vertical is performed while observing the local horizon in the peripheral field of view. During the orientation of the spacecraft along the local vertical the horizon is symmetric relative to the center of the screen. Course orientation is performed by a viewing the movement of the earth's landmarks on the screen of the sighting device. A reticule on the screen of the central field of sight makes it possible to monitor a course angle, and also to determine angular dimensions and the relative location of the other spacecraft.

2.3.4 Shade Gauge

Shade gauges (TI) are located outside the descent vehicle at the right and left windows. The TI makes it possible for a cosmonaut to perform a rough visual check of the orientation of the spacecraft with respect to the sun. The gauge is a transluscent screen with a rod mounted in the center of the screen. With the spacecraft oriented toward the sun, the shadow of the rod is minimal. A circle is drawn on the screen concentric with the rod mounting point. When the shadow of the rod falls within the circle, the spacecraft $+OY_{C4}$ axis is aimed at the sun within ±10°.

2.4 COSMONAUT CONTROL PANEL

The cosmonaut control panels (PK) are used for the display of information and for control of the spacecraft systems. During the operation of the attitude and translation control system, the consoles of the two command-signal devices (KSU) and the instrument panel (PD) of the descent vehicle are used. The control panels contain command instrumentation, displays of information, warning displays, and communication controls.

2.4.1 Command Signal Devices

The command signal devices (KSU) are intended for the control of spacecraft systems and units, the confirming the execution of commands, and monitoring the condition of units and systems. The KSU consists of a left and a right command signal device (see Figures 4 and 5). Switching on of the left KSU panel, the right KSU panel, or of both simultaneously, and also their switching off is done from the instrument panel (Figure 11). On the panel of the KSU are:

1. Sixteen keys for the selection of systems or modes with associated titles.
2. A display with 16 electroluminescent windows.
3. Twenty-four numbered command keys for on and off switching.

The selection of appropriate SOUD matrices in the display windows: Orientation Modes, Prep. for Descent Orientation, Settings, Programs, Reserve System, Combined Electronic Instrument (KEI), is performed by depressing the appropriate keys. The selection of the Reserve System Mode (fuel systems for the SIO and SKDU) can be switched on only after overriding the interlock on the PD. After the indicated commands appear in the front window panel of the displays, the required function is switched on by depressing the "ON" key located beside them. The execution of the command is confirmed by the illumination of an electroluminescent indicator. The display indicates execution of a command regardless of its source (from the ground through the radio communication link, from the PK through the KSU, and the PVU). For the switching off of a unit, the appropriate "OFF" key is depressed. The selection keys of a system or mode, as well as the "ON" and "OFF" switching keys, have mechanical interlocks, which prevent simultaneous depressing of more than one key.

2.4.2 The Instrument Panel

The instrument panel (PD) of the descent vehicle is intended to provide the crew with the information on the operation of the spacecraft primary systems. The instrument panel (PD, see Figure 6) is composed of: the program monitoring indicator (IKP), the digital display unit (BTsI), combined electronic instrument (KEI), the elctroluminescent indicator (ELS), (Figure 7), and the critical command unit (Figure 11).

2.4.2.1 Combined Electronic Instrument

The combined electronic instrument (KEI) is used for the monitoring of the SOUD analog parameters and of other spacecraft systems. In manual control system operation the KEI functions in two modes. In the television mode, the instrument makes it possible to observe another spacecraft during rendezvous and docking. In an "unrastered" mode of the instrument (CRT), the KEI displays the signals of the ionic sensor. The position of the longitudinal axis of the spacecraft relative to the direction of the incident ionic flow is depicted as a luminous spot on the face. The deflection of the spot from the center of the screen is proportional to the displacement angle. The displacement of the spot along a vertical axis corresponds to an angular deviation with respect to the pitch channel. Displacement along the abscissa corresponds to deviation with respect to the yaw channel. A displacement at the edge of the screen corresponds to OX_{C4} deviation from the direction of the incident ionic flow of ±9°. The KEI can also monitor pressure in the SIO.

2.4.2.2 Program Monitoring Display

The program monitoring display (IKP, see Figure 8), monitors the progress of a program called for by the onboard program-time system (PVU).

IKP makes it possible to determine the content of the monitored program, elapsed program time in a monitored program on a time scale, and the time of command execution indicated by extinguishing of light indices.

2.4.2.3 Digital Display Unit

The digital display unit (BTsI, Figure 9) serves for the manual input and the monitoring of automatic settings into the SOUD, for monitoring the remaining propellant of the SKDU, and the spacecraft incremental velocity due to thrusting.

The BTsI is a system of electromechanical counter enabling the cosmonaut to monitor and introduce angular settings (α_x, α_y, $\dot{\alpha}_z$) and a velocity increment value ("impulse"). The register "RESOURCE" indicates the amount of remaining SKDU propellant at a given moment. Input of automatic settings is monitored through the digital data of the BTsI.

On the BTsI, there is a light "DKD" which lights up when the DKD is selected.

2.5 DOCKING AND ORIENTATION ENGINE SYSTEM

The docking and orientation engine system (SIO), utilized during orientation and translation of the center of mass, includes the control thrusters operating on hydrogen peroxide. There are two sets of thrusters: orientation engines (DO) with 1 kg thrust, and the docking and orientation engines (DPO) with a 10 kg thrust. The latter are utilized in the high torque modes: stabilization during operation of the main corrective engine (SKD), for the translation of the spacecraft during docking, and also in other modes of control. DO and DPO are not used simultaneously. There are no thermal constraints for SIO operation.

The pressure and fuel feed components of the SIO (Figure 10) system are:

1. A pressure feed system (primary and backup)
2. A fuel feed system (primary and backup)
3. Control thrusters (URD)

During the preparation of the SIO for operation, the electrically operated valves of the gas supply of the pressurization system and the electrically operated valve of a fuel feed are opened. Electrically operated valves in the mains of the pressurization and fuel systems have backup pyrotechnic valves. Gas from a spherical tank is supplied to a pressure regulator and pressurizes the fuel. On command of the BVDPO, the electrically operated valves of the control thrusters (URD) feed fuel into the control thrusters. At the end of an orientation mode, the electrically operated gas supply valve of the pressurization system and the electrically operated fuel feed valve are shut off. After depletion of propellant from the primary tanks, switchover to a reserve fuel tank is performed. The switchover from of the fuel tanks can be commanded from either the ground or from the PK. It is possible to feed from both tanks simultaneously. In the case of a pressure leak of one of the pressurization system, fuel pressurization is provided by the other system. For this case, the pressure crossfeed is opened and the failed pressurization system is isolated.

When selecting engines DO and DPO the electrically operated fuel feed valve for the corresponding fuel system is opened. The mains, connecting the fuel systems, are normally opened. Pyrotechnic valves allow separate operation of the DPO off the main fuel system and the DO off the backup system. Maximum working pressure in the fuel system is 15.5 kg/cm^2. Test pressure is 18.5 kg/cm^2.

URD operation is telemetered. Firings of the URD are displayed on a signal panel in the form of the signals:("СОПЛА ДО") and("СОПЛА ДПО" Gas pressure in the pressurization system, and the temperature of the primary elements of the SIO are monitored on the combined electronic instrument (KEI) and by telemetry.

If any of the thrusters fails-on, it is necessary to switch over from the DO system (1 kg) to the DPO system (10 kg) or vice versa by command from the PK or ground station.

2.6 DESCENT VEHICLE ORIENTATION ENGINES

In the descent vehicle there is an additional system of orientation thrusters, which operates on the commands of the descent control system (SUS). The switching on of the SIO SUS is inhibited until the commands to separate the spacecraft modules is given. During orbital flight of the spacecraft, the primary SIO SUS parameters are monitored on the combined electronic instrument (KEI) and by telemetry.

2.7 MAIN AND BACKUP CORRECTIVE ENGINES

The main and backup corrective engine system (SKDU) of the Soyuz spacecraft consists of two engines:

- the single chamber (main) corrective engine (SKD);
- the dual chamber (backup) corrective engine (DKD).

The switching of either SKDU engine is performed by the spacecraft automatic equipment in accordance with the corresponding PVU program upon receipt of a go ahead signal from the control system (SOUD). The crew can also cancel the program and fire the engine manually from the control panel (PK) using the following sequence:

- the depression of the command key "БЛОК ВЫКЛ"
- the removal of mechanical interlock from the button "SKDU ON";
- command input to the "SKDU ON" (Figure 11).

Monitoring of the switching on of the SKDU is provided by the "SKDU ON" light on the ELS (Figure 7). Simultaneously with the SKD, only the DPO engines are used.

3.0 OPERATIONAL MODES OF THE CONTROL SYSTEM (SOUD)

Attitude control of spacecraft can be performed in automatic or manual modes. The crew has the capability of selecting the mode of control from the KSU console.

The switching and operation of the automatic mode is performed by starting the program timing device (PVU) through the command signal system (KSU) or by radiocommunication command. It can also be accomplished by sequential crew inputs commands from the KSU. The manual modes of spacecraft attitude control are turned on by KSU commands.

3.1 AUTOMATIC CONTROL MODES

In automatic control modes; the following functions are performed:

- orbital orientation;
- orbital or inertial attitude hold;
- program attitude maneuvers;
- orientation to the sun;
- stabilization during the SKDU operation.

3.1.3 Orbital Orientation

The mode of orbital orientation is performed using an ionic and the infrared vertical sensors. The following instruments are used in this mode: ID, IKV, BDUS, BVDPO, and DO SIO.

The IKV is used to orientate the $-OY_{C4}$ spacecraft axis to the center of the earth and provides analog signals of angular errors in the pitch and roll channels. The orientation in the yaw channel is provided by the ionic sensor, by means of analog signals of angular errors. The pitch channel is provided a rate command input to compensate for orbital rotation.

Deadbands of the SIO thruster ignition in this mode are 1 to 2 degrees in angle and 0.07 degrees/second in angular rate.

3.1.2 Attitude Hold

The inertial attitude hold mode is performed in two versions: with or without the use of the gyros. In the first case, the attitude signals are generated by the gyro system and angular rates are generated by the BDUS. In the second case, the attitude signals and angular rate signals are generated by BDUS.

The following instruments are also used in this mode: BVDPO and SIO thrusters. The SOUD provides inertial orientation in all three axes with angular deviations not more than 1°.

Whenever the spacecraft attitude while in an inertial attitude hold mode (including program attitude maneuvers) deviates in any axis by an angle greater than 6° from the reference attitude using the BDUS, or 8° using the gyros, an emergency signal "АВАРИЯ" is generated.

In case of the "Emergency" command from the gyro system the SOUD is switched off and the light "Modes OFF" on KSU comes on. If the gyro system fails there is still a capability of reestablishing the reference for orbital and inertial attitude hold modes, maneuvers and stabilization during the SKDU operation both automatically and manually. In this case it takes less than 15 minutes to establish the orbital orientation. If necessary this time should be extended for the time needed for the maneuvers with a rate of +0.45° per sec.

In case of the "Emergency" command when BDUS is used, the light "АВАРИЯ" on ELS and on audio signal comes on. If as a result of disturbances, the attitude is changed by more than 7.5° relative to the original reference system, the original reference system is lost. After rate damping, the control system will maintain the new inertial reference system which is determined by the magnitude of the disturbance.

When a BDUS package fails there still remains a capability of all the automatic and manual SOUD modes.

To perform inertial attitude hold the following instruments are used: IKV, BDUS with the integration of an angular rate for the yaw channel, or using the BDUS with the integration of angular rates for all channels.

In both cases, the pitch channel supplies a rate input to the BDUS to compensate for orbital velocity.

The orbital attitude hold is switched on after aligning to the orbital orientation using the IKV and ID sensors or manual modes. To monitor the accuracy of the orbital orientation, the ionic sensor is turned on in the indicator mode and angular information from it is displayed on the KEI. The correction of the errors of the orbital orientation, caused by the drift of the BDUS, is accomplished by periodic reestablishment of the initial orbital orientation.

3.1.3 Program Attitude Maneuvers

In an inertial attitude hold mode, the Soyuz spacecraft can perform attitude maneuvers. This mode can be performed when using either the gyros or the BDUS operating in an angular rate integration mode. Using the gyros the program maneuvers are performed through roll and yaw at angles from 0° to 360° at a maneuver rate of -0.66 degrees/second in roll and +0.66 degrees/second in yaw.

Using the BDUS, the maneuvers can be performed in all three axes at angles from 0 to 360° with a maneuver rate of +0.45 degrees/second.

The maneuver angles are preset either by a radiocommunication command or by the crew through the BTsI and the maneuver sequence is initiated either through inputs from the PVU or cosmonaut commands to the KSU. Also the maneuver angles can be input from a radiocommunication command.

3.1.4 Sun Orientation of the Spacecraft

In the sun orientation mode the sun sensor (SD), BDUS, BVDPO, and DO SIO are used. Sun acquisition is automatic by maneuvering the spacecraft about the pitch axis. After the sun appears in the SD field of view, the spacecraft is maneuvered until the sun is in the central zone of the sensor.

After the alignment of the OY_{C4} axis in the direction of the sun, the SOUD can maintain this orientation with an angular deflection not more than ±6°. Alternately, a rotation can be performed around the OY_{C4} axis at a rate of 2.5 degrees/second, which ensures the gyro spin stabilization of the OY_{C4} axis in the direction of the sun to recharge the batteries with the control system (SOUD) switched off. These modes are initiated either through inputs from the PVU or cosmonaut commands to the KSU.

3.1.5 Stabilization using the Main or Backup Corrective Engines (SKDU)

The inertial attitude stabilization with SKD operation is performed using the BDUS, BVDPO, DPO SIO, and with the gyros or without them (obtaining the angular signals from the BDUS).

In the operation of the backup corrective engine (DKD), the angles and angular rate signals are input to the stabilization assembly (BS), where control commands to the drivers of the DKD are generated. The setting, which defines the magnitude of the corrective or retro impulse, is inserted into the integrating accelerometer either from the PK or from radio link command. The switching on of the stabilization mode is performed by initiating an automatic program either by a radio communication command or the cosmonaut via the PK. The selection of an engine and sensors (BDUS or gyros), which provide angle information, is perform by a preset input command on the PK or by a radiocommunication command.

Just as for other automatic modes, this mode can be implemented by a set of commands from the PK.

3.2 MANUAL CONTROL MODES

In the manual control modes, the SOUD provides:

- damping any initial angular rates;
- the orientation of spacecraft in an orbital coordinate system (local vertical with a given course angle);
- stabilization with SKD operation;
- single axis orientation to the sun;
- docking.

3.2.1 Manual Orientation Mode

In the manual orientation mode (RO) using the BDUS, the cosmonaut determines the magnitude and direction of the angular deviation from the desired orientation by means of the visual monitoring instrument (periscope or shade guage) from TV data or ID data, and moves the right control knob (RUP). The RUP inputs enter the angular rates sensor unit (BDUS) and displace the sensor "null position" by a corresponding angular rate value. The thrusters fire until the control signals become less than the deadband. After this the thrusters are switched off, and the spacecraft continues to rotate at a constant rate. After the angular deviation is reduced to zero, the cosmonaut returns the control knob to the neutral position, and the thrusters damp the angular rate below the rate deadband of the BVDPO. The RO mode is switched on by pressing buttons "K" and "5" on the KSU. The "RO" display is lighted.

3.2.2 Manual Pulse Orientation Mode

The manual pulse orientation mode (IRO) is implemented without the angular rate sensors. The cosmonaut moves the RUP to the stop and closes the contacts. On the closing of the contacts the BVDPO generates a command to the control thrusters for a fixed time interval.

Angular rate increments from a single pulse about the appropriate axis in IRO modes:

	I kg Thrust	IO kg Thrust
roll	0.03 deg/sec	0.077 deg/sec
pitch	0.007 deg/sec	0.06 deg/sec
yaw	0.006 deg/sec	0.06 deg/sec

In order to generate repeated pulses, the control knob must be returned into the neutral position and deflected again. The IRO mode is switched on by pressing the buttons "K" and "7" on the KSU. The "IMPULSE RO" display lights up.

3.2.3 Orbital Orientation

Orbital orientation is established with the aid of the cosmonaut's sighting device. Generally, orientation is attained by searching for the earth by means of a roll channel (K) rotation. Following the first rotation, a maneuver is performed about the pitch channel (T) for the local vertical orientation. The position of the visible horizon in the peripheral field of the sighting device indicates to the cosmonaut the orientation of the spacecraft in the roll and pitch axes.

For proper local vertical orientation, the earth's horizon should appear symmetric in the peripheral zone relative to the center of the periscope screen.

The third rotation is performed in the yaw channel (R) until the direction of motion of the earth's surface in the central field of the sighting device coincides with a given course. Afterwards the cosmonaut can maintain orbital orientation either with or without the use of the BDUS. To establish orientation along the X or Y axes in the RO mode, the ionic sensor or infrared sensor, respectively, can also be used.

3.2.4 Single-Axis Sun Orientation

Single-Axis orientation to the sun is performed in the RO mode. The cosmonaut receives visual data on the sun location from the shade gauge.

3.2.5 Manual Docking Control

Manual control for docking is used to perform a rendezvous from a range (200-300 m) until mechanical contact in the sunlit portion of the orbit. The initial relative velocity in this case must not exceed ±1-2 m/sec. To accomplish docking a target is installed on the passive spacecraft and is observed through the sighting device during the docking portion of the flight.

During manual control of docking the cosmonaut orients the spacecraft along his line of sight, commanding angular rates using the right control knob (RUP), while sighting the target of the passive vehicle through the sighting device. In this case the optical axis of the sighting device is aligned with the OX_{C4} axis. The lateral motion of the center of mass is controlled by the cosmonaut using the left control knob (RUL), and longitudinal motion is controlled using the toggle switch located on the RUL to fire the DPO SIO thrusters. Manual docking control at contact insures maintenance of the docking parameters within the limits for normal functioning of the docking assembly.

3.2.6 Manual Stabilization

For manual stabilization during SKD operation, the cosmonaut maintains attitude control using the right control (RUP) and with the aid of the sighting device. Control in this case differs from the orbital manual mode only by the necessity to compensate for the disturbance torques produced by the SKD.

3.3 OPERATIONAL MODES FOR THE DOCKED CONFIGURATION

For nominal joint mission operations, the Soyuz control system is switched off on capture (on signal from the contact sensors on the docking mechanism). The contact sensors generating the signal to switch off the SOUD are tripled and work in series. In the docked configuration contingency situations can arise which are related to crew safety and require that control of the docked spacecraft be transferred to the Soyuz. In this case, the Soyuz SOUD can be reactivated through crew or ground commands. The required modes of SOUD operation in the docked configuration and the SOUD's capability to perform these operations are to be determined.

4.0 SAFETY ASSESSMENT OF THE CONTROL SYSTEM

The safety of the mission during the operation of the attitude and translation control system is assured by:

- by the redundancy of the SOUD modes;
- by arranging the most important instruments of the SOUD in a configuration yielding reliable performance (BVDPO, for example, is triply redundant); and by the redundancy of command sensors (BDUS - two complete sets, ID - two complete sets), of the SIO thrusters (DO and DPO), and of the corrective engines (SKD and DKD). The switching of these instruments and assemblies is implemented either from the PK or on a radio-link.
- by monitoring on the PK and telemetry the condition of the SKDU, SIO and operation of its engines, and also by the monitoring of the performance of the commands and programs;
- by the selection of the sequence of commands and operations, which eliminate any spurious inputs of commands affecting flight safety.

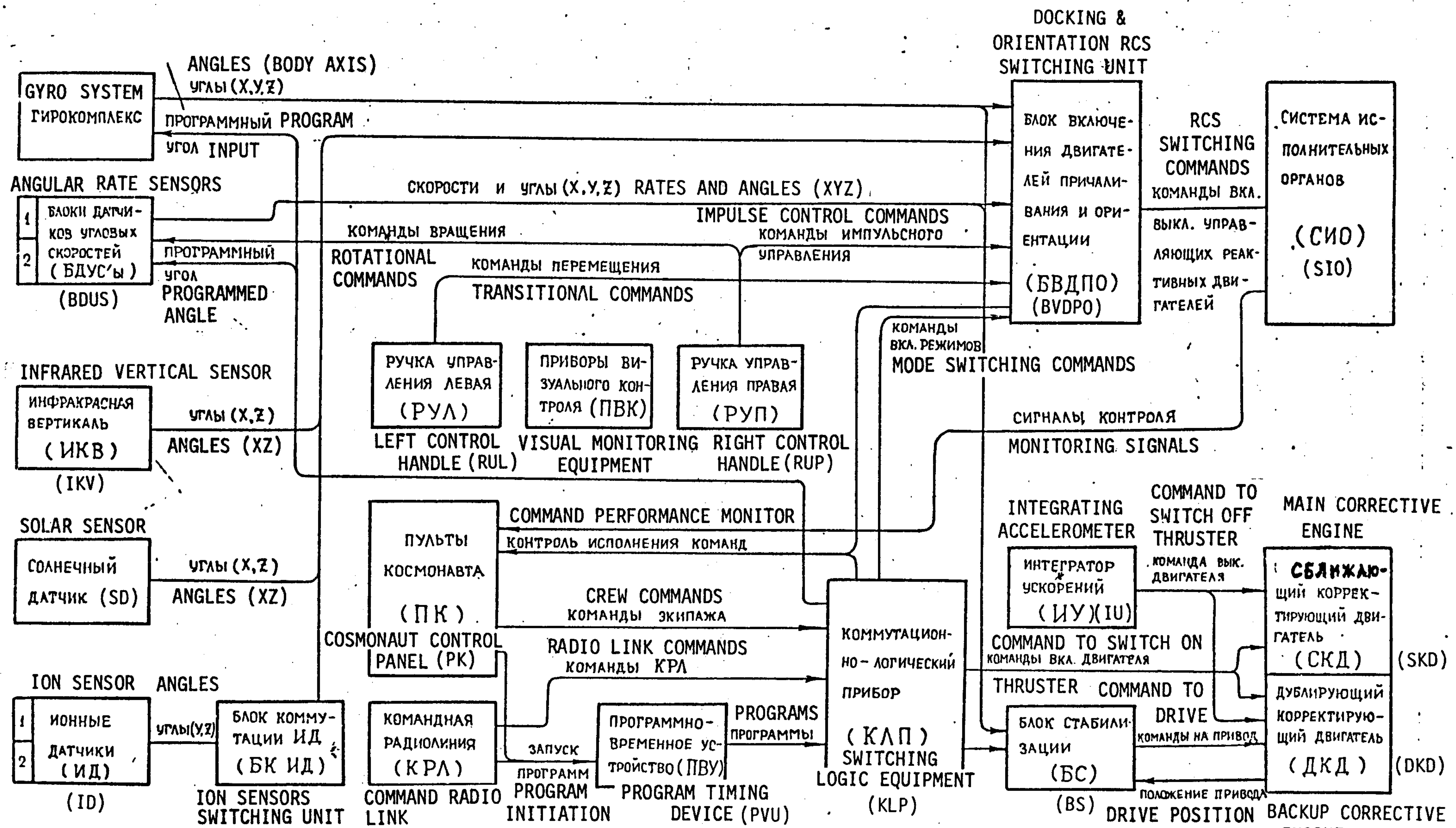

РИСУНОК I. БЛОК-СХЕМА СИСТЕМЫ ОРИЕНТАЦИИ И УПРАВЛЕНИЯ ДВИЖЕНИЕМ

Figure 1. - Block diagram of RCS & Motion Control.

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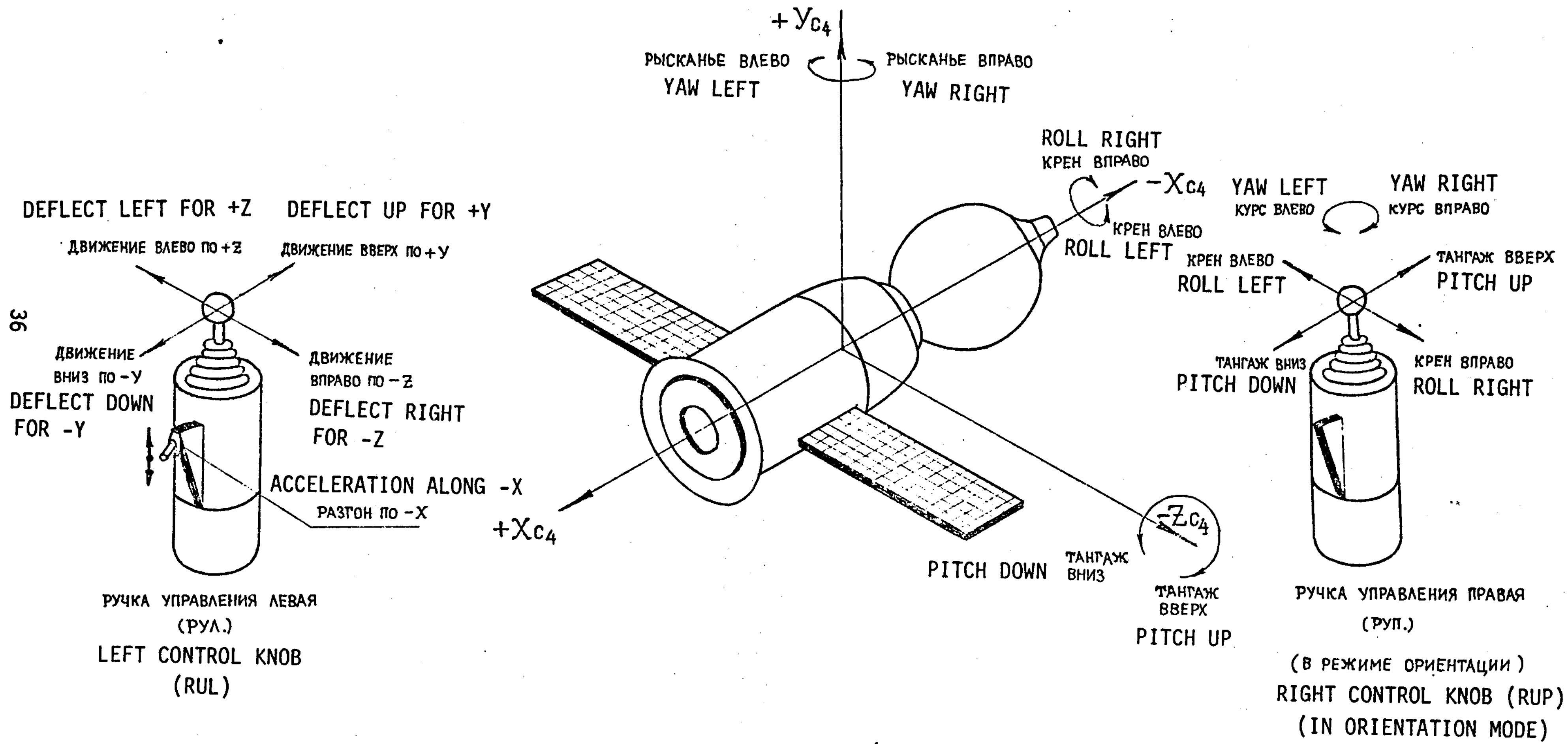

РИСУНОК 2. РУЧКИ УПРАВЛЕНИЯ

Figure 2. - Hand Controllers

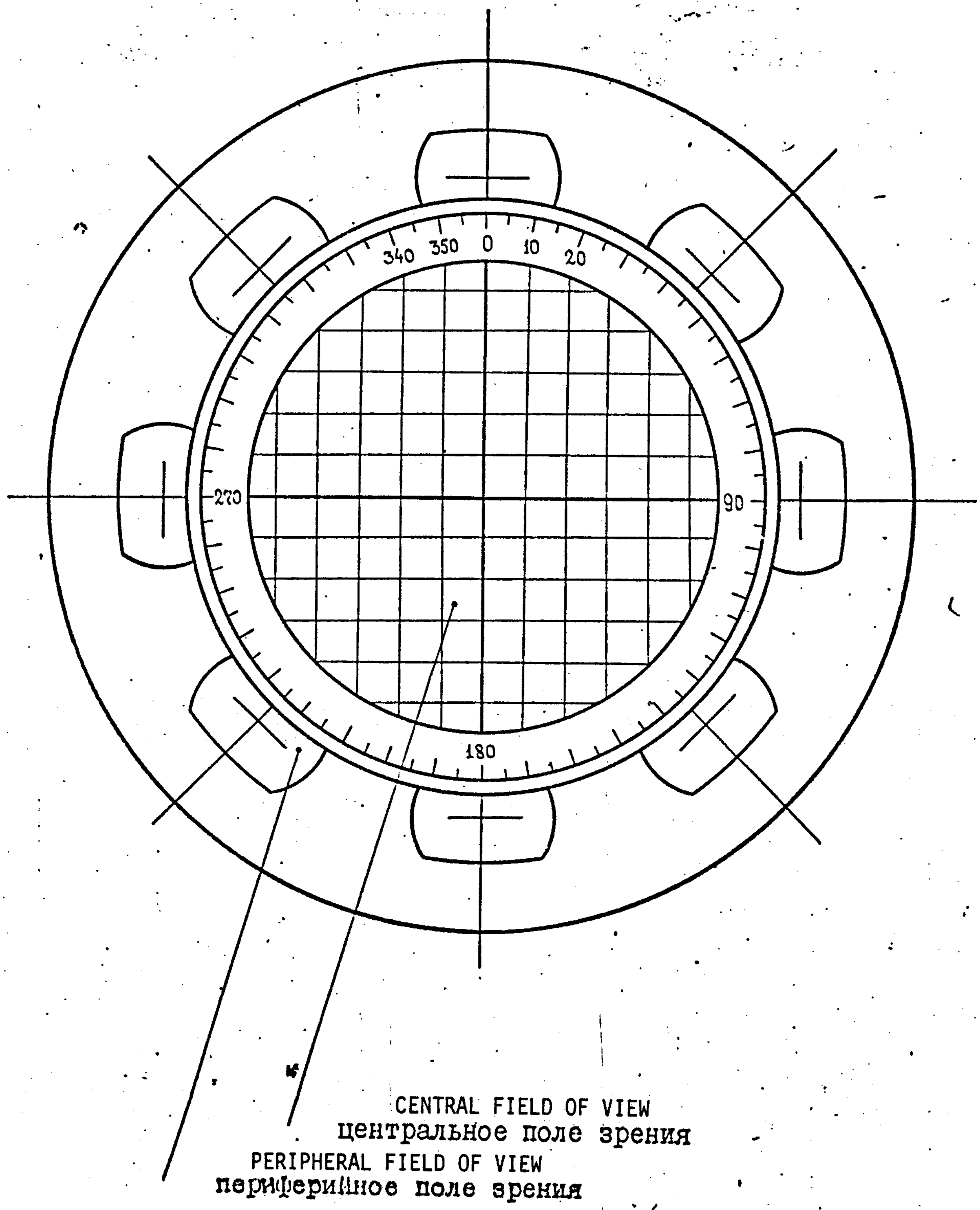

РИСУНОК 3. ЭКРАН ВИЗИРА

Figure 3. - Screen of sighting device (periscope reticule).

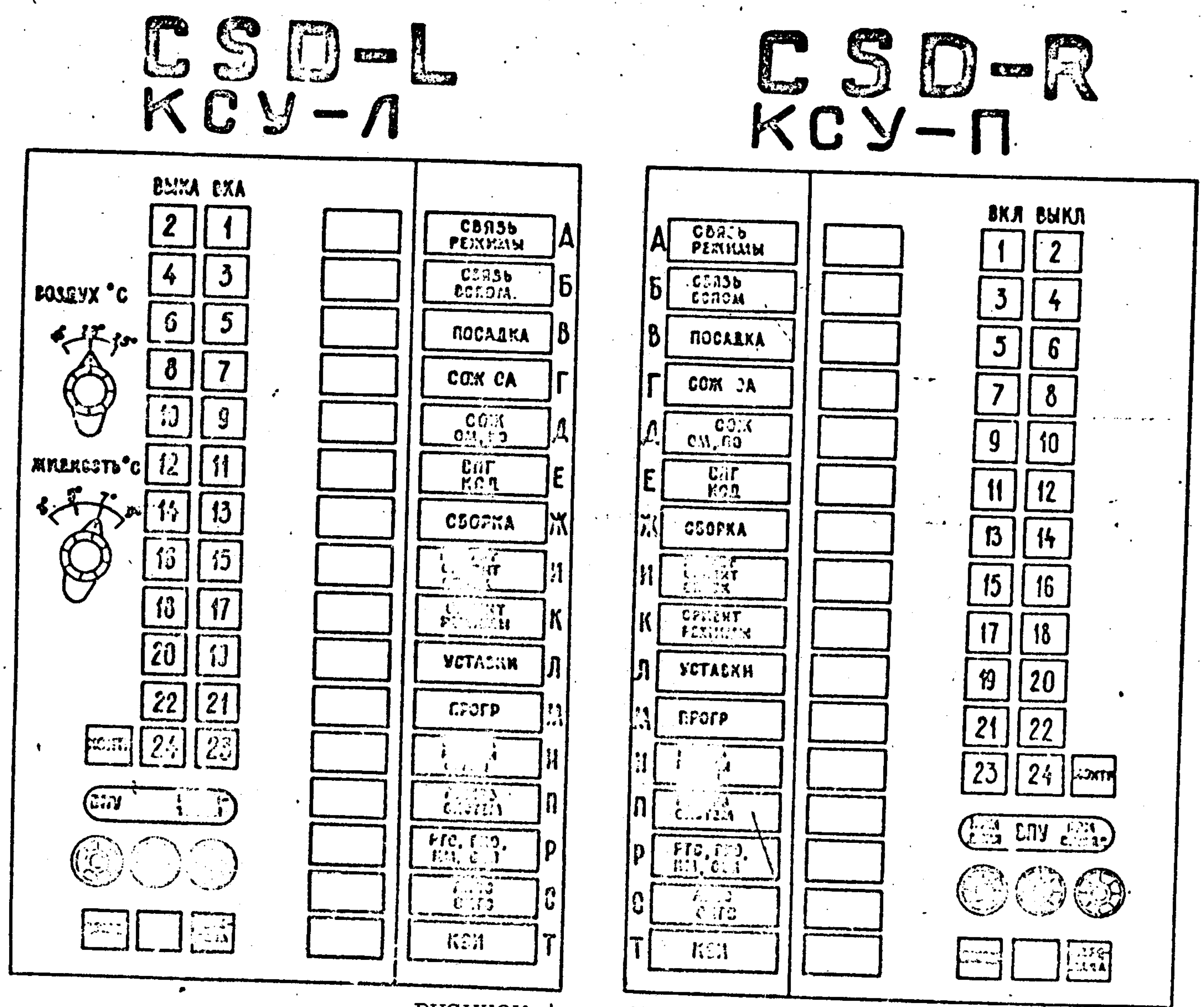

РИСУНОК 4. – КСУ-Л КСУ-П.

Figure 4. - CSD-L CSD-R.

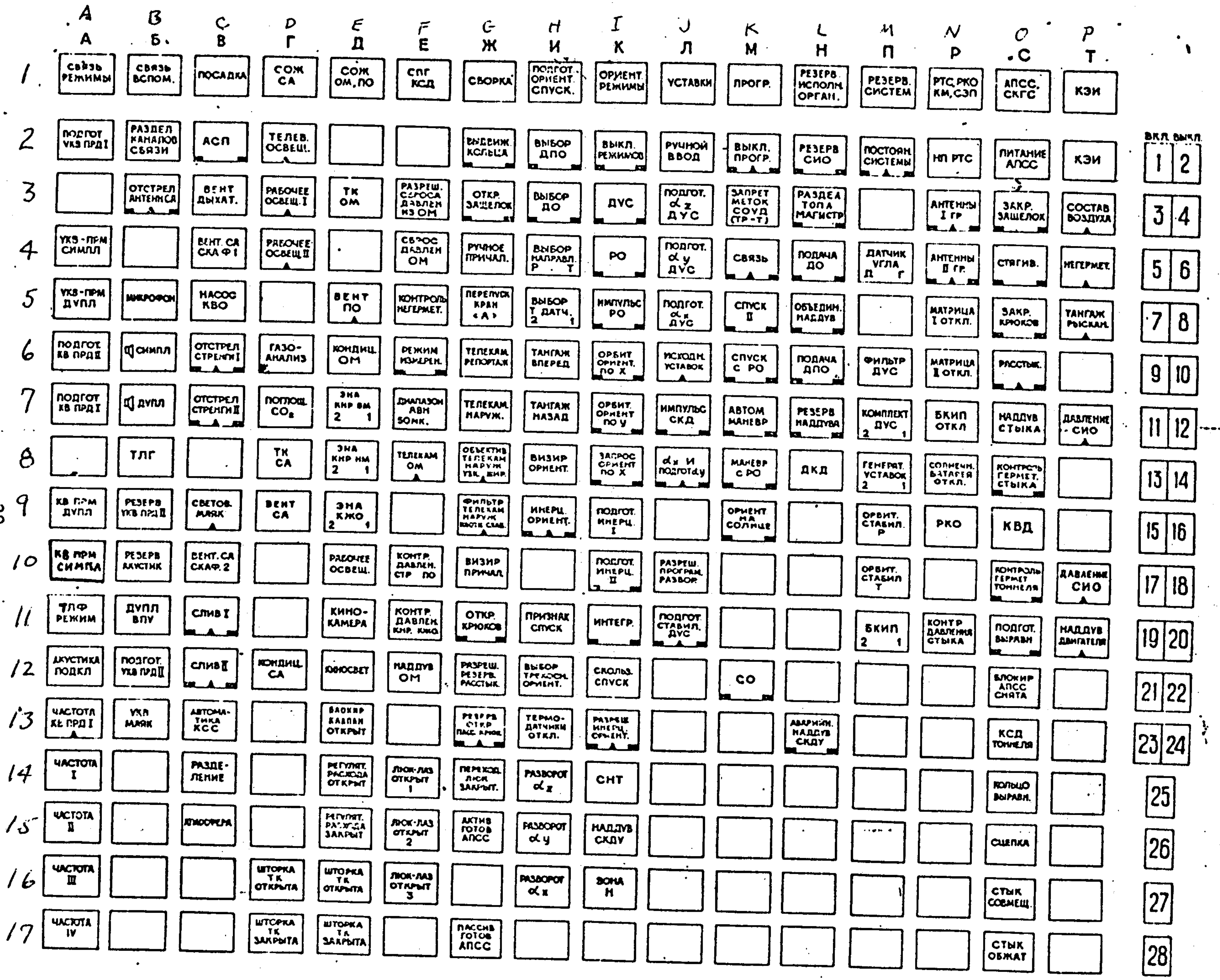

РИСУНОК 5. Транспаранты КСУ

Figure 5. - CSD Control Lights.

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FIGURE 5* (CONT)

1-A	COMMUNICATION MODEL
2-A	PREP, VHF XMTR I
4-A	VHF SIMPLEX RCVR
5-A	VHF DUPLEX RCVD
6-A	PREP, VHF XMTR II
7-A	PREP, VHF XMTR I
9-A	DUPLEX VHF RCVR
10-A	SIMPLEX VHF RCVR
11-A	TELEPHONE MODE
12-A	CONNTCT ACOUSTICS
13-A	VHF XMTR I FREQUENCY
14-A	FREQUENCY I
15-A	FREQUENCY II
16-A	FREQUENCY III
17-A	FREQUENCY IV
1-B	AUXILIARY COMMUNICATION
2-B	COMMUNICATION CABLE SEPARATION
3-B	DESCENT VEHICLE ANTENNA JETTISON
5-B	MICROPHONE
6-B	SIMPLEX
7-B	DUPLEX
8-B	TELEGRAPH
9-B	BACKUP VHF XMTR II
10-B	BACKUP ACOUSTICS
11-B	DUPLEX INTERCOM

*THIS LIST CONTAINS A PARTIAL TRANSLATION OF THE COMMAND SIGNAL DEVICE SWITCHES SHOWN IN FIGURE 5.

12-B	PREP. VHF XMTR II
13-B	VHF BEACON
1-C	LANDING
2-C	
3-C	RESPIRATORY VENT.
4-C	DESCENT VEHICLE VENT. SPACE SUIT I
5-C	
6-C	
7-C	
9-C	LIGHT BEACON
10-C	DESCENT VEHICLE VENT SPACE SUIT II
11-C	
12-C	
13-C	
14-C	SEPARATION
15-C	ATMOSPHERE
1-D	DESCENT VEHICLE LIFE SUPPORT SYSTEM
2-D	TELEV. LIGHT.
3-D	OPERATION LIGHT I
4-D	OPERATION LIGHT II
6-D	GAS - ANALYSIS
7-D	CO_2 CONSUMP.
8-D	
9-D	DESCENT VEHICLE VENT.
12-D	DESCENT VEHICLE AIR-CONDITIONING
16-D	
17-D	

1-E	OM, EM LIFE SUPPORT SYSTEM
3-E	
5-E	EM VENT.
6-E	OM CONDITIONING
7-E	
8-E	
9-E	
10-E	OPERATION LIGHT
11-E	MOVIE CAMERA
12-E	MOVIE LIGHT
13-E	SHUT OFF VALVE OPEN
14-E	FLOW REGULATOR OPEN
15-E	FLOW REGULATOR CLOSED
16-E	
17-E	
1-F	
3-F	PERMISSION FOR PRESSURE DUMPING FROM OM
4-F	OM PRESSURE DUMPING
5-F	PRESSURE INTEGRITY MONITORING
6-F	MEASURING MODE
7-F	
8-F	OM TV CAMERA
10-F	
11-F	
12-F	OM PRESSURIZATION
14-F	HATCH I OPEN

15-F	HATCH 2 OPEN
16-F	HATCH 3 OPEN
1-G	ASSEMBLY
2-G	RING EXTENSION
3-G	CAPTURE LATCHES OPENING
4-G	MANUAL APPROACH
5-G	
6-G	TV CAMERA REPORTING
7-G	EXTERIOR TV CAMERA
8-G	EXTERIOR TV CAMERA LENS, NARROW WIDE
9-G	
10-G	APPROACH SIGHTING DEVICE
11-G	HOOKS OPENING
12-G	PERMISSION FOR BACKUP UNDOCKING
13-G	BACKUP PASSIVE HOOKS OPENING
14-G	TRANSFER HATCH CLOSED
15-G	
17-G	

1-H	PREPARATION FOR DESCENT ORIENTATION
2-H	SELECT 10 KG THRUSTERS
3-H	SELECT 1 KG THRUSTERS
4-H	SELECT DIRECTION (YAW, PITCH)
5-H	SELECT ION SENSOR (2 - 1)
6-H	PITCH FORWARD
7-H	PITCH BACKWARD
8-H	ORIENT PERISCOPE
9-H	INERTIAL ORIENTATION
11-H	DESCENT CONDITIONER
12-H	SELECT 3-AXIS ORIENTATION
12-H	THERMAL SENSOR SWITCH OFF
14-H	α_Z MANEUVER
15-H	α_Y MANEUVER
16-H	α_X MANEUVER
1-I	ATTITUDE MODES
2-I	MODES SWITCH OFF
3-I	RATE GYRO
4-I	MANUAL ORIENTATION
5-I	MINIMUM IMPULSE MANUAL ORIENTATION
6-I	ORBIT ORIENTATION ALONG X
7-I	ORBIT ORIENTATION ALONG Y
8-I	TEST ORIENTATION ALONG X
9-I	PREPARATION FOR INERTIAL I
10-I	PREPARATION FOR INERTIAL II
11-I	INTEGRATING ACCELEROMETER
12-I	SLIP MANEUVERS

13-I	PERMISSION FOR INERTIAL ORIENTATION
14-I	ION CURRENT
15-I	PRESSURIZE CORRECTIVE ENGINES
16-I	ZONE H
1-J	SETTINGS
2-J	MANUAL SETTINGS
3-J	PREPARATION OF α_Z - RATE GYRO
4-J	PREPARATION OF α_Y - RATE GYRO
5-J	PREPARATION OF α_X - RATE GYRO
6-J	INITIAL CONFIGURATION
7-J	IMPULSIVE MAIN CORRECTIVE ENGINE
8-J	α_X AND PREPARATION OF α_Y
10-J	PERMISSION FOR PROGRAMMED TURN
11-J	PREPARE RATE GYROS
1-K	PROGRAMS
2-K	PROGRAM OFF
3-K	PROHIBIT COMMANDS TO THE CONTROL SYSTEM FROM THE TIMER
4-K	COMMUNICATION
5-K	DESCENT II
6-K	DESCENT WITH MANUAL ORIENTATION
7-K	AUTOMATIC MANEUVERS
8-K	MANEUVERS WITH MANUAL ORIENTATION
9-K	ORIENTATION AT THE SUN
1-L	RESERVE SYSTEM
2-L	RESERVE RCS
3-L	FUEL SUPPLY ISOLATION PYROVALVE
4-L	DO FUEL SUPPLY PYROVALVE
5-L	JOINT PRESSURIZATION PYROVALVE

6-L	DPO FUEL SUPPLY PYROVALVE
7-L	RESERVE PRESSURE PYROVALVE
8-L	BACKUP CORRECTIVE ENGINE
13-L	BACKUP PRESSURIZATION OF CORRECTIVE ENGINES
1-M	RESERVE SYSTEM
2-M	PERMANENT SYSTEM
4-M	GYRO ASSEMBLY (RATE, FREE GYRO)
6-M	BDUS FILTER
7-M	BDUS COMPLEX (2 - 1)
8-M	PULSE GENERATOR SETUP
9-M	ORIENTATION STABILIZATION - X FORWARD
10-M	ORIENTATION STABILIZATION - X BACKWARD

1-N	
2-N	
3-N	
4-N	
5-N	I DEVIATION MATRIX
6-N	II DEVIATION MATRIX
7-N	
8-N	
8-N	
11-N	DOCKING PRESSURE CONTROL
1-0	
2-0	
3-0	LATCHES CLOSING
4-0	RETRACTION
5-0	CLOSING HOOKS
6-0	UNDOCKING
7-0	DOCKING PRESSURIZATION
8-0	DOCKING INTERFACE PRESSURE INTEGRITY MONITORING
9-0	

10-0	TUNNEL PRESSURE INTEGRITY MONITORING
11-0	PREPARATION FOR ALIGNMENT
12-0	
13-0	TUNNEL PRESSURE RELIEF VALVE
14-0	GUIDE RING
15-0	CAPTURE
16-0	STRUCTURAL RING CONTACT
17-0	STRUCTURAL RING LATCHES PRELOADED
1-P	
2-P	
3-P	ATMOSPHERE COMPOSITION
4-P	LEAKAGE
5-P	PITCH YAW
7-P	
10-P	
11-P	PROPULSION SYSTEM PRESSURIZATION

INSTRUMENT BOARD

ПРИБОРНАЯ ДОСКА ПД1-М

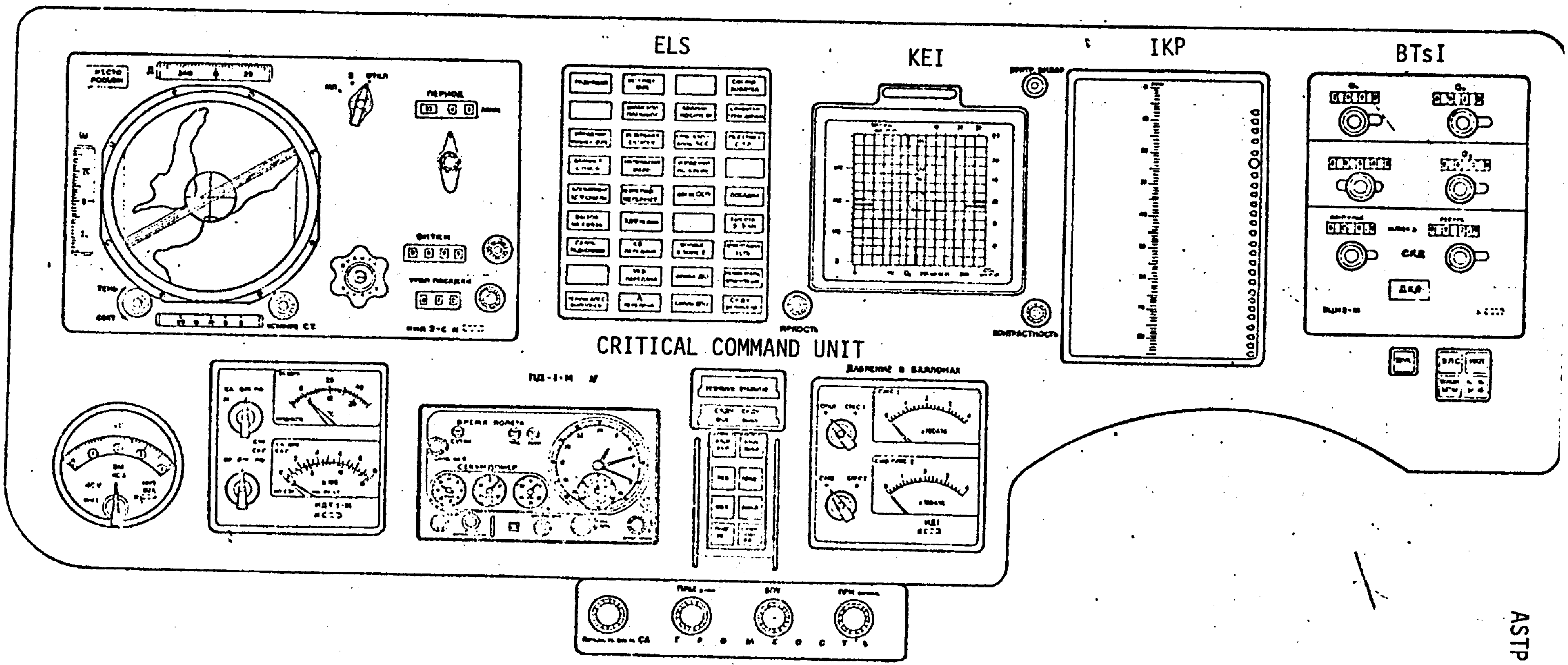


РИСУНОК 6. – ПРИБОРНАЯ ДОСКА ПД1-М

Figure 6. – Instrument Board..

ELECTROLUMINESCENT INDICATOR

ЭЛЕКТРОЛЮМИНЕС-ЦЕНТНЫЙ СИГНА-ЛИЗАТОР(ЭЛС)

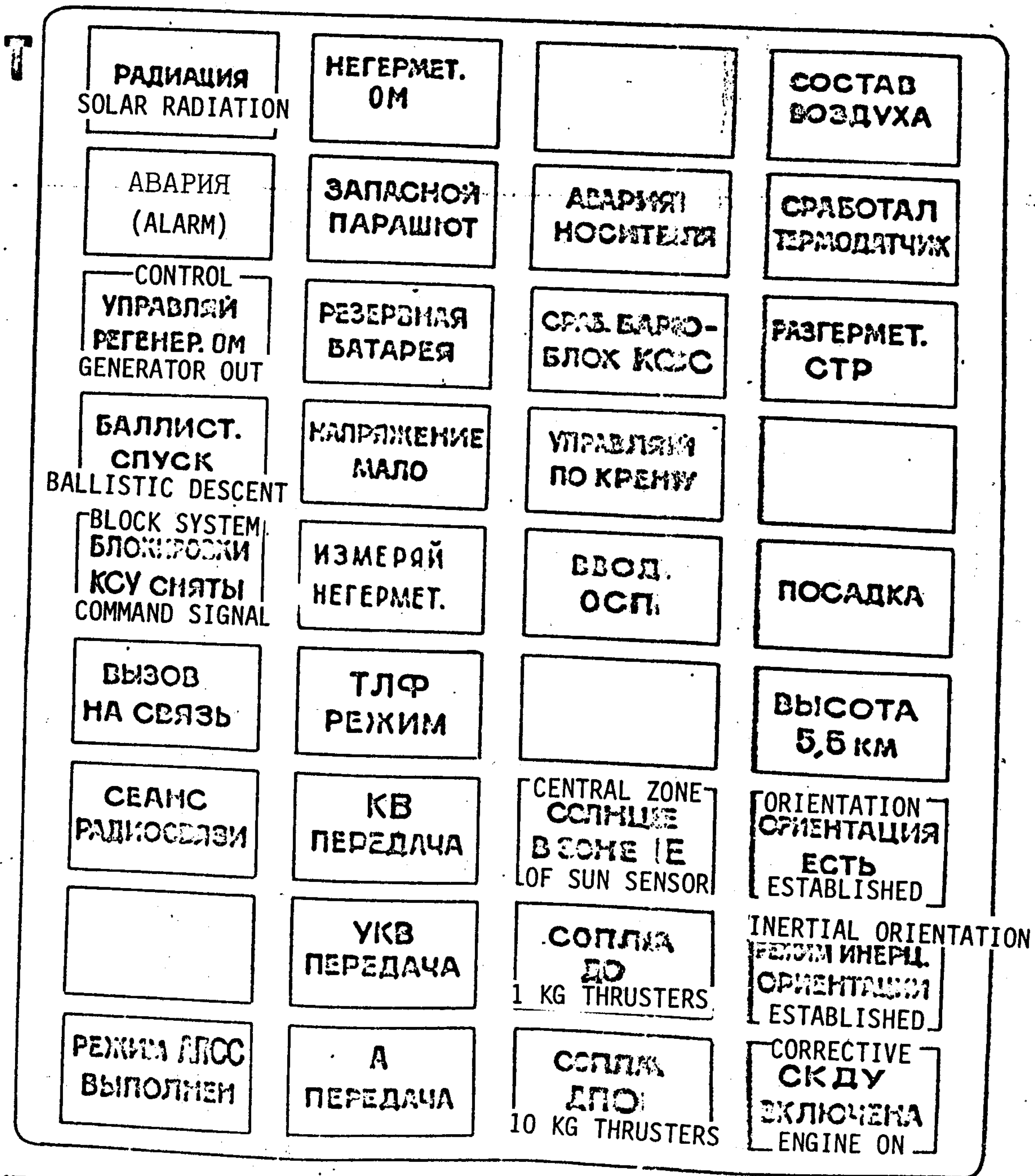


РИСУНОК 7. – ЭЛЕКТРОЛЮМИНЕСЦЕНТНЫЙ СИГНАЛИЗАТОР/ЭЛС/

Figure 7. - Electroluminescent Indicator.

PROGRAM MONITORING INDICATOR

ИНДИКАТОР КОНТРОЛЯ ПРОГРАММ ИКП-С

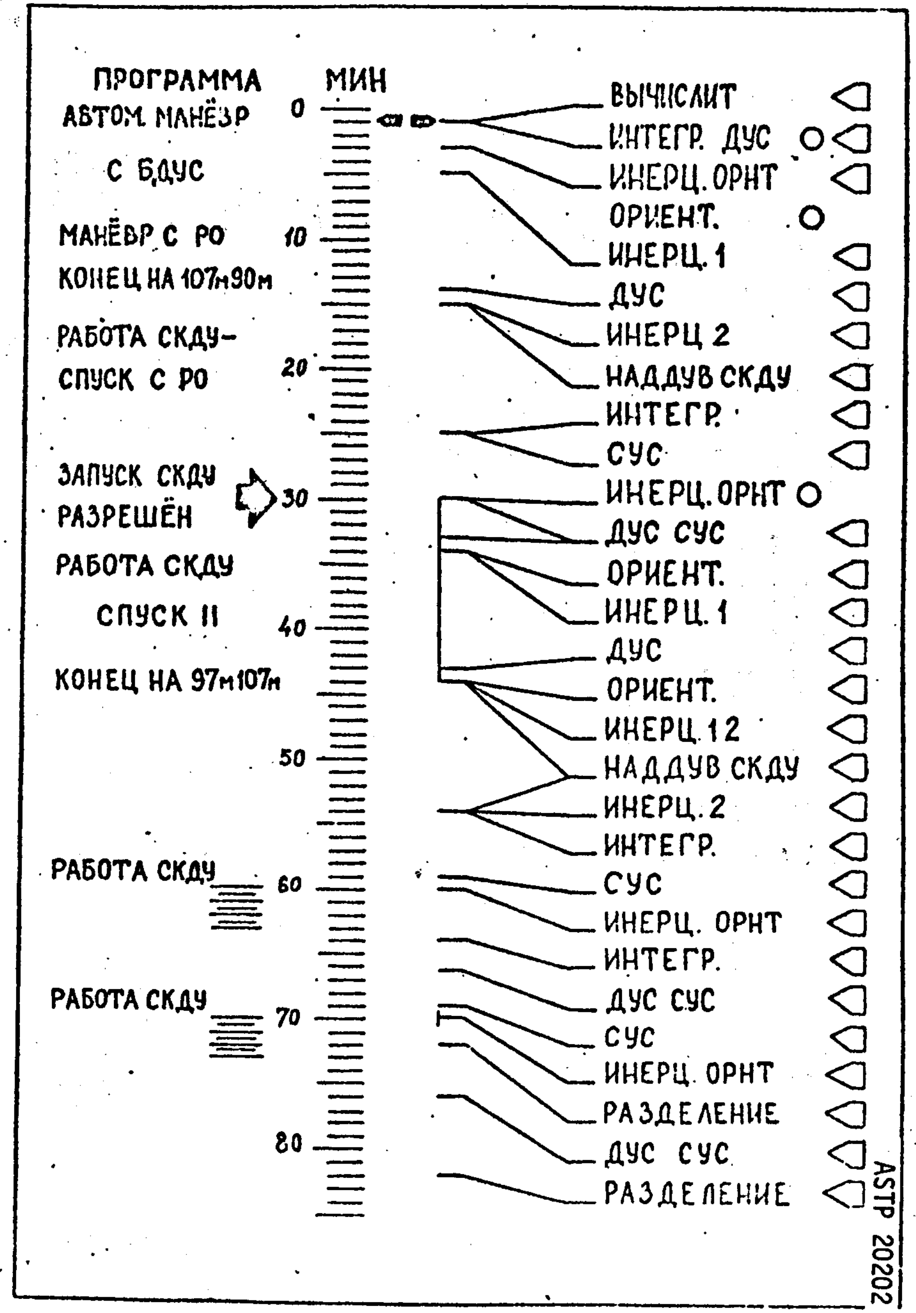


РИСУНОК 8. - ИНДИКАТОР КОНТРОЛЯ ПРОГРАММ ИКП-С

Figure 8. - Program Monitoring Indicator.

DIGITAL DISPLAY UNIT

БЛОК ЦИФРОВОЙ ИНДИКАЦИИ БЦИ2-

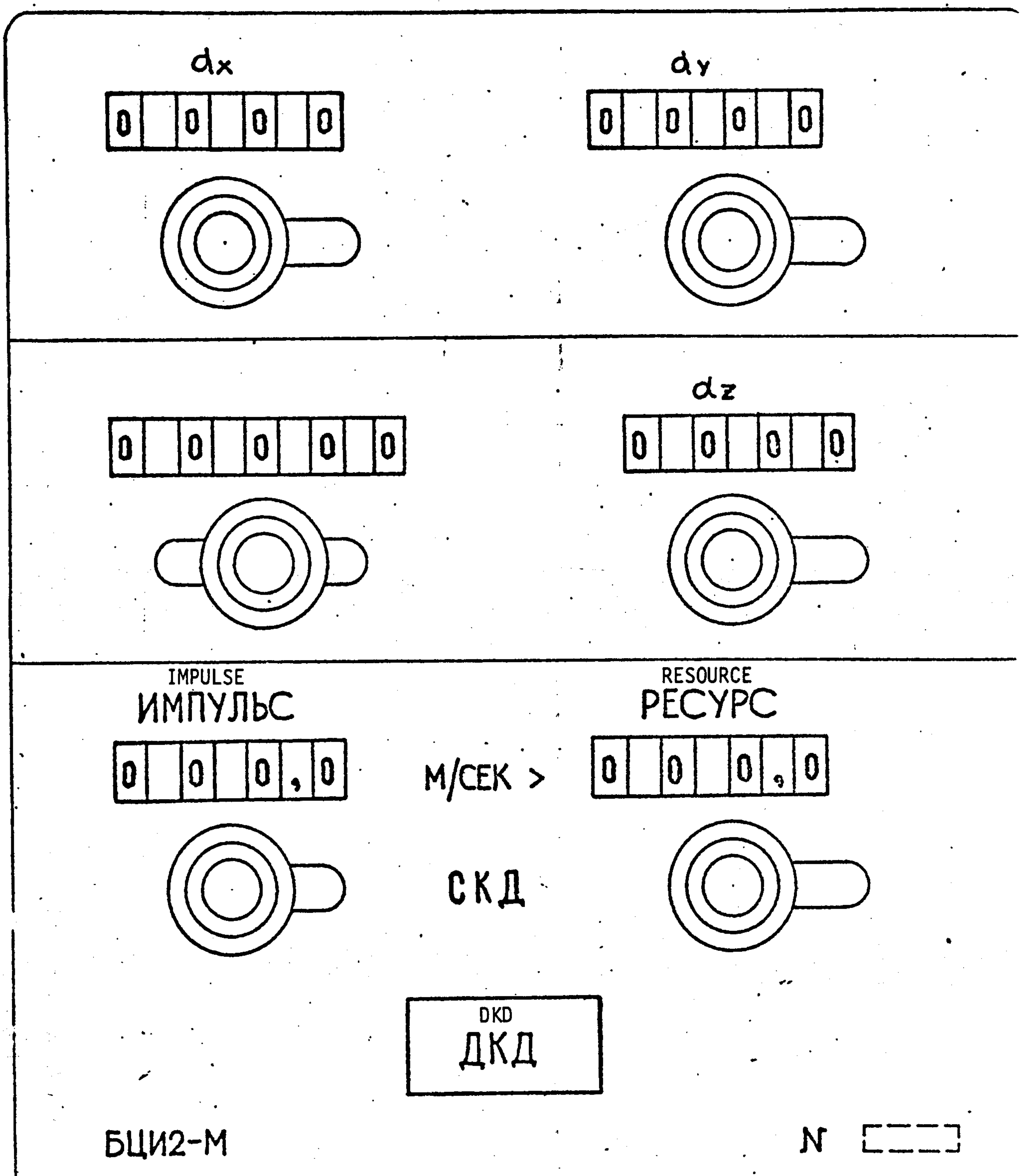
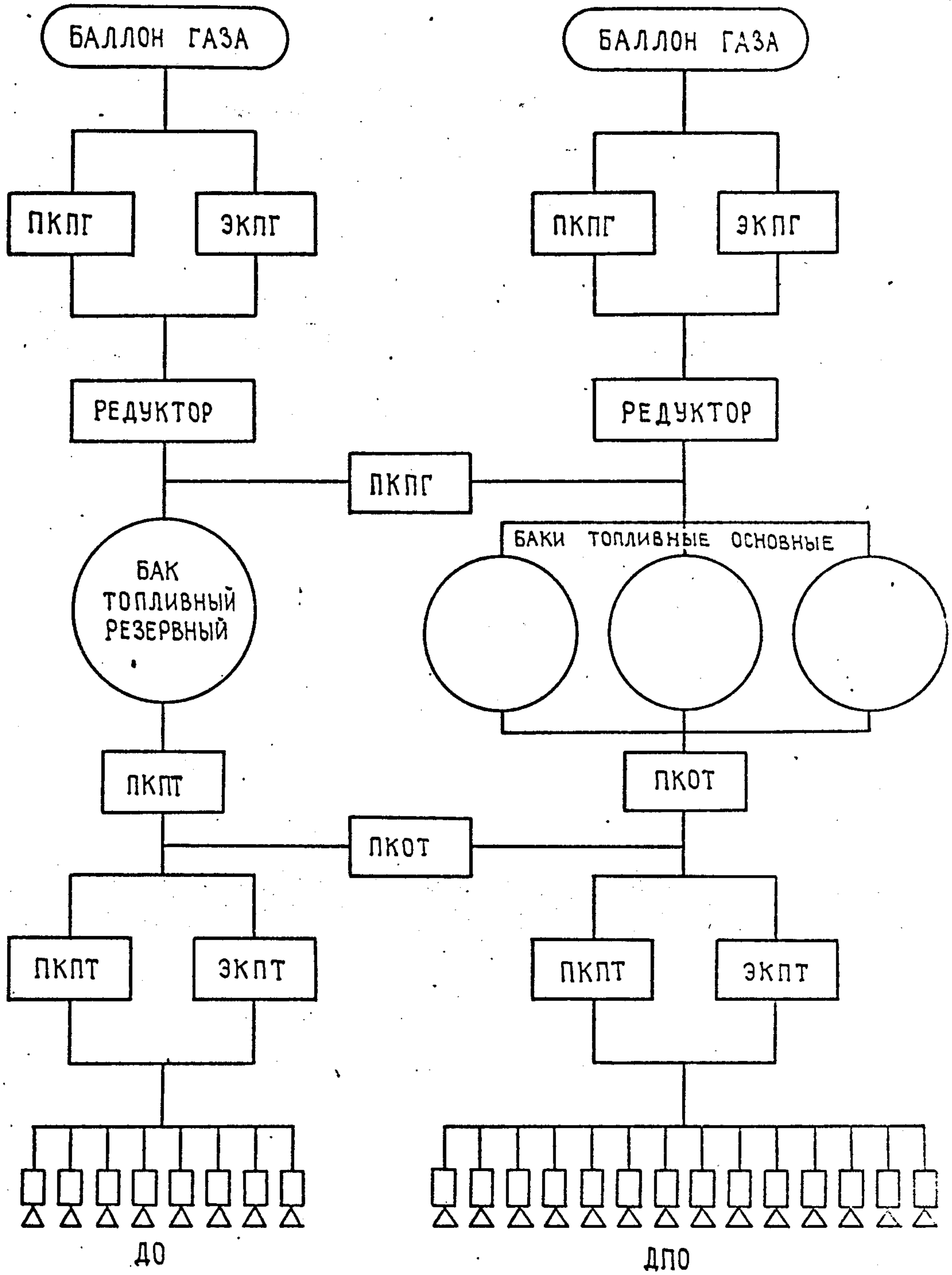


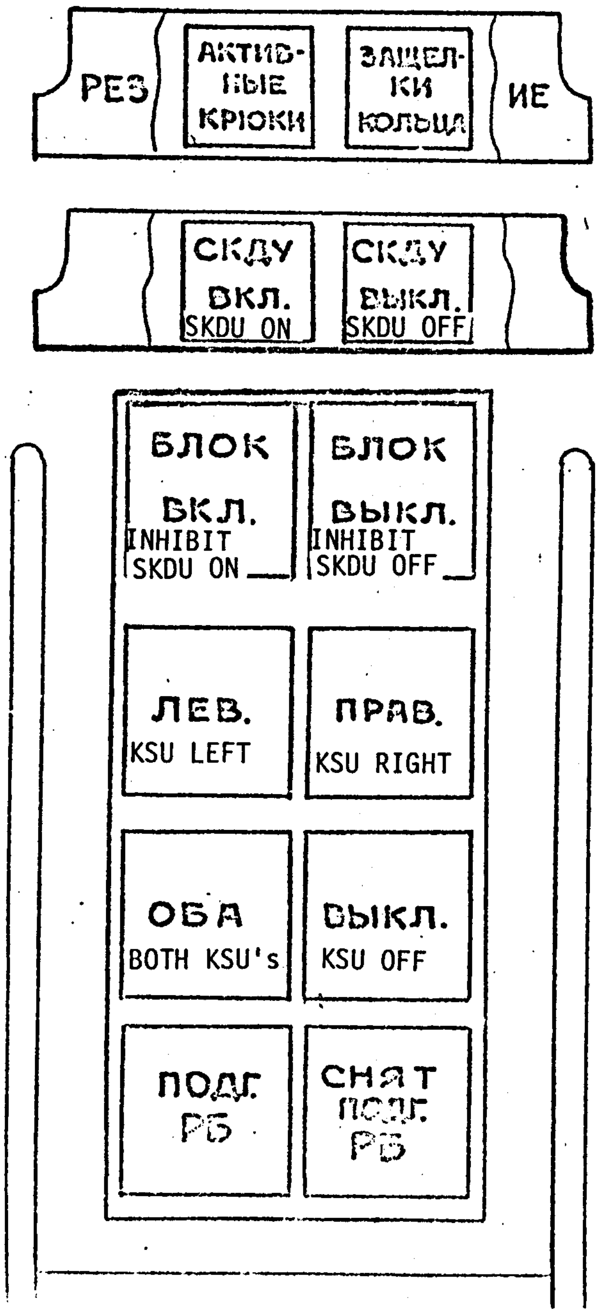
РИСУНОК 9. - БЛОК ЦИФРОВОЙ ИНДИКАЦИИ БЦИ2-М

Figure 9. - Digital Display Unit.



ПКПГ – gas supply pyrovalve
ЭКПГ – gas supply electrovalve
ЭКПТ – fuel supply electrovalve
ПКПТ – fuel supply pyrovalve
ПКОТ – fuel cutoff electrovalve

РИСУНОК 10 Пневмогидравлическая схема СИО
Figure 10. - Pneumohydraulic Diagram For



CRITICAL COMMANDS UNIT

БЛОК ОСОБО ВАЖНЫХ КОМАНД

РИСУНОК 11. – БЛОК ОСОБО ВАЖНЫХ КОМАНД

Figure 11. – Critical Commands Unit.

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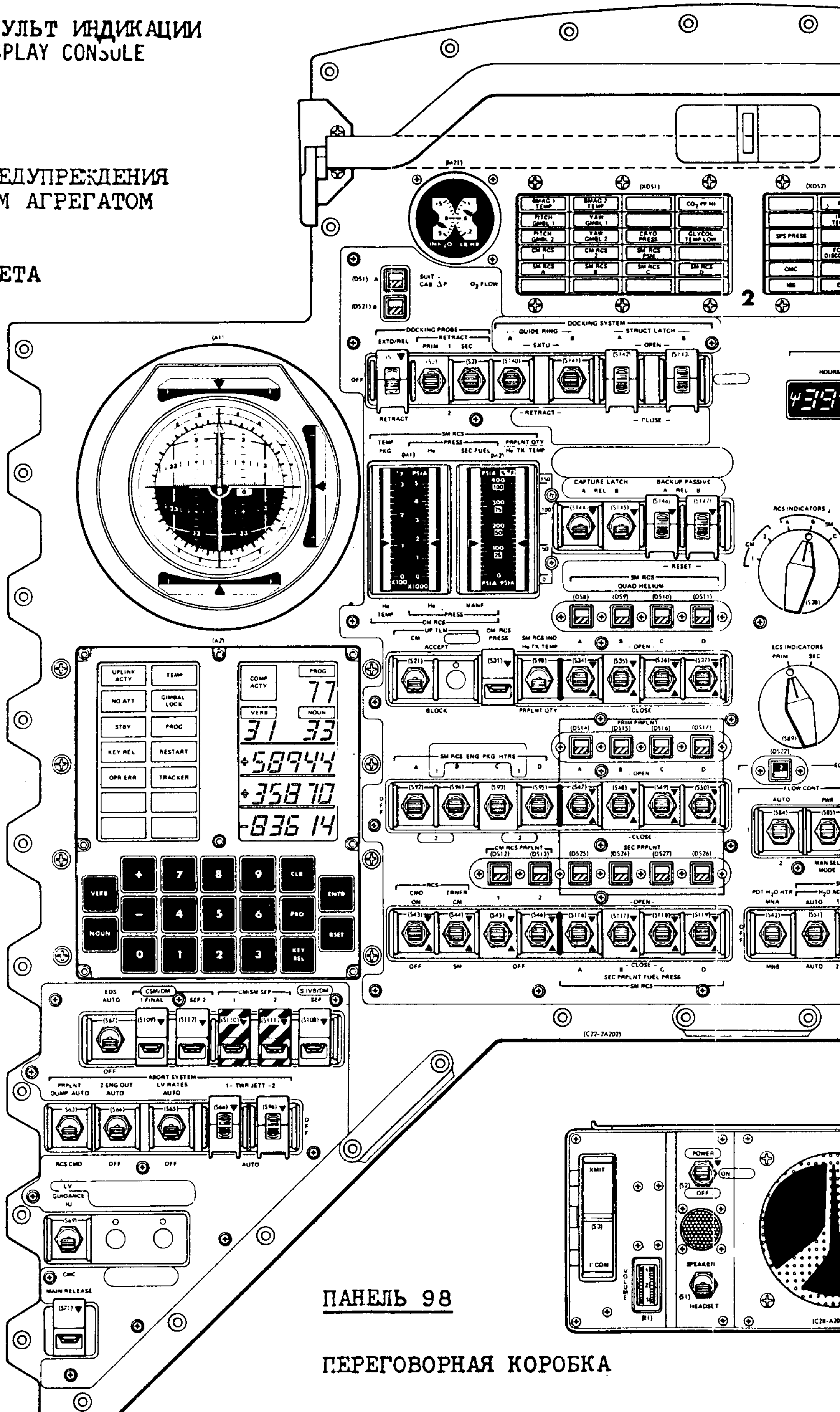
ГЛАВНЫЙ ПУЛЬТ ИНДИКАЦИИ
MAIN DISPLAY CONSOLE

ПАНЕЛЬ 2

УКАЗАТЕЛЬ ПОЛОЖЕНИЯ
КЛАВИШИ КОМПЬЮТОРА
ИНДИКАТОРЫ СИСТЕМЫ ПРЕДУПРЕЖДЕНИЯ
УПРАВЛЕНИЕ СТЫКОВОЧНЫМ АГРЕГАТОМ
УПРАВЛЕНИЕ РСУ
УПРАВЛЕНИЕ СОЖ
УКАЗАТЕЛЬ ВРЕМЕНИ ПОЛЕТА

PANEL 2

ATTITUDE INDICATOR
COMPUTER KEYBOARD
C & W INDICATORS
DOCKING SYSTEM CONTROLS
RCS CONTROLS
ECS CONTROLS
MISSION TIMER

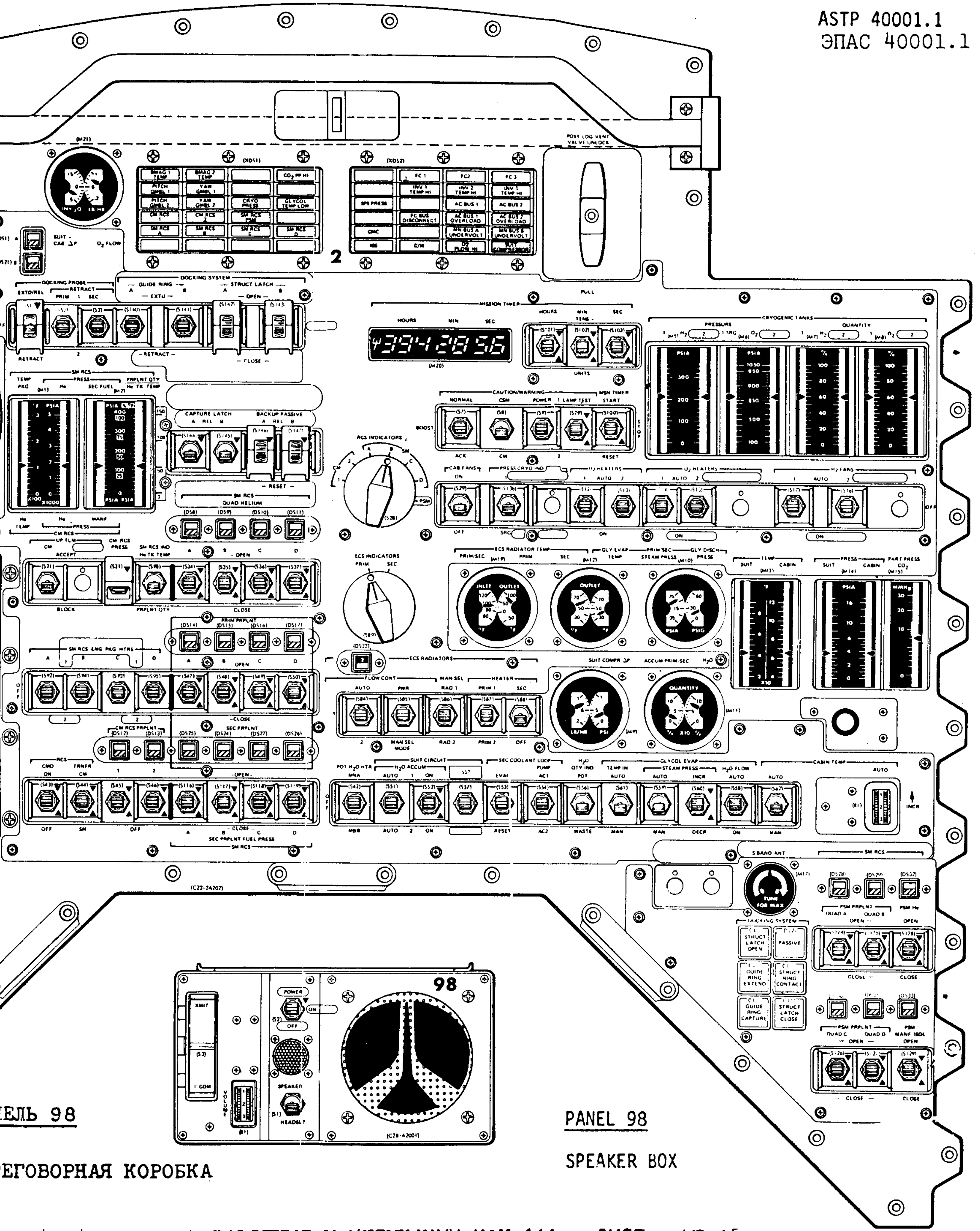


ПАНЕЛЬ 98

ПЕРЕГОВОРНАЯ КОРОБКА

РИС 4-14 ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКА

FIGURE 4-14 CSM 111 DISPLAYS AND CO



ЕЛЬ 98

ЕГОВОРНАЯ КОРОБКА

PANEL 98

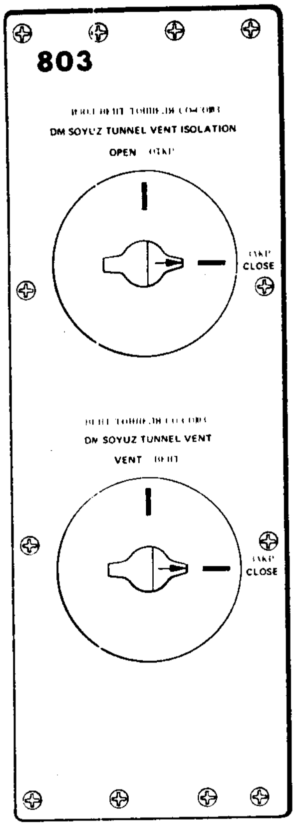
SPEAKER BOX

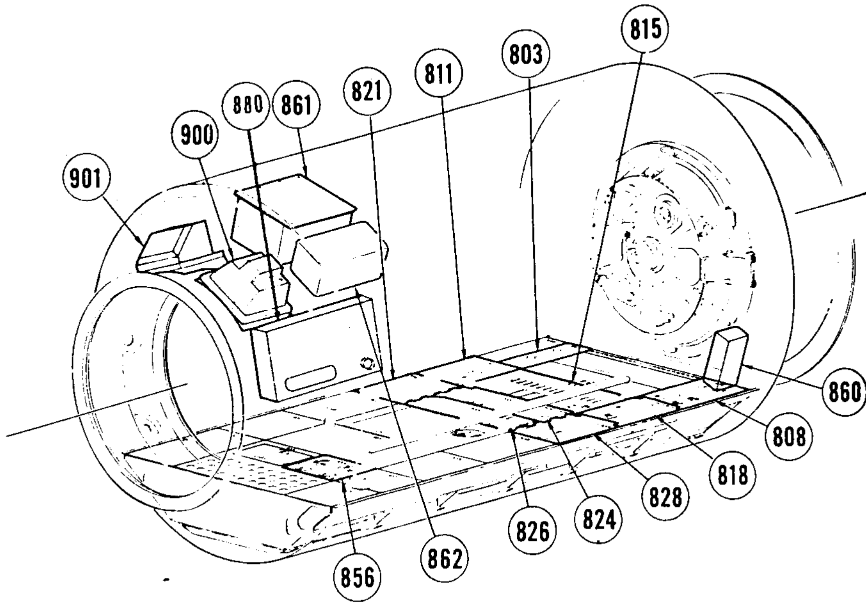
РИС 4-14 ПУЛЬТ УПРАВЛЕНИЯ И ИНДИКАЦИИ КСМ 111 ЛИСТ 3 ИЗ 15

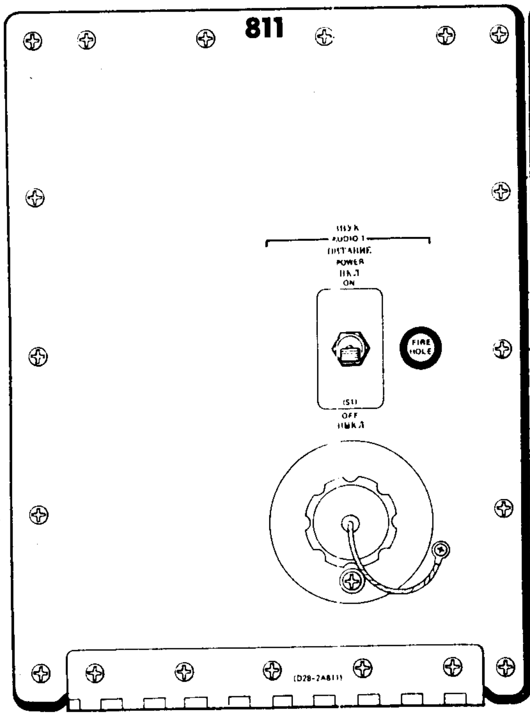
FIGURE 4-14 CSM 111 DISPLAYS AND CONTROLS PANELS (SHEET 3 OF 15)

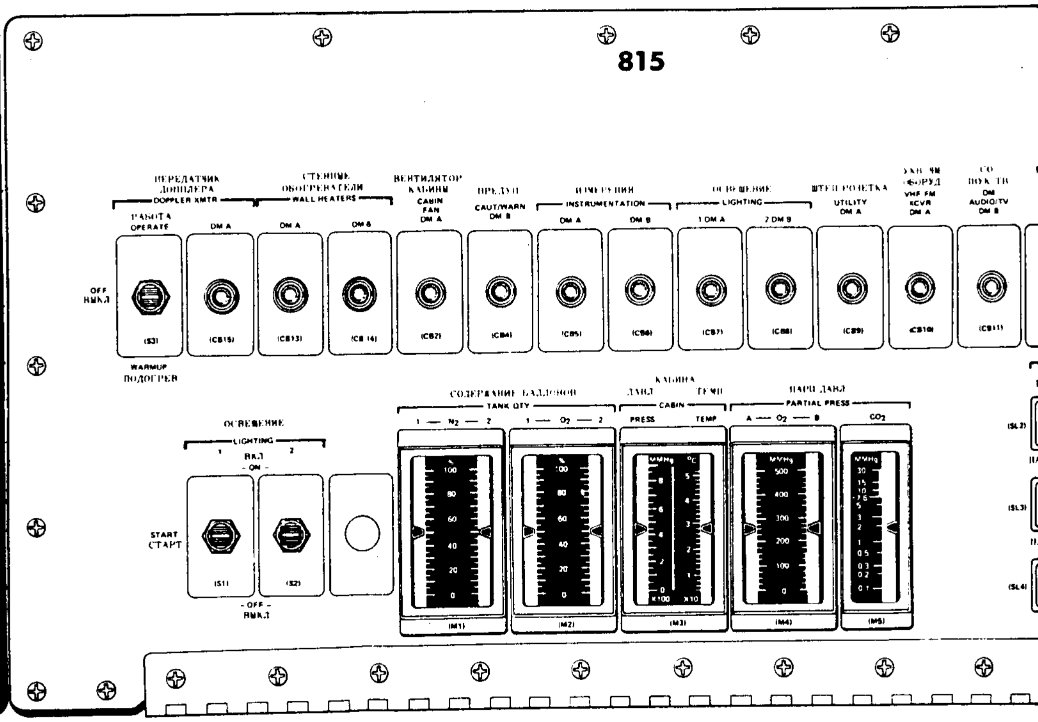
DOCKING MODULE

СТЫКОВОЧНЫЙ МОДУЛЬ









DOCKING MODULE

СТЫКОВОЧНЫЙ МОДУЛЬ

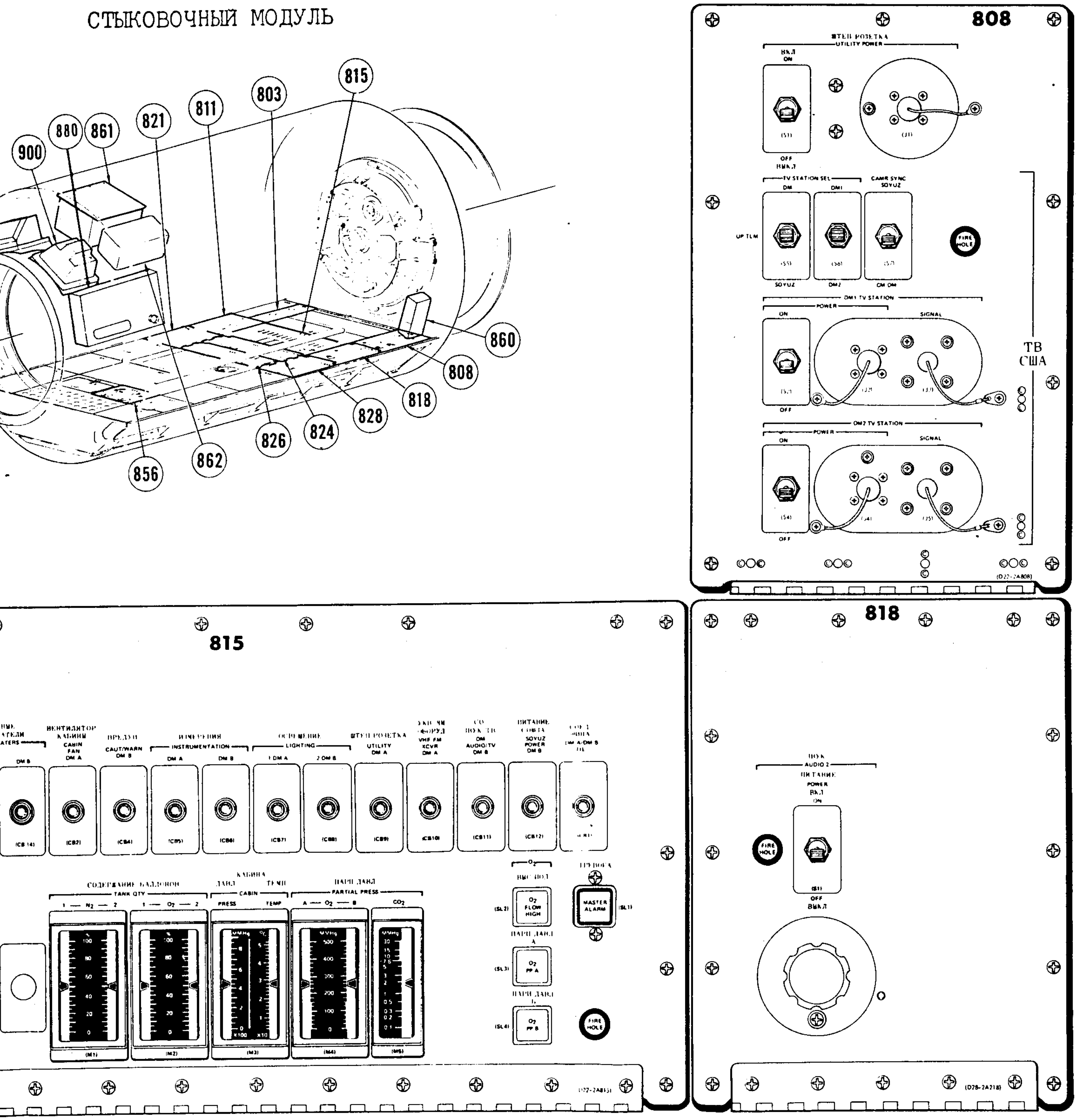
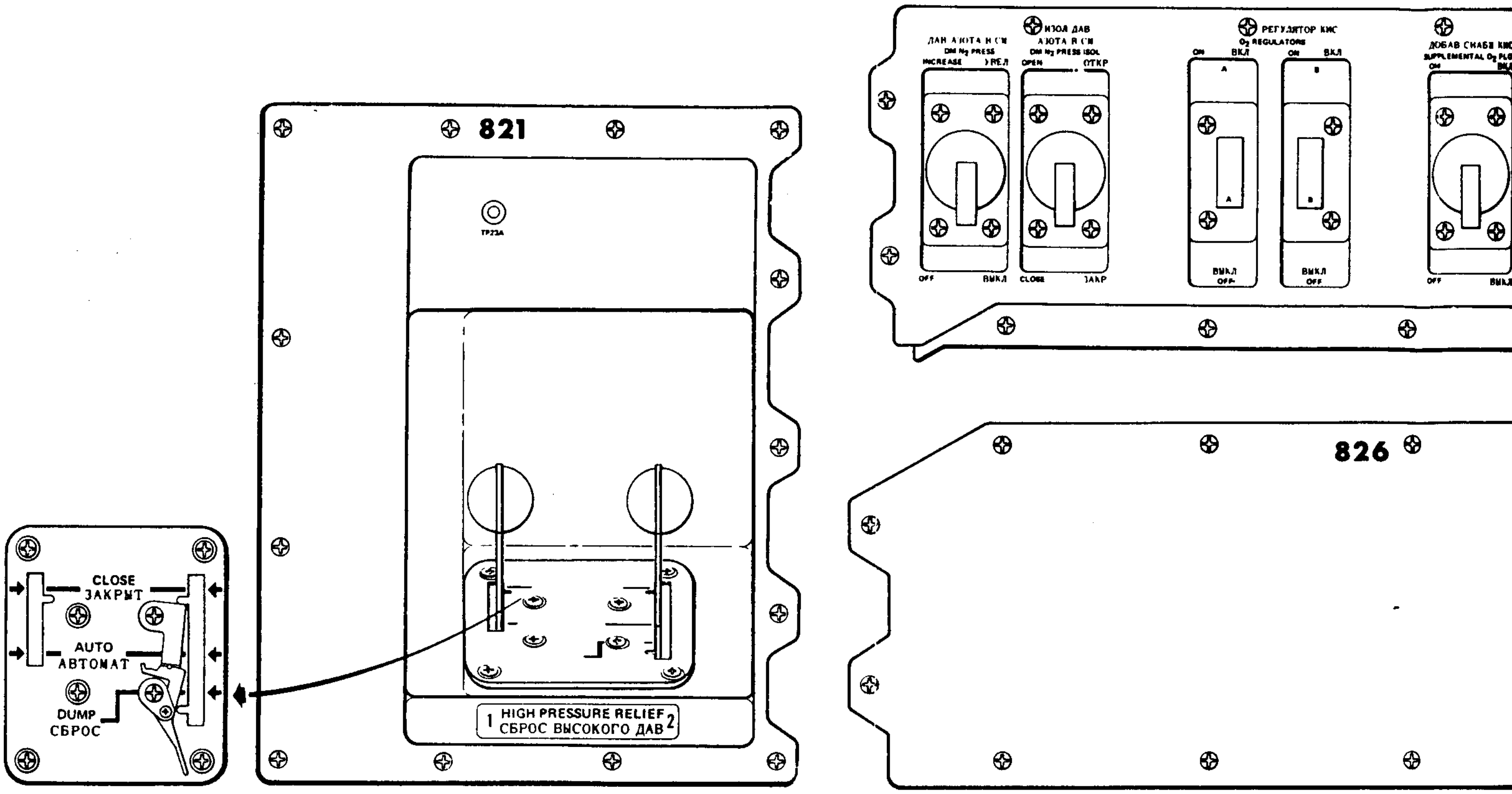


FIGURE 4-19 - Docking module display and control panels - sheet 1 of 3

РИС. 4-19 - Панели индикации и управления стыковочного модуля - Лист 1 из 3



821
826
CLOSE
ЗАКРЫТ
AUTO
АВТОМАТ
DUMP
СБРОС
1 HIGH PRESSURE RELIEF 2
СБРОС ВЫСОКОГО ДАВ
O$_2$ REGULATORS
OPEN
ОТКР
CLOSE
ON
ВКЛ
OFF
ВЫКЛ

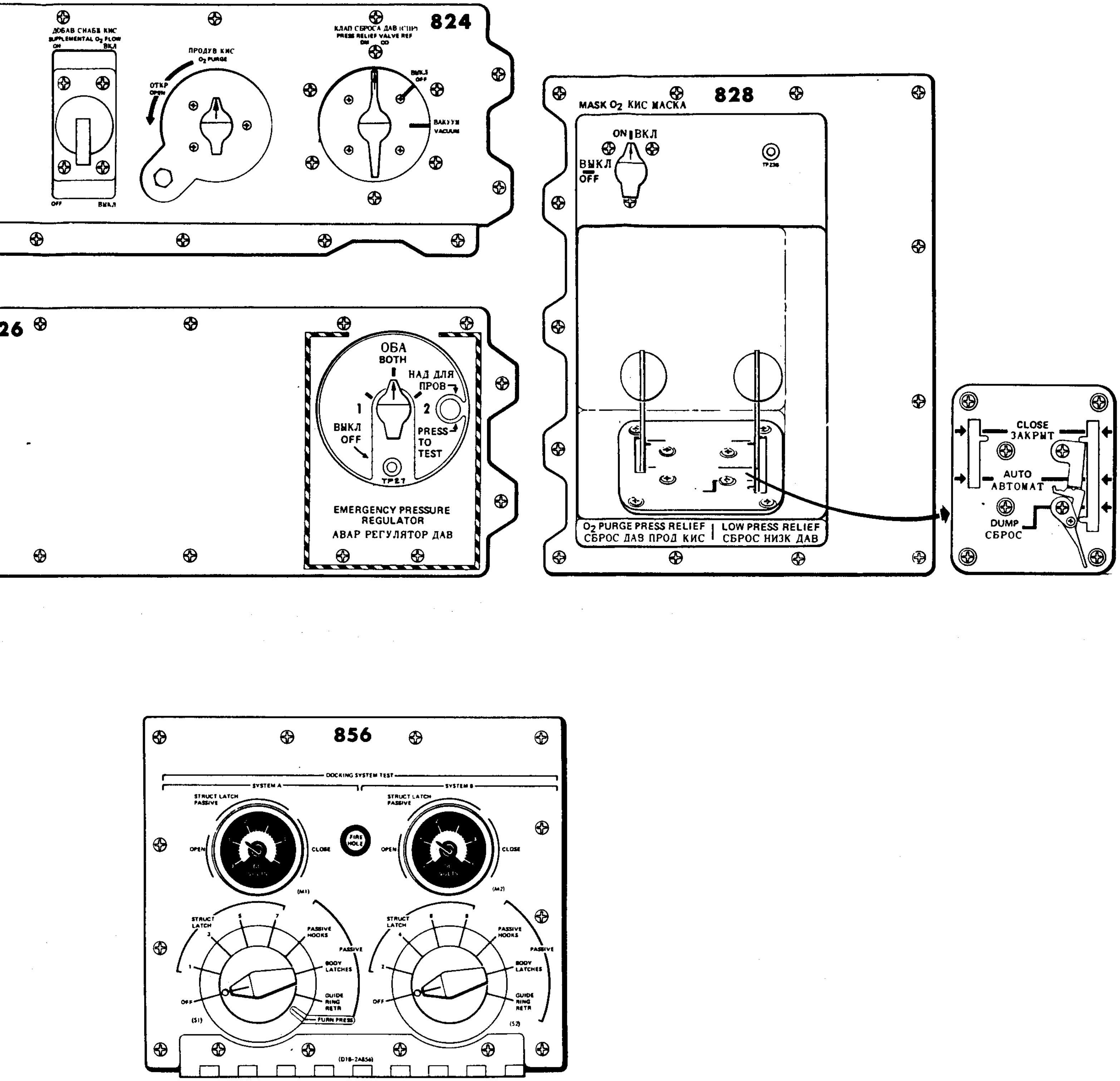
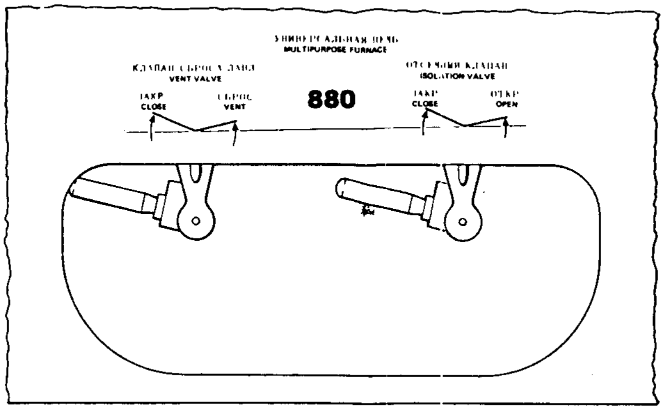


FIGURE 4-19 DOCKING MODULE DISPLAY AND CONTROL PANELS - sheet 2 of 3

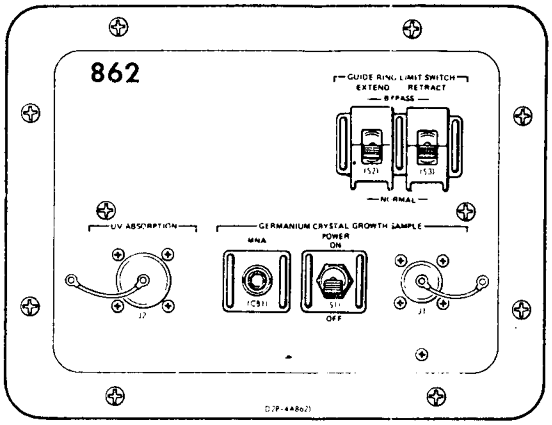
РИС 4-19 – Панели индикации и управления стыковочного модуля – Лист 2 из 3

SOYUZ

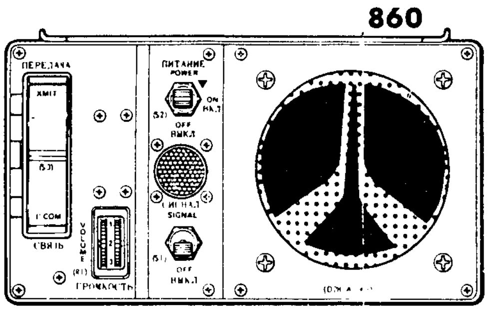
СОЮЗ



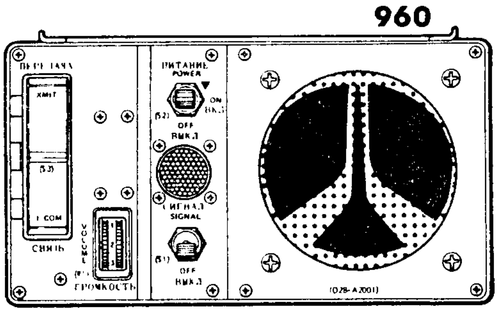
MULTIPURPOSE FURNACE
VENT VALVE
CLOSE
VENT
880
ISOLATION VALVE
CLOSE
OPEN



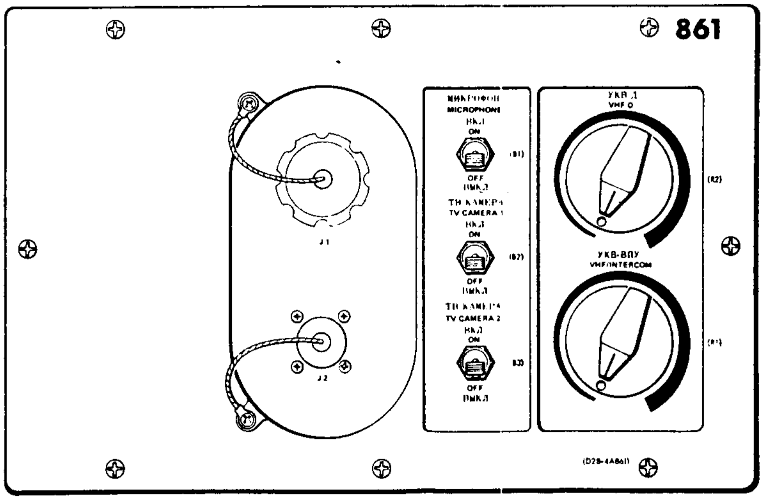
862
GUIDE RING LIMIT SWITCH
EXTEND
RETRACT
BYPASS
NORMAL
UV ABSORPTION
GERMANIUM CRYSTAL GROWTH SAMPLE
POWER
ON
OFF
J2
J1



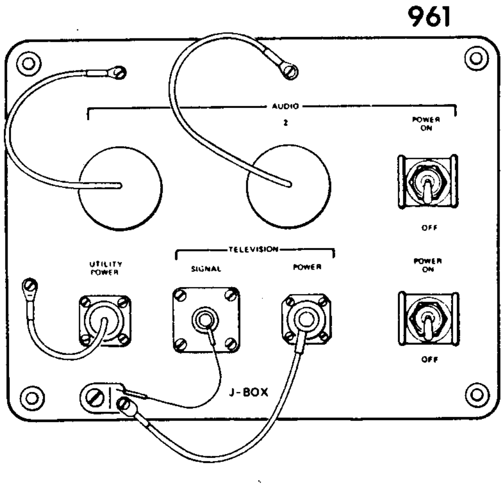
860
ПЕРЕДАЧА
XMIT
I COM
СВЯЗЬ
ПИТАНИЕ
POWER
ON
OFF
SIGNAL
ГРОМКОСТЬ



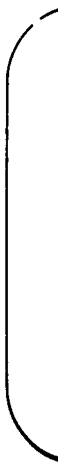
960
XMIT
I COM
СВЯЗЬ
ПИТАНИЕ
POWER
ON
OFF
SIGNAL
ГРОМКОСТЬ
(D28-A2001)



861
MICROPHONE
ON
OFF
TV CAMERA 1
ON
OFF
TV CAMERA 2
ON
OFF
VHF O
УКВ-ВПУ
VHF/INTERCOM
J1
J2
(D28-4A861)



961
AUDIO
2
POWER
ON
OFF
TELEVISION
SIGNAL
POWER
UTILITY
POWER
POWER
ON
OFF
J-BOX



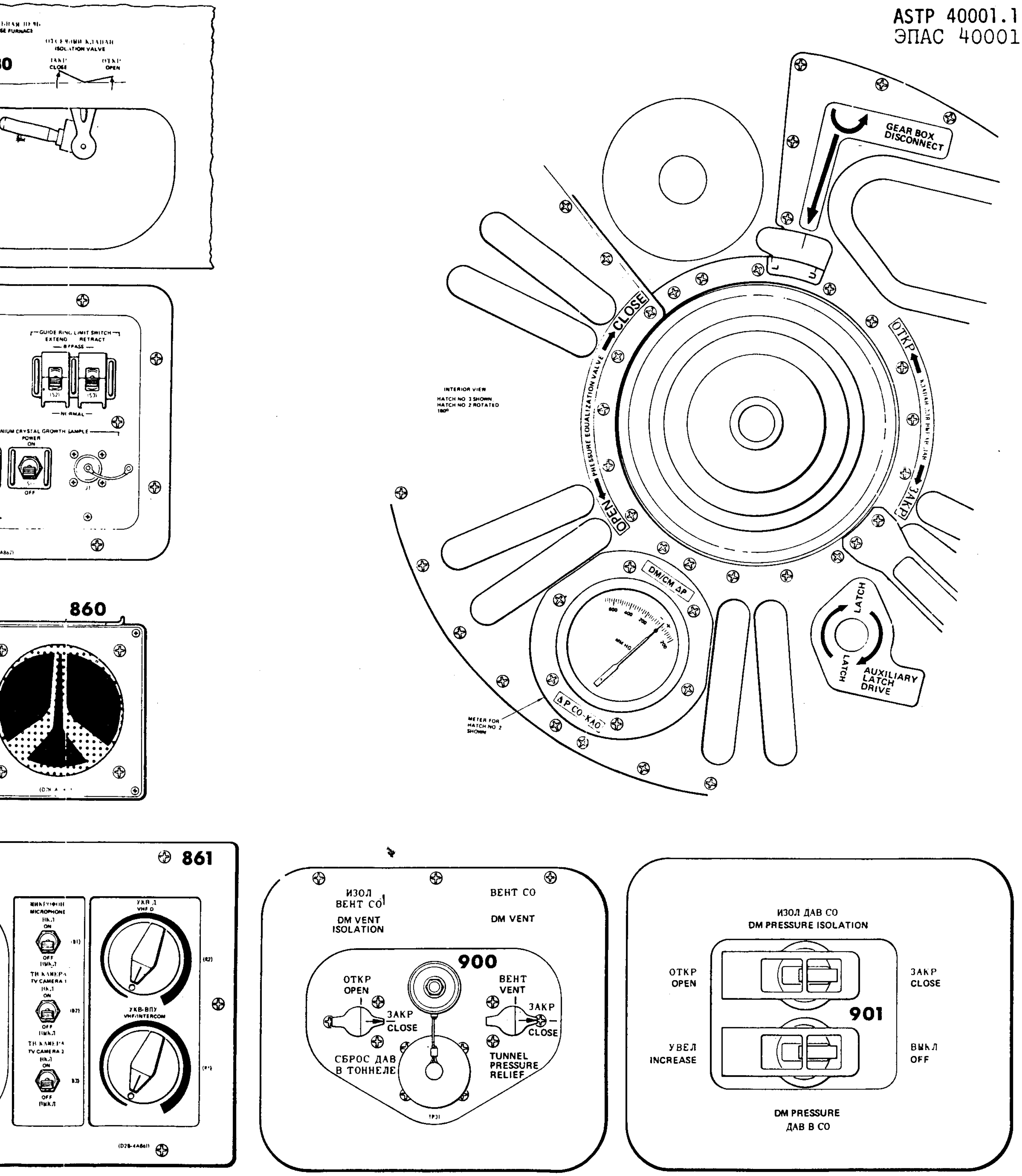


FIGURE 4-19 DOCKING MODULE DISPLAY AND CONTROL PANELS - sheet 3 of 3

РИС 4-19 - Панели индикации и управления стыковочного модуля - Лист 3 из 3