

Approved per signature page

SERVICE MODULE
ATMOSPHERE REVITALIZATION SUBSYSTEM
(СОГС)
SM

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Revision Log

1E	09 Oct 00	6—1E	09 Oct 00	10—12E	09 Oct 00
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INTRODUCTION

These COGC crew procedures contain information for the crew about Elektron, Vozdukh, БМП system, СПОПТ, COGC operation, and schematics

These crew procedures are intended for trained crew members who have completed the full training course and simulations

These crew procedures may be updated pending ISS assembly, systems modification and procedure validation at simulators and training facilities, and as a result of ground tests

These crew procedures are developed per ББС software release 4.30.14 and RS Laptop software dated 07.03.00

ACRONYMS AND ABBREVIATIONS

АВК	- emergency vacuum valve
БВС	- onboard computer system
БВК	- Vozdukh vacuum valve group
БВКФ	- filter vacuum valve unit
БИД	- Elektron pressure gauge
БЖ	- liquid unit
БКГА	- gas analyzer calibration assembly
БКО	- purification column unit
БМП	- micropurification unit
БОА	- atmosphere purification unit
БП	- pump unit
БПА	- nitrogen purge assembly
БПО	- preliminary desiccant assembly
БУ	- control unit
БУС-ВМ	- Signal-VM controller
БФ СО ₂	- CO ₂ filter unit
ВИР-1	- air flow meter
ВКЛ	- on, turn on, activate
ГА	- gas analyzer
ГА-Э	- Elektron gas analyzers
ДД	- pressure sensor
ДДИ	- induction pressure sensor
ДнаЗ-М	- report to MCC-М
ДпоУЗ-М	- √MCC-М
ЕДВ	- water container
загл	- cap
ЗАКР	- close, closed
ЗИП	- spares kit
ИГЗ	- gas analyzer status indicator
ИК0501	- SM gas analyzer

КВД РО-ПрК	- РО-ПрК pressure equalization valve
КТ-02	- hygrometer
КЭ	- solenoid valve
Кл	- valve
кн	- pushbutton, pb
МВ	- pressure gauge
МН	- mini-pump
МНО	- primary mini-pump
МНР	- backup mini-pump
Н/С	- off-nominal situation
ОТКЛ	- off, turn off, deactivate
ОТКР	- open, opened
ПКО	- dessicant selector valve
ПК СОА	- Vozdukh ORU test panel
поУЗ-М	- on MCC-M GO
ПП	- adsorbent cartridge
ППС	- system power panel
ПрК	- transfer tunnel
ПСС	- caution and warning panel
ПУВН	- cabin air heaters control panel
ПУС	- Signal-VM control panel
ПУ СОА	- Vozdukh CO2 removal control panel
ПхО	- transfer compartment
перекл	- switch, sw
РН	- manual pump
РО	- working compartment
С1-С4	- first (...fourth) electric heater bank
СвД	- light-emitting diode, LED
СМ	- Service Module
СОА	- atmosphere purification system
СОГС	- atmosphere revitalization subsystem
с/с	- comm pass
СТ-64	- current stabilizer
СУ	- docking assembly
ТГК	- solid oxygen generator
ТК	- Soyuz transport vehicle
ТКГ	- Progress cargo vehicle
ФГБ	- Functional Cargo Block, FGB
ФВП	- harmful contaminants filter
ЦУП-М	- Mission Control Center-Moscow
ЭЛВ	- hydrogen valve
ЭЛВК	- vacuum valve
ЭЛК	- oxygen valve

SYMBOLS

	- illuminated
	- blinking
	- not illuminated
	- illumination status changes when command is issued
	- sw → ON (i.e. up relative to label on panel)
	- sw → OFF (i.e. down relative to label on panel)
BEHT → OCHOBH	- sw labeled BEHT → OCHOBH (if there are two positions labeled OCHOBH and PE3EPB, respectively)
BEHT → PE3EPB	- sw labeled BEHT → PE3EPB (if there are two positions labeled OCHOBH and PE3EPB, respectively)
	- mouse left click
	- rotate clockwise
	- rotate counterclockwise
	- rotate clockwise to stop
	- rotate counterclockwise to stop
	- adjust by rotating
	- place physical device in designated state
	- disconnect
	- connect
	- press pushbutton
	- press pushbutton to lock
	- press pushbutton to release
	- check (in case of discrepancy, attempt a corrective action one time only)
	- verify
	- continuously monitor
	- verify aurally
ЗВУК	- acknowledge audio alarm
15:46:28	- 15 h 46 min 28 sec
P>75 atm	- an anticipated off-nominal situation, if the condition left of the asterisks on the same line is not met, perform action(s) enclosed by asterisk lines
***** ***** manual vlv *****	
АВК-БМП	- advisory information (subsequent monitoring is not required)
P.H ₂ O	- partial pressure of water
P.O ₂	- partial pressure of oxygen
P(MB)	- pressure gauge reading
P.CO ₂	- partial pressure of carbon dioxide
ΔP.O ₂ (Laptop,РАСЧ)	- pressure differential of one value obtained using different methods
C.H ₂ in O ₂	- concentration of hydrogen in oxygen
	- a cyclic action (repeat steps enclosed by double bracket)

1. GENERAL INSTRUCTIONS

1.1. CREW RESPONSIBILITIES

While performing operations, the crew is responsible for the following actions:

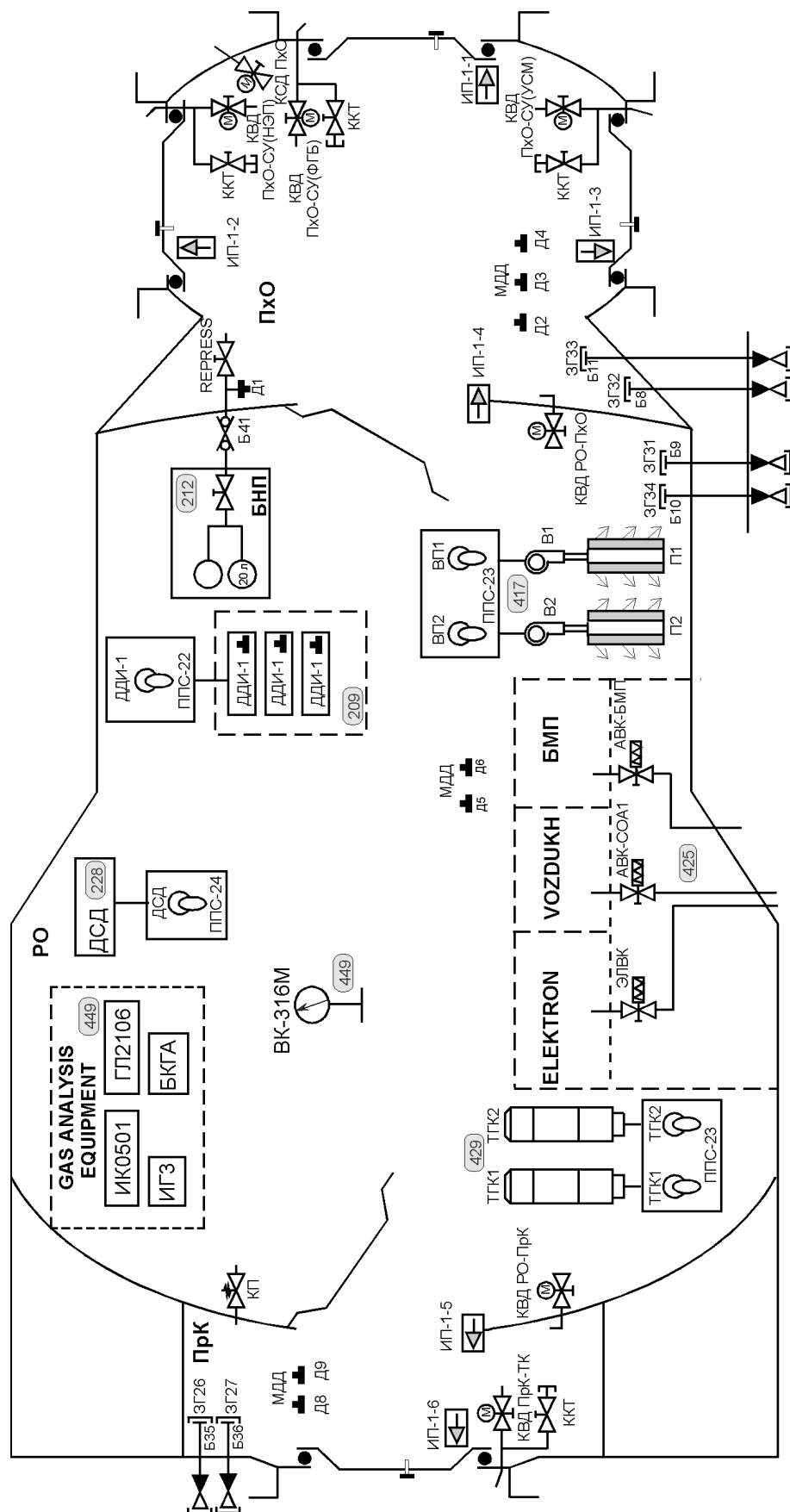
1. Perform operations per these crew procedures and **MCC-M** instructions, in accordance with the crew functional responsibilities and current status of the onboard systems
2. Report to **MCC-M** completed operations
3. Monitor systems operation per these crew procedures and **MCC-M** instructions
4. When there is a deviation from nominal systems operation, the crew is responsible for the following actions:
 - record the time when the deviation (malfunction) was detected
 - record the nature of the deviation (malfunction)
 - **report to MCC-M** at the earliest available comm pass
5. If an anticipated off-nominal situation occurs use these crew procedures for troubleshooting and isolation
6. Perform indicator panel lamp test
7. Issue commands from control panels by fully pressing and holding pushbuttons (without lockout feature) for 1 – 2 sec
8. Record actual time spent performing operations
9. When working with hardware equipped with protective caps and covers:
 - remove caps and covers before operations
 - re-install caps and covers after operations

1.2. SAFETY PRECAUTIONS

To ensure nominal systems operation and crew safety, the crew is responsible for the following actions:

1. When working with the system, use only hardware, tools, and protective devices designated by these crew procedures or by **MCC-M**
2. Upon detection of an off-nominal situation, not documented in these crew procedures, the crew is responsible for the following actions:
 - stop working with the system
 - record time when the off-nominal situation was detected
 - record the nature of the off-nominal situation
 - **report to MCC-M** at earliest available comm pass
3. Do not replace fuses when system or instrument is powered
Replace fuses per amperage labeled on the fuse
On MCC-M GO repeat fuse replacement

2. COFC SCHEMATIC



3. PRESSURE MONITORING AND CONTROL HARDWARE

3.1. TOTAL PRESSURE MONITORING

Pressure monitoring is done per pressure gauge or via RS Laptop:

RS Laptop Depressurization

Current Pressure

◀

3.2. SETTING PRESSURE LIMITS

RS Laptop CM:СЖО:СОГС

proc F26_APS_7 *(Pressure value limits)*

variable 1: _____ *(on MCC-M GO set lower limit)*

variable 2: _____ *(on MCC-M GO set upper limit)*

Execute

Depressurization

◀ High Low

NOTE

Default settings are as follows:
 lower pressure limit – 720 mmHg
 upper pressure limit – 780 mmHg

3.3. DIRECTIONAL AIR FLOW SENSOR OPERATION

1. ИП-1 ACTIVATION

RS Laptop CM:СЖО:СОГС and ФГБ:СЖО:СОГС

↓ pb near required ИП-1

◀ ИП-1 III

2. ИП-1 DEACTIVATION

RS Laptop CM:СЖО:СОГС and ФГБ:СЖО:СОГС

↓ pb near ИП-1

◀ ИП-1 III

Remove deactivated ИП-1 from hatch and temp tether

3.4. DEPRESSURIZATION MONITORING MODE RESETTING FOR EVA

- | | |
|--------------------|--|
| | 1. <u>OPERATION PRIOR TO EVA</u> |
| ДСД | sw → 630 |
| On MCC-M GO | Deactivate required ИП-1 (see 3.3, step 2) |
| RS Laptop | <div style="border: 1px solid black; padding: 2px;">Depressurization</div> proc F26_APS_22 (Use МДД pressure sensor)
Execute
<div style="border: 1px solid black; padding: 2px;">Вкл. МДД</div> |
| | 2. <u>OPERATION AFTER EVA</u> |
| ДСД | sw → 690 |
| | Install removed ИП-1 on hatches and activate them (see 3.3, step 1) |
| RS Laptop | <div style="border: 1px solid black; padding: 2px;">Depressurization</div> proc F26_APS_19 (Use ДДИ pressure indicator)
Execute
<div style="border: 1px solid black; padding: 2px;">Вкл. ДДИ</div> |

3.5. SM PRESSURIZATION FROM PROGRESS

(01:00:00)

Air supply control:

- valves РПК-1, РПК-3 (first assembly)
- valves РПК-2, РПК-4 (second assembly)

NOTE

РПК valves and outlet nozzle are in Progress БО along plane IV
on oxygen supply facility panel

- | | |
|-------------|--|
| | 1. P[MB] init = _____ mmHg
Place air duct at a distance of 10 cm from outlet nozzle
Direct air flow to outlet nozzle |
| Progress БО | 2. РПК-3 (4) → ОТКР (Open)
РПК-1 (2) → ОТКР (Open)
↙ P[MB] |
| 00:00:00 | 3. At P[MB] = P[MB] init + P on MCC-M GO: |
| 00:01:00 | РПК-1 (2) → ЗАКР (Close)
РПК-3 (4) → ЗАКР (Close) |

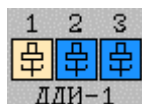
NOTE

During air pressurization do not perform operations in Progress, if possible

3.6. PRESSURE MONITORING AND CONTROL HARDWARE MALFUNCTIONS

1.

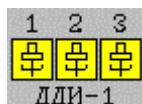
ПСС □ MESSAGE
 RS Laptop  'SM Pressure Sensor DDI1 (2, 3) Failure-RS'
 CM:СЖО:СОГС



Continue operation
 Report to MCC-M

2.

ПСС □ OTHER 3ВУК
 RS Laptop  'SM Pressure Sensors DDI Failure-RS'
 CM:СЖО:СОГС



ППС-22 ✓  ДДИ-1
 ◀ ■ LED Д12

On MCC-M GO:


proc F26_APS_22 (Use МДД pressure sensor)

Execute

Вкл.МДД

NOTE

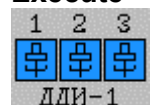
Cabin pressure sensors are used only for pressure measurement
 and are not used in depressurization monitoring mode

ППС-22  ДДИ-1
 Replace ДДИ-1 per RODF: IFM IVA SM

After ДДИ-1 replacement:

ППС-22  ДДИ-1

RS Laptop CM:СЖО:СОГС
 On MCC-M GO proc F26_APS_19 (Use ДДИ pressure indicator)
 Execute



(≈ in 15 min after procedure start)

4. SOLID OXYGEN GENERATOR (ТГK)

NOTE

Activate ТГK at $P.O_2(RS \text{ Laptop}) \leq 147 \text{ mmHg}$

4.1. SOLID OXYGEN GENERATOR (ТГK) OPERATION

(00:15:00)

1. CARTRIDGE PREPARATION

Remove cover from container

Loosen winged screws (five)

Remove cartridge, aligning cartridge housing guides with seat slots

↔ metal cap using 19 mm wrench and → container

↙ integrity of seal on cartridge edge

↙ white paint on the cartridge bottom

↙ no mechanical damage (dents, scratches) on cartridge

Use another cartridge

Report to MCC-M

CAUTION

Time interval from cap removal until cartridge activation must not exceed 3 min

2. CARTRIDGE INSTALLATION

Remove thermal protective cover

Release ТГK clamping mechanism

Insert cartridge, capsule first, into housing

Engage ТГK clamping mechanism:

Handle → retainer

3. ТГK ACTIVATION

338, ППС-23

⚙ ТГK1(2)

🌀 fan is running

After 1 min repeat fan activation:

ППС-23 ⚙ ТГK1(2)

If fan does not operate:

Perform 4.5. step 1

Report to MCC-M

Install thermal protective cover

00:00:00

Impact housing handle on ТГK housing ↷ to click

↙ cartridge activation (warm air flow after 2-3 min)

Perform 4.5, step 2

4. ТГK DEACTIVATION

03:00:00

ППС-23 ⚙ ТГK1(2)

4.2. SOLID OXYGEN GENERATOR (ТГК) CARTRIDGE REPLACEMENT

(00:20:00)

CAUTION

Replace cartridge no sooner than 3 hours after last cartridge was activated
In case of fan failure, cartridge cooling time is increased to 8 hours

Remove thermal protective cover
Release ТГК clamping mechanism
Remove used cartridge
⚠ darkening of color indicator at bottom of cartridge

Report to MCC-M cartridge #

⚠ seal integrity on cartridge edge (if damaged, clean ТГК internal flange using screwdriver)
Metal cap (removed prior to activation) → ⚠ used cartridge (19 mm wrench)
Used cartridge → container:
Unstow new cartridge from container and → ТГК (see 4.1, step 1)

CAUTION

It is not allowed to stow new unused cartridge in ТГК

4.3. SOLID OXYGEN GENERATOR (ТГК) FILTER REPLACEMENT

(00:30:00)

Prepare custom wrench

ППС-23

1. FAN DISASSEMBLY
√ no cartridge in ТГК
⊕ ТГК1(2)
↔ connector X1
Move away washers locking fan wingnuts
Loosen wingnuts (three) rotating 3-4 turns
Remove fan from housing
2. FILTER DISASSEMBLY
Remove impact mechanism handle by turning ↻
Remove custom bolts (three) using custom wrench
Retrieve filter from housing and → discard
3. UNSTOWING OF FILTER FROM ЗИП
Remove screws fastening protective cover
Remove cover from filter and → discard
⚠ no rubber seal on filter flange
(part of protective cover)
⚠ integrity of seal on ТГК housing flange

4. NEW FILTER INSTALLATION

Filter → housing to click matching red alignment marks on bracket and TГK housing

Secure filter on TГK housing (do not allow it to be skewed)
with custom bolts (three) rotating each screw with
custom wrench ↻ 1/3 turn

5. FAN INSTALLATION ON TГK HOUSING

↙ connector X1 pins in good condition

Reinstall fan

Tighten wingnuts (three)

Insert wingnut tab into slot of custom washer

Lock wingnuts with custom washers

→↔ connector X1

✓ fan operation by activating and deactivating it via ППС-23

4.4. TГK FAN REPLACEMENT

(00:30:00)

CAUTION

In the event of fan failure during cartridge burning, replace fan
no sooner than in 8 hours after cartridge activation

1. Remove fan from TГK housing (see 4.3, step 1)
Remove ring containing wingnuts (three) from fan housing by removing screws (six)
2. Unstow new fan from [СТР] ЗИП
Remove protective grill from new fan by removing screws (three)
Removed ring →↔ new fan (on side of protective grill)
Remove static electricity from fan connector 210Ю=G1(G2)-X1 using
special cap [ОСРС 19 АТВ]
3. New fan → TГK housing (see 4.3, step 5)
✓ operation of fan by activating and deactivating it via ППС-23

4.5. ТГК MALFUNCTIONS

1.

Fan failure

1. Bad contact in connector X1

ППС-23

⌚ ТГК1(2)

✓ mating of connector X1

ППС-23

⌚ ТГК1(2)

2. Foreign object lodged in fan

ППС-23

⌚ ТГК1(2)

Remove fan from ТГК (see 4.3, step 1)

Remove foreign object

ППС-23

⌚ ТГК1(2)

3. Motor malfunction

Replace fan (see 4.4)

2.

No cartridge decomposition

(no temperature increase at ТГК outlet)

Rotate cartridge into new position

Repeat cartridge start (up to 4 times)

In event of failure:

Remove cartridge

Inspect and if necessary clean foreign objects from ТГК internal flange
(using screwdriver)

Remove fan (see 4.3, step 1)

✓ wingnuts on ТГК filter are fully tightened (to stop)

Install fan (see 4.3, step 5)

Insert cartridge and restart

In event of failure replace cartridge (see 4.2)

Restart cartridge

In case of failure – replace filter from ЗИП (see 4.3)

3.

Fan stops after cartridge decomposition has begun

After 08:00:00

Replace filter and fan when cartridge decomposition is complete

5. ELEKTRON (OXYGEN GENERATION ASSEMBLY)

Designations used on RS Laptop display in Elektron schematic:

RS Laptop	T_{\max}	- abnormally high electrolyzer temperature sensor
	I	- electrolyzer current sensor
	U	- electrolyzer voltage sensor
	ДО2В	- upper limit violation O2 pressure sensor
	ПЭСВ	- electrolyte in the hydrogen line sensor
	ПЭСК	- electrolyte in the oxygen line sensor
	ДАК	- capsule nitrogen pressure sensor
	ДК	- sensor of capsule pressure low set point (end of purge $0.6 \pm 0.05 \text{ kg/cm}^2$)
	ДКН	- low limit violation capsule pressure sensor (0.9 kg/cm^2)
	БЕ	- buffer tank
	МНО	- primary mini-pump
	МНР	- backup mini-pump
	НБП	- pump unit pump
	КОВ	- deionized water container (ЕДВ)
	КЭ1-КЭ3	- position of solenoid valves КЭ1-КЭ3
	ЭЛВ1	- hydrogen valve
	ЭЛК1	- oxygen valve
	ЭЛВК	- vacuum valve
	O2 in H2	- gas analyzer sensor for O2 in H2 (activation threshold 15 mmHg)
	H2 in O2	- gas analyzer sensor for H2 in O2 (activation threshold is 2%)
	H2 in air	- gas analyzer sensor for H2 in air (activation threshold is 2%)

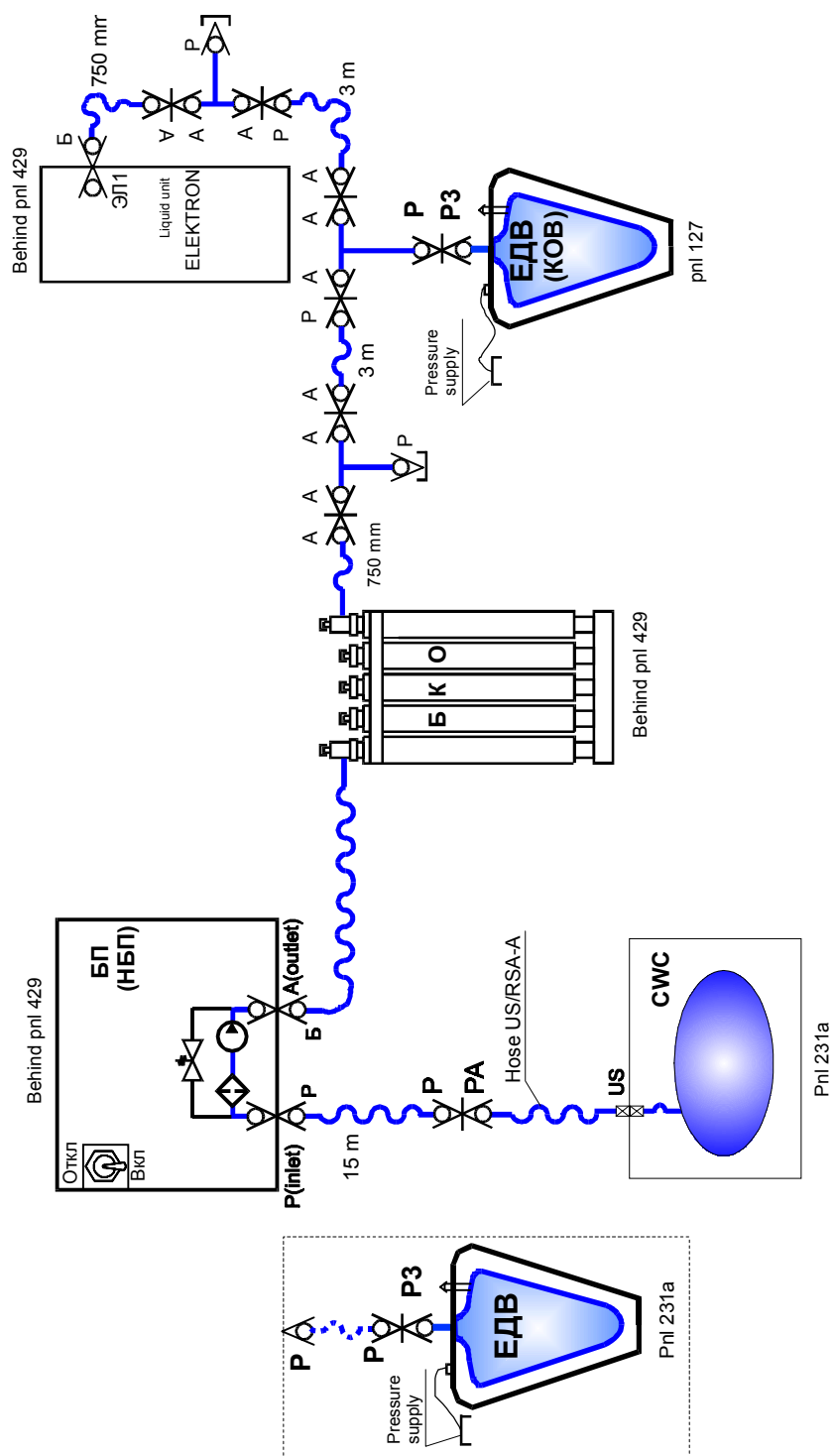
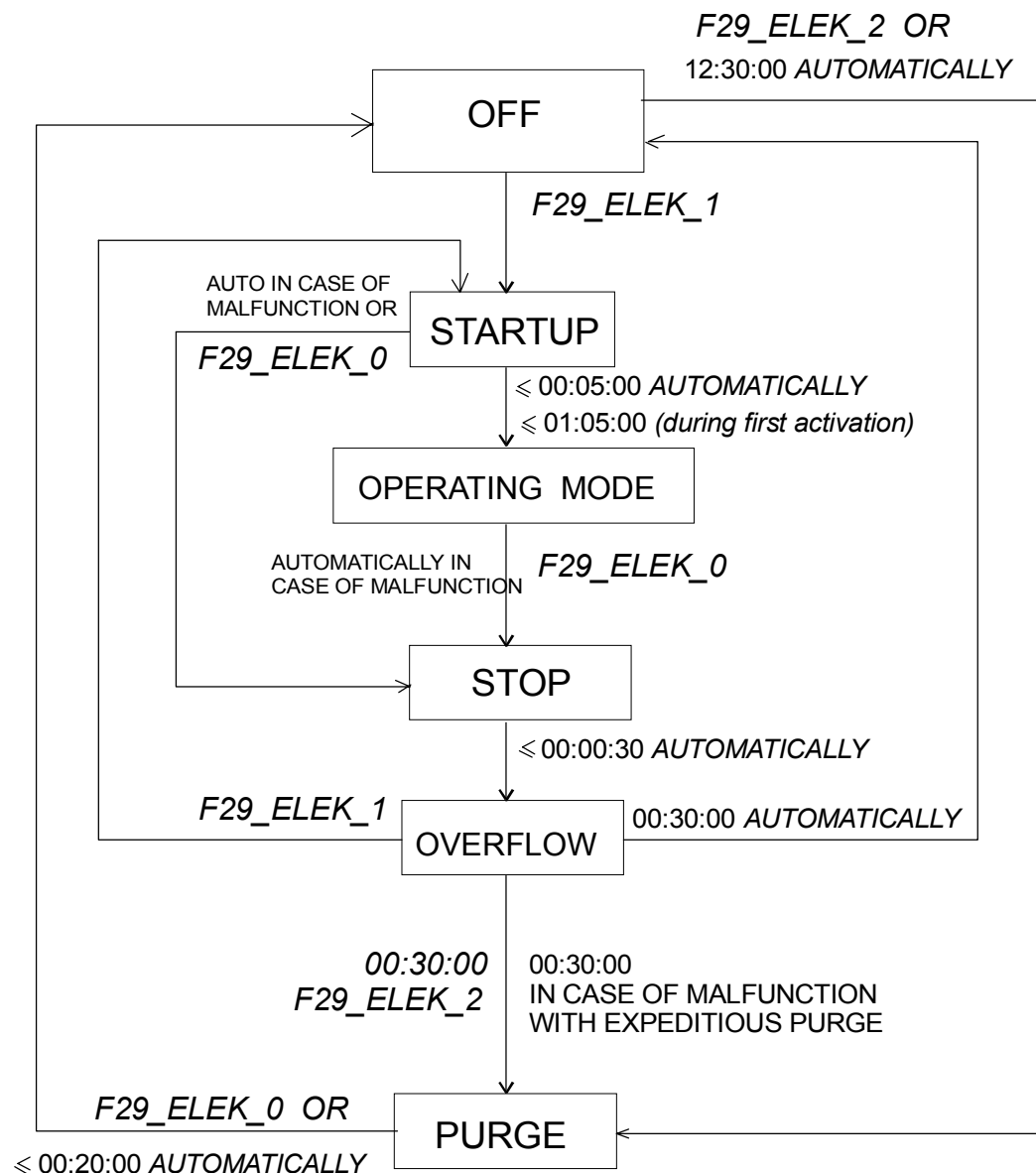


Figure 5.1 Elektron – [CBO] (water supply system) Connection Schematic

5.1. ELEKTRON OPERATIONAL FEATURES

Brief description of transitions between Elektron modes:



To stop Elektron mode execution and to cancel accidentally issued command:

RS Laptop

CM : CЖО : CКО

proc F29_ELEK_0 (БС Elektron Shutdown)

Execute

System Statys	Stop	
System Statys	Overflow	

≤ 00:00:30


√MCC-M

5.2. ELEKTRON ACTIVATION

1. ELEKTRON SETUP FOR THE ACTIVATION

On MCC-M GO select CWC (ЕДВ)

Configure equipment for Elektron [CBO] connection per Figure 5.1

429 Pump Unit	√  ВКЛ (On)
425	√ ЭЛВК — closed
430	√ ЭЛК1 — closed
	√ ЭЛВ1 — closed
429, 430 Liquid Unit	√ cap → ← ЭЛ 201 √ connector ЭЛ1 → ← connector Б of hose А-Б √ valve ВН2 — ОТКР (Open) √ cap → ← X5 of liquid unit √ cap 3Г29 ↔ liquid unit √ connectors MP1, MP2, MP3, MP4 are mated √ valve ВН1 — ЗАКР (Close)
430	√ cap 3Г28 ↔ pipeline ЭЛ 203 (oxygen outlet)
127 CT-64	√ sw — КОДЫ (Codes)

Report to MCC-M (during the first activation and after replacements)


2. OPERATING MODE ACTIVATION

RS Laptop CM : CЖО : CKO

If $P(\text{ДАК}) \leq 0.9$

| Pressurize liquid unit with nitrogen per 5.6

During the first activation and when gas analyzers are deactivated:

	 System Statys	Off	ГA not ready
00:00:00	proc F29_ELEK_3 (<i>Elektron Gas-analyzer Activation</i>)		
	Execute		
01:00:00	proc F29_ELEK_1 (<i>БС Elektron Start</i>)		
	Execute		
	System Statys	Startup	
≤ 01:05:00	System Statys	Operation Mode	

When activated after PRESSURIZATION:

System Statys Off Charge capsule

When activated during OVERFLOW:

System Statys Overflow

When activated after OVERFLOW:

System Statys Off

00:00:00

proc F29_ELEK_1 (BC Elektron Start)


Execute

System Statys Startup

≤ 00:05:00

System Statys Operation Mode

NOTE

1. During system operation  may appear momentarily (power is supplied to primary mini-pump or to backup mini-pump, pressure in line has not reached operating level)
 2. KЭ1 (BE is empty), pump unit pump (KOB is empty) activate automatically as required
- Approximate time of pump unit pump operation is 40 min

5.3. SETTING OF OXYGEN EXTRA PARTIAL PRESSURE (ON MCC-M GO)

Setting is performed on **MCC-M GO** when system is operating

RS Laptop

CM : CЖO : CKO : Task

Extra P.O ₂ (mmHg) (param Резерв O ₂)	P.O ₂ (mmHg)
0	160 + 5
1	161 + 5
2	162 + 5
3	163 + 5
4	164 + 5
5	165 + 5
6	166 + 5
7	167 + 5
8	168 + 5
9	169 + 5
10	170 + 5

On MCC-M GO

proc F29_ELEK_7 (*Elektron reserve oxygen task*)

param _____ (0 --- 10)

Execute

O2Excess 0---10

5.4. ELEKTRON DEACTIVATION (ON MCC-M GO)

On MCC-M GO the system can be deactivated using expeditious purge

RS Laptop

CM : CЖО : CKO

proc F29_ELEK_0 (*BC Elektron Shutdown*)

00:00:00

Execute

System Statys

Stop

≤ 00:00:30

System Statys

Overflow

NOTE

During OVERFLOW and prior to PURGE repeated activation of Elektron is allowed (F29_ELEK_1)

00:30:00

System Statys

Off

On MCC-M GO perform expeditious purge:

proc F29_ELEK_2 (*BC Elektron repressurization*)

Execute


System Statys


Purge


Only during deactivation:

proc F29_ELEK_4 (*Elektron Gas-analyzer Deactivation*)

Execute

 H2 in air

 H2 in O2

 O2 in H2

12:00:00

Activated automatically F29_ELEK_2 (*BC Elektron repressurization*)

System Statys

Purge

≤ 12:20:00

Completed automatically PURGE

System Statys

Off

Charge capsule

5.5. MANUAL CONTROL MODE (ON MCC-M GO)

1. MANUAL CONTROL MODE ACTIVATION

RS Laptop

CM : CKO : CKO

✓ System Statys Off

RS Laptop

proc F29_ELEK_5 (BC Elektron panel Activation)

Execute

System Statys Manual Control

CAUTION

1. Procedure output from MANUAL CONTROL mode is inhibited
2. In MANUAL CONTROL mode the system is not shutdown automatically when failure occurs

proc F29_ELEK_11 (BC Elektron command Transmission)

MCC-M defines command sequence

On MCC-M GO the following commands may be executed:

RS Laptop

1. **param** 1221(1253, 1030) (KЭ1(2, 3) Open)

Execute



KЭ1(2,3) – valve is open, powered

2. **param** 1237(1014, 1046) (KЭ1(2, 3) Close)

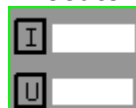
Execute



KЭ1(2,3) – valve is closed, unpowered

3. **param** 1015 (CT-64 power ON)

Execute



Electrolyzer is powered

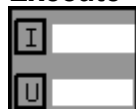
proc F29_ELEK_9 (Elektron CT64 current regulation task)

param _____

Execute

4. **param** 1254 (CT-64 power OFF)

Execute



Electrolyzer is unpowered

5. **param** 1095 (*MHO power ON*)

Execute



primary mini-pump – powered

6. **param** 1111 (*MHP power ON*)

Execute



backup mini-pump - powered

7. **param** 1127 (*MHO,MHP power OFF*)

Execute



primary mini-pump, backup mini-pump – unpowered

8. **param** 1143 (*БП CBO power ON*)

Execute



pump unit pump – powered

9. **param** 1159 (*БП CBO power OFF*)

Execute



pump unit pump - unpowered

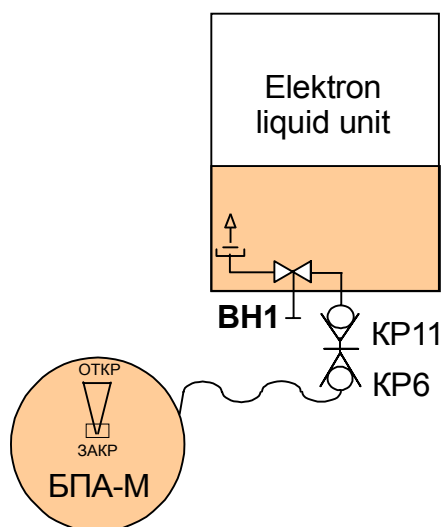
2. EXITING FROM MANUAL CONTROL MODE

proc F29_ELEK_0 (*БС Elektron Shutdown*)

Execute

System Statys	Off	
---------------	-----	--

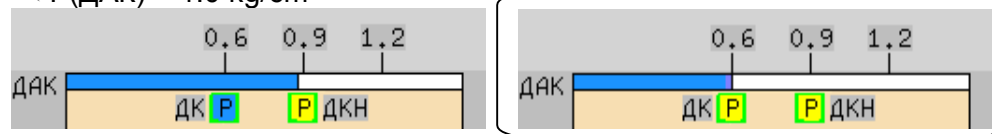
5.6. LIQUID UNIT CAPSULE PRESSURIZATION WITH NITROGEN FROM NITROGEN PURGE ASSEMBLY (БПА-М)



Liquid Unit $\sqrt{\text{connector KP6 of БПА-М} \rightarrow \leftarrow \text{connector KP11 of liquid unit}}$

RS Laptop **CM : CЖО : CKO**

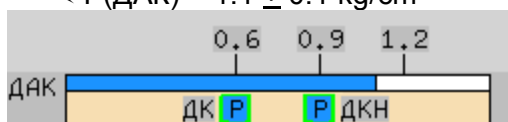
$\angle P(\text{ДАК}) < 1.0 \text{ kg/cm}^2$



Liquid Unit Knurled cartridge of the manual valve BH1 depress and ↻ (remove restraints)
BH1 → ОТКР (Open)

БПА-М БПА-М manual valve → ОТКР (Open)

RS Laptop $\angle P(\text{ДАК}) = 1.1 \pm 0.1 \text{ kg/cm}^2$



БПА-М БПА-М manual valve → 3AKP (Close)

Liquid Unit BH1 → 3AKP (Close)
Secure manual valve BH1

RS Laptop \angle **System Status**

(«Charge capsule» is canceled after F29_ELEK_1 issue, see 5.2)

5.7. ELEKTRON ГA INPUT VOLTAGE MEASUREMENT USING GAS ANALYZER STATUS INDICATOR (ИГЗ)

1. ELEKTRON ГA INPUT VOLTAGE MEASUREMENT

√ Unstow gas analyzer status indicator from ЗИП ГA

ИГЗ

gas analyzer status indicator adapter →|← cnctr X4 of checked gas analyzer
sw → 2

Measure checked gas analyzer V_{input}
sw → 1

When measuring O_2 in H_2 ГA (ГЛ5188)

	ГA-1 V_{input} (ИГЗ) = _____ V	(should be 23 --- 34 V)
	ГA-2 V_{input} (ИГЗ) = _____ V	(should be 23 --- 34 V)
	ГA-3 V_{input} (ИГЗ) = _____ V	(should be 23 --- 34 V)

When measuring O_2 in H_2 ГA (ТП1187)

	ГA-1 V_{input} (ИГЗ) = _____ V	(should be 23 --- 34 V)
	ГA-2 V_{input} (ИГЗ) = _____ V	(should be 23 --- 34 V)

When measuring H_2 ГA (ТП1188)

	H_2 ГA V_{input} (ИГЗ) = _____ V	(should be 23 --- 34 V)
--	--------------------------------------	-------------------------

Return ГA, gas analyzer status indicator to initial configuration per step 2
(if necessary)

Report to MCC-M

2. ГA, GAS ANALYZER STATUS INDICATOR RETURN TO INITIAL CONFIGURATION:

ИГЗ

√ sw → 1

gas analyzer status indicator adapter ←|→ ГA connector X4

gas analyzer status indicator adapter →|← gas analyzer status indicator
Return gas analyzer status indicator to ЗИП ГA stowage location

5.8. ELEKTRON GA OUTPUT VOLTAGE MEASUREMENT USING GAS ANALYZER STATUS INDICATOR

1. ELEKTRON OUTPUT VOLTAGE MEASUREMENT

√ Unstow gas analyzer status indicator from ЗИП ГА

gas analyzer status indicator adapter → ← cnctr X4 of checked gas analyzer
sw → 3

ИГЗ

Measure checked gas analyzer V_{output}
sw → 1

When measuring O_2 in H_2 ГА (ГЛ5188)

ГА-1 V_{output} (ИГЗ) = _____ V

ГА-2 V_{output} (ИГЗ) = _____ V

ГА-2 V_{output} (ИГЗ) = _____ V

Convert ГА V_{output} to physical values:

$P.O_2$ in $H_2 = 3.33 \cdot \text{ГА } V_{\text{output}}$ (mmHg)

$P_1.O_2$ in $H_2 =$ _____ mmHg (for ГА-1)

$P_2.O_2$ in $H_2 =$ _____ mmHg (for ГА-2)

$P_3.O_2$ in $H_2 =$ _____ mmHg (for ГА-3)

When measuring O_2 in H_2 ГА (ТП1187)

ГА-1 V_{output} (ИГЗ) = _____ V

ГА-2 V_{output} (ИГЗ) = _____ V

Convert ГА V_{output} to physical values:

$C.H_2$ in $O_2 = 0.417 \cdot \text{ГА } V_{\text{output}}$ (%)

$C_1.H_2$ in $O_2 =$ _____ % (for ГА-1)

$C_2.H_2$ in $O_2 =$ _____ % (for ГА-2)

When measuring H_2 ГА (ТП1188)

H_2 ГА V_{output} (ИГЗ) = _____ V

Convert H_2 ГА V_{output} to physical values:

$C.H_2 = 0.417 \cdot \text{ГА } V_{\text{output}}$ (%)

$C.H_2 =$ _____ %

Return ГА, gas analyzer status indicator to initial configuration per step 2
(if necessary)

Report to MCC-M

2. ГА, GAS ANALYZER STATUS INDICATOR RETURN TO INITIAL CONFIGURATION

ИГЗ

√ sw → 1

gas analyzer status indicator adapter ↔ ГА connector X4

gas analyzer status indicator adapter → ← gas analyzer status indicator
Return gas analyzer status indicator to ЗИП ГА stowage location

5.9. ELEKTRON GA CIRCUIT INTEGRITY CHECKOUT USING GAS ANALYZER STATUS INDICATOR

1. ELEKTRON CIRCUIT INTEGRITY CHECKOUT

√ Unstow gas analyzer status indicator from ЗИП ГА

gas analyzer status indicator adapter → ← cnctr X4 of checked gas analyzer

ИГЗ

sw → 3

↓ ПУСК (Start)

□ ПРОБЕРКА (Checkout)

Measure checked gas analyzer V_{output}

↓ СТОП (Stop)

■ ПРОБЕРКА (Checkout)

sw → 1

During O_2 in H_2 ГА checkout (ГЛ5188)

ГА-1 V_{output} (ИГЗ) = _____ V (should be 0 --- 4.25 V)

ГА-2 V_{output} (ИГЗ) = _____ V (should be 0 --- 4.25 V)

ГА-3 V_{output} (ИГЗ) = _____ V (should be 0 --- 4.25 V)

During O_2 in H_2 ГА checkout (ТП1187)

ГА-1 V_{output} (ИГЗ) = _____ V (should be 0.75 --- 4.25 V)

ГА-2 V_{output} (ИГЗ) = _____ V (should be 0.75 --- 4.25 V)

During H_2 ГА checkout (ТП1188)

H_2 ГА V_{output} (ИГЗ) = _____ V (should be 0.75 --- 4.25 V)

Return ГА, gas analyzer status indicator to initial configuration per step 2
(if necessary)

Report to MCC-M

2. ГА, GAS ANALYZER STATUS INDICATOR RETURN TO INITIAL CONFIGURATION:

ИГЗ


√ sw → 1

gas analyzer status indicator adapter ↔ ГА connector X4

gas analyzer status indicator adapter → ← gas analyzer status indicator

Return gas analyzer status indicator to ЗИП ГА stowage location

5.10. ELEKTRON MALFUNCTIONS

ПСС ☐ ADVISORY MESSAGE (green)
 RS Laptop  SM ELEKTRON Fault-RS (SM ELEKTRON Capsule Pressure Low Limit-RS)
 CM : CKO : CKO
Report to MCC-M failure cause

00:00:00	In case of failures, the system is automatically shutdown
	System Statys <input type="text" value="Stop"/> <input type="text" value="Fault"/>
≤ 00:00:30	System Statys <input type="text" value="Overflow"/> <input type="text" value="Fault"/>
	Automatically executed F29_ELEK_2 (BC Elektron repressurization)
00:30:00	System Statys <input type="text" value="Purge"/> <input type="text" value="Fault"/>
≤ 00:50:00	System Statys <input type="text" value="Off"/> <input type="text" value="Fault"/>

If failure cause is not determined:

On MCC-M GO
 RS Laptop **proc** F29_ELEK_10 (Elektron Fault discrete Reset)
Execute
 ПСС ☒ ADVISORY MESSAGE
 Activate system per 5.2, step 2
 Verify possible failure for 10 min
Report to MCC

1.

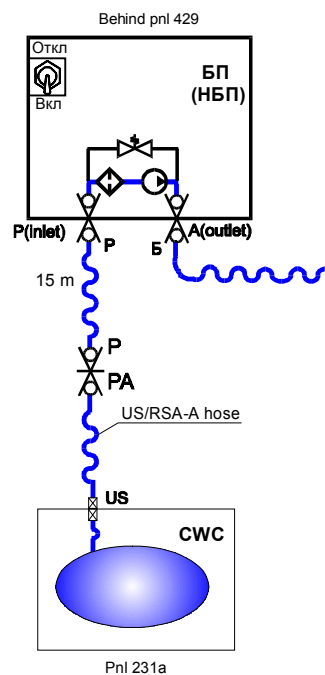


KOB – water container is empty

RS Laptop **proc** F29_ELEK_10 (Elektron Fault discrete Reset)
Execute

ПСС ☒ ADVISORY MESSAGE

Check if there is water in CWC
 If there is no water in CWC:
 Replace CWC (install full CWC see Figure)
 If there is water in CWC:
 Replace pump unit per RODF:
 IFM IVA SM
 Activate system per 5.2, step 2
 In case of repeated failure √MCC-M



2.



НБП – pump unit pump failure

proc F29_ELEK_10 (*Elektron Fault discrete Reset*)
Execute

If system was shutdown automatically:

Replace [КОВ](ЕДВ) (install full ЕДВ)

Activate system per 5.2, step 2

If system was not shutdown automatically:

БП < water container is full

БП ⚙ ОТКЛ (Off)

Report to MCC

Every three days activate pump unit for 1 hour (⚙ ВКЛ (On))

3.



ДО2В – oxygen pressure is abnormally high

RS Laptop

proc F29_ELEK_10 (*Elektron Fault discrete Reset*)
Execute

Activate system per 5.2, step 2

In case of repeated failure:

1. cap 3Г34 ↔ КР1

БИД (ИД-4) → ← КР1

↓ pb on БИД

< P₁(БИД) _____

✓ pb on БИД

cap 3Г34 → ← КР1

Report to MCC-M P₁(БИД)

✓MCC-M

2. On MCC-M GO

cap 3Г35 ↔ КР2

БИД (ИД-4) → ← КР2

↓ pb on БИД

< P₂(БИД) _____

✓ pb on БИД

cap 3Г35 → ← КР2

Report to MCC-M P₂(БИД)

✓MCC-M

4.

P ДКН - pressure in the pressurized capsule is abnormally low

If P(ДАК) < 0.9

Repress liquid unit capsule with nitrogen per 5.6

proc F29_ELEK_10 (*Elektron Fault discrete Reset*)**Execute**

Activate system per 5.2, step 2

If P(ДАК) > 0.9

Report to MCC-M**On MCC-M GO** **proc** F29_ELEK_10 (*Elektron Fault discrete Reset*)**Execute****On MCC-M GO** activate system per 5.2, step 2In case of repeated failure √**MCC-M**

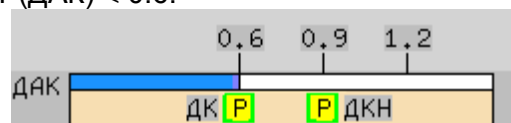
5.

ДК P - pressure in capsule is at lower setpoint

RS Laptop

proc F29_ELEK_10 (*Elektron Fault discrete Reset*)**Execute**

If P(ДАК) < 0.6:



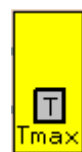
Repress liquid unit capsule with nitrogen per 5.6

Activate the system per 5.2, step 2

If P(ДАК) > 0.9

On MCC GO activate the system per 5.2, step 2In case of repeated failure √**MCC-M**

6.



T_{max} – electrolyte temperature is abnormally high

RS Laptop

proc F29_ELEK_10 (*Elektron Fault discrete Reset*)**Execute****Report to MCC-M**

7.

 ПЭСК

 ПЭСВ – electrolyte detected in the oxygen (hydrogen) line

RS Laptop **proc** F29_ELEK_10 (*Elektron Fault discrete Reset*)
 Execute
 Report to MCC-M

8.

 MHO – primary mini-pump failure

The system is automatically switched to backup mini-pump

During activation of system after momentary deactivation:

RS Laptop **proc** F29_ELEK_10 (*Elektron Fault discrete Reset*)
 Execute

During activation of system after deactivation for more than 6 hours:

RS Laptop **proc** F29_ELEK_0 (*BC Elektron Shutdown*)
 Execute

On MCC-M GO **proc** F29_ELEK_10 (*Elektron Fault discrete Reset*)
 Execute
 proc F29_ELEK_1 (*BC Elektron Start*)
 Execute

9.

 MHP – backup mini-pump failure

RS Laptop **proc** F29_ELEK_10 (*Elektron Fault discrete Reset*)
 Execute

 КЭ-3 (after OVERFLOW)

connector KP6 of nitrogen purge assembly ↔ connector KP11 of liquid unit
 connector KP6 of nitrogen purge assembly →|← connector ЭЛ201 of liquid unit
 Knurled cartridge of the manual valve BH2 depress and ↻ (remove restraints)
 BH2 → 3AKP (Close)

00:00:00 БПА-M manual valve → ОТКР (Open)

00:02:00 БПА-M manual valve → 3AKP (Close)

connector KP6 of nitrogen purge assembly ↔ connector ЭЛ201 of liquid unit

BH2 → ОТКР (Open)

Secure manual valve BH2

Connector KP6 of nitrogen purge assembly →|← connector KP11 of liquid unit

Activate system per 5.2, step 2

In case of repeated failure √MCC-M

10.

**KЭ1 – KЭ1 failed to close**

RS Laptop **proc** F29_ELEK_10 (*Elektron Fault discrete Reset*)
Execute

Connector of ЭЛ1 ↔ liquid unit
 Maintenance access hatch ↔ liquid unit
 KЭ1 → 3 (closed)
 KЭ1 → midposition (electrical control)
 Maintenance access hatch →|← liquid unit
 Connector of ЭЛ1 →|← liquid unit

Activate system per 5.2, step 2
 In case of repeated failure √**MCC-M**

11.

**KЭ1 – KЭ1 failed to open**

RS Laptop **proc** F29_ELEK_10 (*Elektron Fault discrete Reset*)
Execute

00:00:00 Maintenance access hatch ↔ liquid unit
 KЭ1 → O (open)
 00:02:00 KЭ1 → 3 (closed)
 KЭ1 → midposition (electrical control)
 Maintenance access hatch →|← liquid unit

Activate system per 5.2, step 2
 In case of repeated failure √**MCC-M**

12.

**KЭ2 – KЭ2 failed to close**

If $P(\text{ДАК}) \leq 0.6$
 Maintenance access hatch ↔ liquid unit
 KЭ2 → 3 (closed)
 KЭ2 → midposition (electrical control)
 Maintenance access hatch →|← liquid unit

RS Laptop **proc** F29_ELEK_10 (*Elektron Fault discrete Reset*)
Execute
 √**MCC-M**

13.

**КЭ2 – КЭ2 failed to open**

ЭЛВ1 → open (handle ОТКРЫТЬ (Open) up and return to initial position until it clicks)
 ЭЛК1 → open (handle ОТКРЫТЬ (Open) up and return to initial position until it clicks)
 ЭЛВК → open (handle ОТКРЫТЬ (Open) up and return to initial position until it clicks)
 Maintenance access hatch ↔ liquid unit
 КЭ3 → O (open)
 КЭ2 → O (open)
 RS Laptop $\angle \angle P(\text{ДАК}) \leq 0.65$
 $\leq 00:20:00$ КЭ2 → 3 (closed)
 КЭ3 → 3 (closed)
 ЭЛВК → closed (\downarrow pb ЗАКРЫТЬ (Close) on ЭЛВ1)
 ЭЛВ1 → closed (\downarrow pb ЗАКРЫТЬ (Close) on ЭЛК1)
 ЭЛК1 → closed (\downarrow pb ЗАКРЫТЬ (Close) on ЭЛВК)
 Maintenance access hatch →← liquid unit

RS Laptop **proc** F29_ELEK_10 (*Elektron Fault discrete Reset*)
Execute
 $\sqrt{\text{MCC-M}}$

14.

**КЭ3 – КЭ3 failed to close**

Maintenance access hatch ↔ liquid unit
 КЭ3 → 3 (closed)
 КЭ3 → midposition (electrical control)
 Maintenance access hatch →← liquid unit

proc F29_ELEK_10 (*Elektron Fault discrete Reset*)
Execute
 $\sqrt{\text{MCC-M}}$

15.

**КЭ3 – КЭ3 failed to open**

Maintenance access hatch ↔ liquid unit
 КЭ3 → O (open)
 КЭ3 → midposition (electrical control)
 Maintenance access hatch →← liquid unit

proc F29_ELEK_10 (*Elektron Fault discrete Reset*)
Execute
 Activate system per 5.2, step 2
 In case of repeated failure $\sqrt{\text{MCC-M}}$

16.



ЭЛК1 (ЭЛВ1, ЭЛВК) – ЭЛК1 (ЭЛВ1, ЭЛВК) failed to open

ЭЛК1 (ЭЛВ1, ЭЛВК) → open (handle ОТКРЫТЬ (Open) up and return to initial position until it clicks)

proc F29_ELEK_10 (*Elektron Fault discrete Reset*)

Execute

If failure occurred after OVERFLOW

00:00:00 $\angle P(\text{ДАК}) > 09$
proc F29_ELEK_2 (*БС Elektron repressurization*)

Execute

System Statys Purge

$\leq 00:20:00$ System Statys Off Charge capsule

Activate system per 5.2, step 2

In case of repeated failure $\sqrt{\text{MCC-M}}$

If failure occurred after OPERATING MODE activation:

Activate system per 5.2, step 2

In case of repeated failure $\sqrt{\text{MCC-M}}$

17.



ЭЛК1 (ЭЛВ1, ЭЛВК) – ЭЛК1 (ЭЛВ1, ЭЛВК) failed to close

ЭЛК1 (ЭЛВ1, ЭЛВК) → closed (\downarrow pb ЗАКРЫТЬ (Close) on ЭЛК1(ЭЛВ1, ЭЛВК))

proc F29_ELEK_10 (*Elektron Fault discrete Reset*)

Execute

$\sqrt{\text{MCC-M}}$

18.

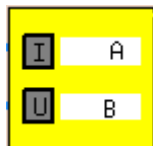
ПСС ☐ CAUTION OTHER (yellow) ЗВУК (if ГА inhibited during the first activation)

RS Laptop “Hydrogen content in oxygen is abnormally high” (if ГА inhibited
 (“Oxygen content in hydrogen is abnormally high”) during the first activation)

H₂ in O₂ (O₂ in H₂, H₂ in air) – ГА reading is abnormal

$\sqrt{\text{MCC-M}}$

19.



- CT-64 failure

proc F29_ELEK_10 (*Elektron Fault discrete Reset*)

Execute

Activate system per 5.2, step 2

In case of repeated failure $\sqrt{\text{MCC-M}}$ (issue **proc** F29_ELEK_10 on **MCC-M GO**)

5.10.1. CT-64 (CURRENT STABILIZER) IS NOT POWERED DOWN

ПСС

WARNING

□ OTHER (red)

ЗВУК

RS Laptop



“Авария “Электрона” СМ”

448

РЦП-С

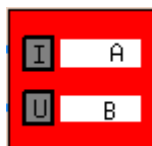
1. Remove power from CT-64:

ПРИЧАЛ Б1 ⚡ Н1

ПРИЧАЛ Б1 ⚡ Н2

Report to MCC-M

RS Laptop

2. СМ : СЖО : СКО**Report to MCC-M** CT-64 icon status change**proc** F29_ELEK_10 (*Elektron Fault discrete Reset*)**Execute**

ПСС

■ OTHER

√MCC-M

5.10.2. SYSTEM OUTPUT MANUAL SETTING

Perform when system is operating

RS Laptop

CM : CЖО : CKO : TASK

CM:CЖО:CKO:Task

Planned Task	<input type="text"/>
Cum. Output	<input type="text"/>
O2 Excess	<input type="text"/>
Deficit	<input type="text"/> A

CTRL

RS Laptop

on MCC-M GO

proc F29_ELEK_6 (*Elektron main production operation*)

param _____ (96 --- 384 Aч)

Execute

Planned Task (param)

where:

96 A/h = 16 A × 6 h (240 L O₂ per 6 hours)

144 A/h = 24 A × 6 h (360 L O₂ per 6 hours)

...

384 A/h = 64 A × 6 h (960 L O₂ per 6 hours)

3 persons consume 450 L O₂ per 6 hours

System produces 1 L O₂ per 0.4 A/h

Daily task is:

450 L O₂ · 0.4 A/h = 180 A/h

5.11. ELEKTRON SCHEMATIC

БД - secondary purification unit
 БДР - flow regulator
 БЕ - buffer tank
 БЖ - liquid unit
 БКО - purification column unit
 БП - pump unit
 БПА-М - nitrogen purge assembly
 БССК - signal & command matching unit
 БХ - refrigerators

ВН - shutoff valve

ЗД - pressure controller

КО - check valve
 КОВ - deionized water container
 КР - connector valve
 КЭ - solenoid valve

МНО - primary mini-pump
 МНР - backup mini-pump

Р - separator

СЖФ - liquid sensor
 СТ-64 - current stabilizer

Т - heat exchanger

УД - pressure equalizer

Ф - aerosol filter

Э - electrolyzer
 ЭЛВ1 - hydrogen valve
 ЭЛВК - vacuum valve
 ЭЛК1 - oxygen valve

ПЭСК

- display designation of system unit state on RS Laptop



6. VOZDUKH (CO₂ REMOVAL SYSTEM)

6.1. VOZDUKH OPERATION FEATURES

For the system control, activate Vozdukh control panel (ПУ COA)

Press pushbuttons on ПУ COA to stop and hold for 1---2 sec

During the system operation, deactivate ПУ COA

Prior to operating atmosphere purification unit (BOA) remove sound isolation cover (if present)

After operating atmosphere purification unit (BOA) install sound isolation cover on BOA

Valves VAC VLV1,2,3, [ABK-COA1] can be open manually, and closed either manually or automatically (via ПУ COA, ИАПУ) and automatically in case of off-nominal situations

When operating VAC VLV1,2,3, [ABK-COA1] monitor VAC VLV1,2,3, [ABK-COA1] status per label on valve visual indicator

Operating VLV GRP handles change position automatically, pass position CLOSED without stopping

VOZDUKH operating modes

Table 6.1-1

	Adsorbent cartridges quantity	switch CYCLE TIME	switch VAC PUMP CYCLE TIME	switch AIR FLOW, % FULL			
				Sleep	Day	Physical exercises	Number of crew-members
Mode 1	2	30 min	1 min	40%	60%, 80%	100%	3-4
Mode 2	3	30 min	2 min	40%	60%, 80%	100%	3-4
Mode 3	2	20 min	1 min	40%	60%, 80%	100%	3-4
Mode 4	3	20 min	2 min	40%	60%, 80%	100%	3-4
Mode 5	2	10 min	1 min	40%	60%, 80%	100%	3-4
Mode 6	3	10 min	2 min	40%	60%, 80%	100%	3-4
				100%	100%	100%	5-6

VOZDUKH control modes

Table 6.1-2

	Adsorbent cartridges quantity	switch CYCLE TIME	switch VAC PUMP CYCLE TIME	switch AIR FLOW, % FULL			
				Sleep	Day	Physical exercises	Number of crew- members
Automatic mode of Vozdukh and air flow cycles control	3	AUTO	2 min	AUTO	AUTO	AUTO	
sw PP CO2 SETPOINT mmHg	3---4.5	3---4.5	3---4.5	3---4.5	3---4.5	3---4.5	2
	5---6	5---6	5---6	5---6	5---6	5---6	3
Automatic mode of Vozdukh cycles control (backup)	3	AUTO	2 min	40	60, 80	100	3-4
Automatic mode of air flow control (backup)	3	10(20, 30) min	2 min	AUTO (sw CYCLE TIME → 30 min)	AUTO (sw CYCLE TIME → 20 min)	AUTO (sw CYCLE TIME → 10 min)	
sw PP CO2 SETPOINT mmHg	3---4.5	3---4.5	3---4.5	3---4.5	3---4.5	3---4.5	2
	5---6	5---6	5---6	5---6	5---6	5---6	3

6.2. VOZDUKH ACTIVATION AFTER BREAK IN OPERATION

425 ПУ COA

1. SYSTEM ACTIVATION

↓ POWER PANEL ON

- ☐ Д14
☐ VAC V1 CL
☐ VAC V2 CL
☐ VAC V3 CL
☒ VAC V OP
☐ SEL VLV MANUAL
☐ SYS INIT

⬇ POWER 1, 2, 3 (three)

⬇ VACUUM PUMP

⬇ FAN

√ ⬇ VLV GRP 1,2,3 (three)

↓ SYS INIT

↓ SEL VLV AUTO ON

☒ SEL VLV MANUAL

all ⬇ HEATER-1, 2 C1-C4 (eight)

On MCC-M GO activate required system mode:

Mode 1(3,5)		Mode 2(4,6)	
ПУ COA	sw VAC PUMP CYCLE TIME — 1 min	ПУ COA	sw VAC PUMP CYCLE TIME — 2 min
BOA	√ VLV GRP 1 — CLOSED before ABSORB	BOA	√ VLV GRP 1,2 — CLOSED before ABSORB
	VLV GRP 2 → CLOSED before REGEN		VLV GRP 3 → CLOSED before REGEN
БПО	√ SELECTOR VALVE — 1	БПО	√ SELECTOR VALVE — 1
BOA	VAC VLV 1 → OTKP (Open)	BOA	VAC VLV 1 → OTKP (Open)
	VAC VLV 2 → OTKP (Open)		VAC VLV 2 → OTKP (Open)
behind 425 [ABK-COA1]	→ OPEN		VAC VLV 3 → OTKP (Open)
		behind 425 [ABK-COA1]	→ OPEN
ПУ COA	⬇ VLV GRP 1,2 (two)	ПУ COA	↓ GANG OPS/VLV GRP 1,2 ON
			<input type="checkbox"/> GANG 1,2
			<input checked="" type="checkbox"/> SYS INIT
			⬇ VLV GRP1,2,3 (three)

00:00:00

sw CYCLE TIME → 30 min (20 min, 10 min) (see Table 6.1-1)

sw AIR FLOW, % FULL → 40 (60, 80, 100)% (see Table 6.1-1)

≤ 00:10:00

Monitor system activation per step 2

2. SYSTEM ACTIVATION MONITORING

Mode 1(3,5)		Mode 2(4,6)	
BOA	⬇ VLV GRP 1 — ABSORB	BOA	⬇ VLV GRP 1 — ABSORB
	⬇ VLV GRP 2 — REGEN		⬇ VLV GRP 2 — ABSORB
БПО	⬇ SELECTOR VALVE — 2		⬇ VLV GRP 3 — REGEN
ПУ COA	<input checked="" type="checkbox"/> SYS INIT	БПО	⬇ SELECTOR VALVE — 2

↓ POWER PANEL OFF

☒ Д14

√ protective covers are installed above VLV GRP, SELECTOR VALVE handles

6.3. MODE 1(3, 5) TO MODE 2(4, 6) TRANSITION (MODE 2(4, 6) TO MODE 1(3, 5) TRANSITION)

BOA ↖ one VLV GRP (or two VLV GRP) changed position — REGEN

ПУ COA ↓ POWER PANEL ON □ Д14

sw CYCLE TIME → OFF

On MCC-M GO system switchover to required mode:

Mode 1(3,5) to mode 2(4,6) transition	Mode 2(4,6) to mode 1(3,5) transition
<p>ПУ COA ⌚ VLV GRP 1,2 (two) ✓ ⌚ VLV GRP 3 ↓ SYS INIT □ SYS INIT □ SEL VLV MANUAL</p> <p> ↓ VAC VLVS CLOSED □ VAC V1 CL □ VAC V2 CL □ VAC V3 CL ■ VAC V OP</p> <p> VLV GRP 1 → CLOSED before ABSORB VLV GRP 2 → CLOSED before ABSORB VLV GRP 3 → CLOSED before REGEN</p> <p>БПО SELECTOR VALVE — 1</p> <p>BOA VAC VLV 1 → OTKP (Open) VAC VLV 2 → OTKP (Open) VAC VLV 3 → OTKP (Open) behind 425 [ABK-COA1] → OPEN</p> <p>ПУ COA ↓ SEL VLV AUTO ON ■ SEL VLV MANUAL ↓ GANG OPS/VLV GRP 1,2 ON □ GANG 1,2 ■ SYS INIT ⌚ VLV GRP 1,2,3 (three)</p> <p>ПУ COA sw VAC PUMP CYCLE TIME — 2 min</p>	<p>ПУ COA ⌚ VLV GRP 1,2,3 (three) ↓ SYS INIT ■ GANG 1,2 □ SYS INIT □ SEL VLV MANUAL</p> <p> ↓ VAC VLVS CLOSED □ VAC V1 CL □ VAC V2 CL □ VAC V3 CL ■ VAC V OP</p> <p> VLV GRP 1 → CLOSED before ABSORB VLV GRP 2 → CLOSED before REGEN Rotate VLV GRP 3 handle on full rotation In direction of arrow on VLV GRP VLV GRP 3 → CLOSED before ABSORB</p> <p>БПО SELECTOR VALVE — 1</p> <p>BOA VAC VLV 1 → OTKP (Open) VAC VLV 2 → OTKP (Open) behind 425 [ABK-COA1] → OPEN</p> <p>ПУ COA ↓ SEL VLV AUTO ON ■ SEL VLV MANUAL</p> <p> ⌚ VLV GRP 1,2 (two)</p> <p>ПУ COA sw VAC PUMP CYCLE TIME — 1 min</p>

00:00:00 sw CYCLE TIME → 30 min (20 min, 10 min) (see Table 6.1-1)

sw AIR FLOW, % FULL → 40 (60, 80, 100)% (see Table 6.1-1)

≤ 00:10:00 Monitor system activation per 6.2, step 2

6.4. VOZDUKH OPERATING MODE CHANGE

Mode1 to mode 3 transition Mode 2 to mode 4 transition Mode 5 to mode 3 transition Mode 6 to mode 4 transition	Mode1 to mode 5 transition Mode 2 to mode 6 transition Mode 3 to mode 5 transition Mode 4 to mode 6 transition
00:00:00 CYCLE TIME → 20 min	00:00:00 CYCLE TIME → 10 min
≤ 00:20:00 ◀ VLV GRP change position	≤ 00:10:00 ◀ VLV GRP change position

Mode 3 to mode1 transition Mode 4 to mode 2 transition Mode 5 to mode 1 transition Mode 6 to mode 2 transition
00:00:00 CYCLE TIME → 30 min
≤ 00:30:00 ◀ VLV GRP change position

6.5. SYSTEM SWITCHOVER TO AUTOMATIC MODE OF VOZDUKH CYCLE AND AIR FLOW CONTROL

П/У COA

√ sw VAC PUMP CYCLE TIME — 2 min

On MCC-M GO:

sw PP CO2 SETPOINT mmHg → 6 (5,5; 5) (for 3 crewmembers)

sw PP CO2 SETPOINT mmHg → 4,5 (4; 3,5; 3) (for 2 crewmembers)

sw ADJUST CYCLE TIME → 100 (90, 80, 70, 60, 50, AUTO) %

00:00:00

2 black rubber caps ↔ outputs of ГА ТП2286 (pnl 421)

00:30:00

⚙ SENSORS Δ CO2

sw CYCLE TIME → AUTO

sw AIR FLOW, % FULL → AUTO

For switchover to the other operating mode:

2 black rubber caps →|← outputs of ГА ТП2286 (pnl 421)

⚙ SENSORS Δ CO2

on MCC-M GO perform 6.2 (6.3)

6.6. MAXIMUM CO₂ ADSORPTION MODE ACTIVATION (FROM MODE 2 (4) TO MODE 6)

Mode is activated during physical exercise and in the presence of visiting crew

П/У COA

√ sw VAC PUMP CYCLE TIME — 2 min

sw CYCLE TIME → 10 min

sw AIR FLOW, % FULL → 100%

6.10. MAINTENANCE CLOSURES OF VAC VLVS (ON MCC-M GO)

on MCC-M GO Close valves once every 7---30 days

ПУ COA

↓ POWER PANEL ON

□ Д14

Modes 1(3,5)		Modes 2(4,6)	
БОА	■ VAC V1 CL ■ VAC V2 CL □ VAC V OP VAC VLV 3 → OTKP (Open) ПУ COA ■ VAC V3 CL		■ VAC V1 CL ■ VAC V2 CL ■ VAC V3 CL □ VAC V OP
	↓ VAC VLVS CLOSED □ VAC V1 CL □ VAC V2 CL □ VAC V3 CL ■ VAC V OP		↓ VAC VLVS CLOSED □ VAC V1 CL □ VAC V2 CL □ VAC V3 CL ■ VAC V OP
БОА	VAC VLV 1 → OTKP (Open) VAC VLV 2 → OTKP (Open) behind 425 [ABK-COA1] → OPEN	БОА	VAC VLV 1 → OTKP (Open) VAC VLV 2 → OTKP (Open) VAC VLV 3 → OTKP (Open) behind 425 [ABK-COA1] → OPEN
ПУ COA	■ VAC V1 CL ■ VAC V2 CL □ VAC V OP	ПУ COA	■ VAC V1 CL ■ VAC V2 CL ■ VAC V3 CL □ VAC V OP

↓ POWER PANEL OFF
Report to MCC-M

■ Д14

6.11. VACUUM VALVE GROUP (ВВК) MANUAL CONTROL

425 ПУ COA √ ⊕ VLV GRP 1(2,3)

under

425 БОА

Remove protective cover from VLV GRP 1(2, 3) housing
by pressing spring latch to release
Press in VLV GRP handle to stop, rotate valve handle
to required position (using directional arrows on handle)
Release VLV GRP handle

Install protective cover on VLV GRP housing
Verify cover is locked on VLV GRP housing

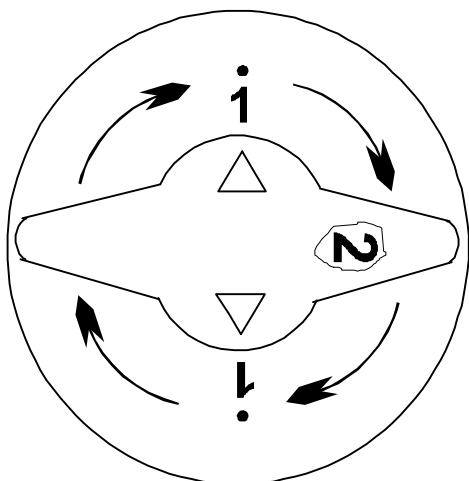
6.12. DESICCANT SELECTOR VALVE (ПКО) MANUAL CONTROL

321 БПО

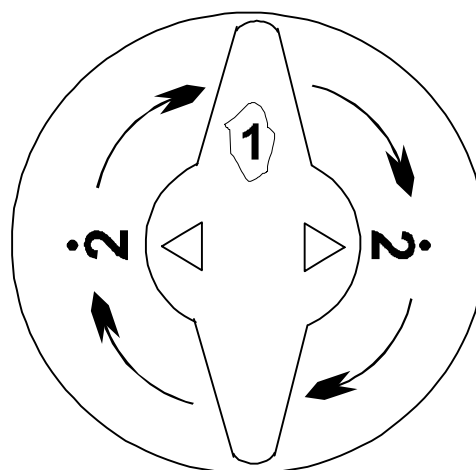
Remove protective cover from desiccant selector valve housing,
by pressing spring latch to release
Press in the desiccant selector valve handle to stop, rotate valve handle
to required position (using directional arrows on handle)
Release desiccant selector valve handle

Install protective cover on desiccant selector valve housing
Verify cover is locked on desiccant selector valve housing

ПКО in position 1



ПКО in position 2



6.13. EMERGENCY VACUUM VALVE [ABK] MANUAL CONTROL

1. [ABK] MANUAL OPENING

Pull locking handle along valve handle and move → OPEN (until soft click)

Verify [ABK] visual indicator shows OTK (Open)K

Release locking handle

Return handle to initial position

Verify [ABK] handle is locked by moving handle towards arrows

OPEN and CLOSE on [ABK] housing

Verify [ABK] visual indicator shows OTK (Open)

2. [ABK] MANUAL CLOSURE

Pull locking handle along valve handle and move → CLOSE (until loud click)

Verify [ABK] visual indicator shows 3AK (Closed)

Release locking handle

Return handle to initial position

Verify [ABK] handle is locked by moving handle towards arrows

OPEN and CLOSE on [ABK] housing

6.14. VOZDUKH MALFUNCTION

ПСС ☐ ADVISORY MESSAGE (green)

RS Laptop  SM VOZDUKH System Failure-SM”

After unit replacement perform stand-alone tests of the removed unit using Vozdukh ORU
see RODF: IFM IVA SM, 1.1

6.14.1. VACUUM PUMP INITIAL FAILURE

00:00:00 ПУ COA ☐ VAC PUMP
possible ☐ VLV GRP 1(2,3)

ПУ COA sw CYCLE TIME → OFF
☒ VLV GRP 1,2,3(three)
☒ VACUUM PUMP
☒ POWER 1, 2, 3 (three) ☒ VAC PUMP
☒ VLV GRP 1(2,3)
 If after vacuum pump failure one VLV GRP is in position PUMP:
 | VLV GRP 1(2,3) from PUMP → REGEN
 | ☒ POWER 1, 2, 3 (three)
 | ↓ SYS INIT
 | ☒ VACUUM PUMP
 | ☒ VLV GRP 1,2,3 (three)
 | sw CYCLE TIME → 30 min (20 min, 10 min) (in position prior to
 | deactivation)
 If ☐ VLV GRP 1(2,3)
 | Resume Vozdukh VLV operation per 6.14.5 VACUUM VALVE
 | GROUP INITIAL FAILURE

Monitor VLV GRP change next position and vacuum pump activation
 Record time when vacuum pump repeated failure was detected since
 VLV GRP started to change position from PUMP, and VLV GRP handles
 position when failure occurred (see 6.14.2 VACUUM
 PUMP REPEATED FAILURE)




6.14.2. VACUUM PUMP REPEATED FAILURE

1. VACUUM PUMP DRIVE FAILURE

BOA VLV GRP → PUMP
Vacuum pump was started for a short time
ПУ COA ☐ VAC PUMP

ПУ COA ☒ VACUUM PUMP
☒ POWER 1, 2, 3 (three) ☒ VAC PUMP
 Deactivate system per 6.9
 Replace vacuum pump per RODF: IFM IVA SM
 Activate system per 6.2
 2. VACUUM PUMP CONTROL UNIT (БУ) FAILURE



BOA VLV GRP from ABSORB → PUMP → REGEN
 Vacuum pump was not started and was not operating
 ПУ COA ☐ VAC PUMP

√  VACUUM PUMP
 VACUUM PUMP
 POWER 1, 2, 3 (three) ■ VAC PUMP

Deactivate system per 6.9
 Replace vacuum pump control unit per RODF: IFM IVA SM
 Activate system per 6.2

3. VACUUM PUMP CHECK VALVE (КП) FAILURE




BOA VLV GRP from ABSORB → PUMP
 Mechanical noise in vacuum pump is audible
 ПУ COA ☐ VAC PUMP

ПУ COA  VACUUM PUMP
 POWER 1, 2, 3 (three) ■ VAC PUMP

Deactivate system per 6.9
 Replace vacuum pump check valve per RODF: IFM IVA SM
 Activate system per 6.2

4. FAILURE OF ABSOLUTE PRESSURE RELAY MEASUREMENT UNIT (ИКДРДа) OR DEGRADED VACUUM PUMP PERFORMANCE

Vacuum pump was operating
 BOA VLV GRP from PUMP → REGEN
 ПУ COA ☐ VAC PUMP

ПУ COA  VACUUM PUMP
 POWER 1, 2, 3 (three) ■ VAC PUMP
 VACUUM PUMP

Check pressure on the vacuum pump inlet (see RODF: IFM IVA SM)
 If pressure is normal (ИКДРДа failure)

On **MCC-M GO** continue operation without ИКДРДа:

cbl 17KC.215Ю=8278A-40 ↔ cnctr X10 of unit 17KC.215Ю.5300-350

If pressure is abnormally high (vacuum pump degraded performance)

On **MCC-M GO** replace vacuum pump (see RODF: SM IFM IVA) or
 increase its cycle time:

ПУ COA sw VAC PUMP CYCLE TIME → 2 min (3 min)

If not possible to replace vacuum pump and increase its cycle time

on **MCC-M GO**:

cbl 17KC.215Ю=8278A-40 ↔ cnctr X10 of unit 17KC.215Ю.5300-350

Deactivate system per 6.9

Activate system per 6.2

After failure is resolved:

cbl 17KC.215Ю=8278A-40 →|← cnctr X10 of unit 17KC.215Ю.5300-350

6.14.3. FAN FAILURE

PU COA ☐ FAN

☒ POWER 1,2 (two)☐ FAN

Deactivate system per 6.9

Activate system per 6.2

In case of repeated failure replace fan per
RODF: IFM IVA SM**6.14.4. PRELIMINARY DESICCANT ASSEMBLY (БПО) OVERHEAT**

PU COA ☐ DBED T↑

Deactivate system per 6.9

On MCC-M GO disconnect thermal relay (БПО1 or БПО2)cbl 17KC.215Ю=8278A-10 ↔ cnctr 215Ю=A10-X8(X10) of unit
БПО1(БПО2)

Replace thermal relay per RODF: IFM IVA SM

cbl 17KC.215Ю=8278A-10 →← cnctr 215Ю=A10-X8(X10) of unit
БПО1(БПО2)

Activate system per 6.2

VLV GRP 3 → CLOSED before ABSORB

VACUUM VALVE GROUP REPEATED FAILURE)

Replace VLV GRP per RODF: IFM IVA SM

6.14.7. VOZDUKH VACUUM VALVE GROUP INITIAL FAILURE

ПУ COA ☐ VLV GRP 1
 ☐ VLV GRP 2(3)
 ☐ VAC V1 CL
 ☐ VAC V2(3) CL

Perform 6.14.5 VOZDUKH VACUUM VALVE GROUP INITIAL FAILURE
 If 2 or 3 vacuum VLV GRPs are in the same position see 6.14.8
 VOZDUKH VACUUM VALVE GROUP REPEATED FAILURE

6.14.8. VOZDUKH VACUUM VALVE GROUP REPEATED FAILURE**1. VACUUM VALVE GROUP DRIVE FAILURE**

ПУ COA ☐ VLV GRP 1(2,3)
 БОА At the beginning of position change VLV GRP handle stayed in
 initial position or → CLOSED after initial position
 Failures of the other VLV GRPs occurred at the end of position change

ПУ COA sw CYCLE TIME → OFF
 ⌚ VLV GRP 1(2,3) ■ VLV GRP 1(2,3)

Deactivate system per 6.9
 Replace VLV GRP per RODF: IFM IVA SM
 Activate system per 6.2

2. VACUUM VALVE GROUP VALVE FAILURE

ПУ COA ☐ VLV GRP 1(2,3)
 VLV GRP handle passed positions REGEN, ABSORB or PUMP without stop
 Failures of the other VLV GRPs occurred after their position change was complete

ПУ COA sw CYCLE TIME → OFF
 ⌚ VLV GRP 1(2,3) ■ VLV GRP 1(2,3)

Deactivate system per 6.9
 Replace VLV GRP per RODF: IFM IVA SM
 Activate system per 6.2

6.14.9. DESICCANT SELECTOR VALVE FAILURE

ПУ COA ☐ SEL VLV

ПУ COA sw CYCLE TIME → OFF
 All Φ HEATER 1, 2 C1-C4 (eight)
 ↓ SEL VLV AUTO OFF ☒ SEL VLV
 ☐ SEL VLV MANUAL

ПКО
 ПУ COA SEL VLV MANUAL → 1
 ↓ SEL VLV AUTO ON ☒ SEL VLV MANUAL
 sw CYCLE TIME → 20 min (30 min) (in position prior to
 deactivation)

Monitor desiccant selector valve change next two positions

If ☐ SEL VLV, SEL VLV remained — 1(2):

ПУ COA ↓ SEL VLV MANUAL ☒ SEL VLV
 ☐ SEL VLV MANUAL

Transfer to manual control of electrical heaters per 6.15

Deactivate system per 6.9

Replace desiccant selector valve per RODF: IFM IVA SM

Activate system per 6.2

6.15. ELECTRICAL HEATER MANUAL CONTROL

00:00:00	[321	БПО	SELECTOR VALVE → 1
02:00:00		452	ПУ COA	Φ HEATER-2 C1-C4 (four)
				Φ HEATER-2 C1-C4 (four)
		321	БПО	SELECTOR VALVE → 2
00:00:00		425	ПУ COA	Φ HEATER-1 C1-C4 (four)
02:00:00				Φ HEATER-1 C1-C4 (four)

6.15.1. VOZDUKH SCHEMATIC

ABK	- emergency vacuum valve
АП	- switching controller
БВК	- Vozdukh vacuum valve group
БОА	- Vozdukh valve panel
БПО	- preliminary desiccant assembly
ВН	- vacuum pump
ВИР-1М	- air flow meter
ГГТ	- gas-gas heat exchanger
ГЖТ	- gas-liquid heat exchanger
ГЖТА	- gas-liquid heat exchanger assembly
Д	- engine
ДТ	- temperature sensor
З	- CLOSED
ИКДРДа	- pressure measurement unit of the absolute pressure relay
КП	- vacuum pump check valve
КТ-02	- hygrometer
МР5-15Г	- Vozdukh fan
О	- PUMP
Ос	- desiccant bed
П	- CROSS CONNECT
ПКО	- desiccant selector valve
ПП	- adsorbent cartridge
Р	- REGEN
С	- ABSORB
С1-С4	- first (...fourth) electric heater bank
Т	- temperature sensor
ТЧ	- temperature limiter
ФЭ	- filter
ЭН1	- electrical heater 1
ЭН2	- electrical heater 2

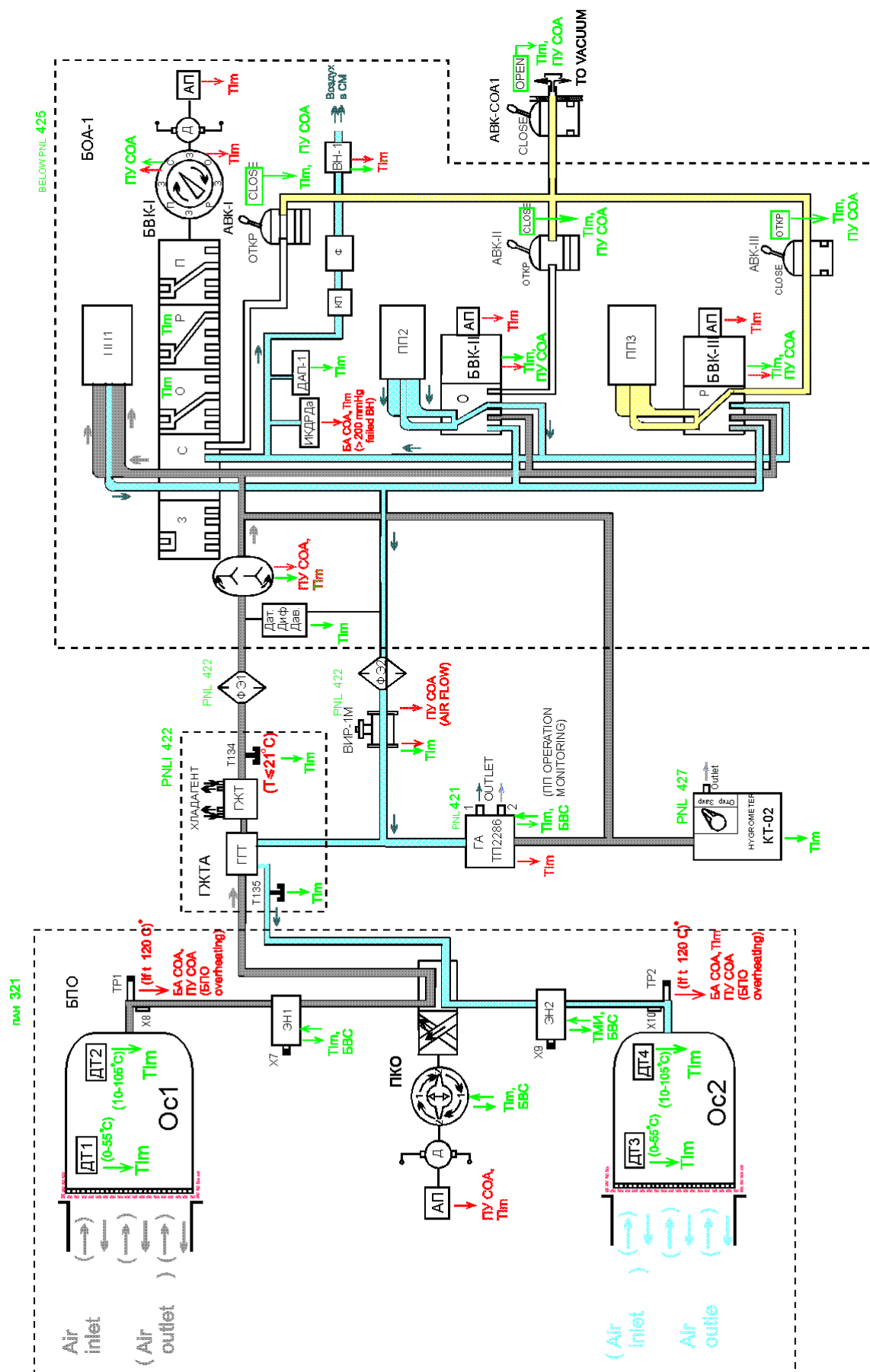


Figure 6.15.1 Vozdukh Schematic

7. MICROPURIFICATION UNIT (СБМП)

7.1. СБМП OPERATIONAL FEATURES

Time of FILTER VLV GRP handle position change < 10sec

VAC VLV-4, VAC VLV-5, and БМП EMERGENCY VACUUM VALVE are opened manually and closed manually or by command via ИНПУ

In case of off-nominal situation VAC VLV-4, VAC VLV-5, and БМП EMERGENCY VACUUM VALVE are closed automatically

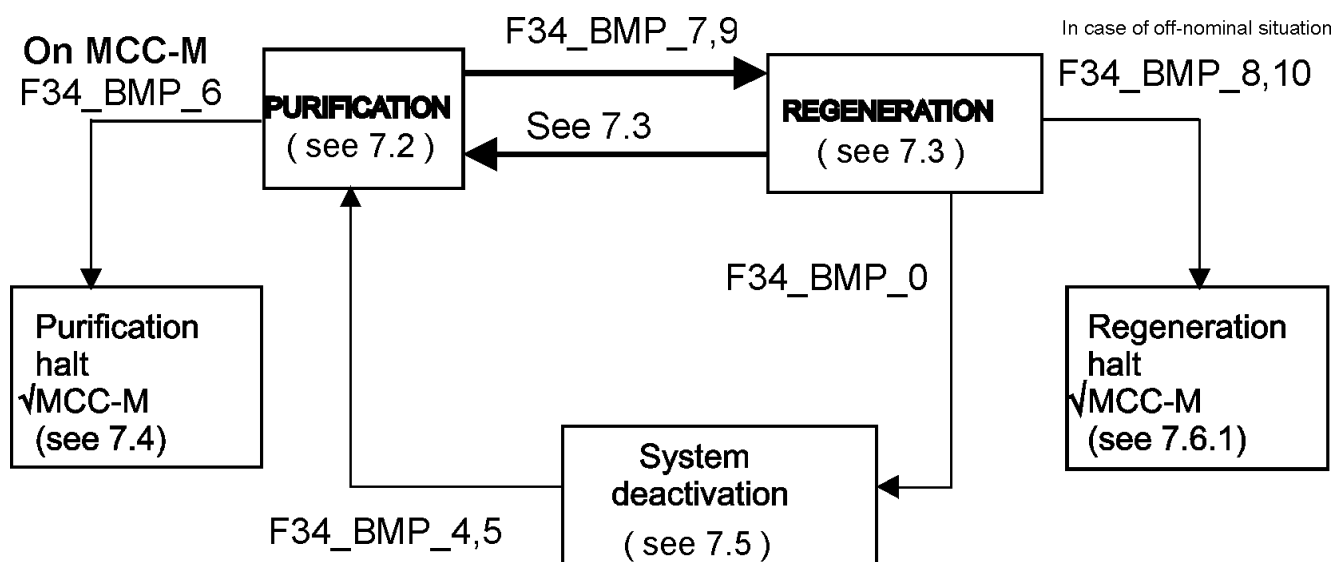
When operating VAC VLV-4,5, and БМП EMERGENCY VACUUM VALVE, monitor status of VAC VLV-4,5, БМП EMERGENCY VACUUM VALVE per status on valve visual indicator and on RS Laptop

Do not change position of handles of FILTER VLV GRP-1 (FILTER VLV GRP-2) → PURIFY during regeneration with the temperature of cartridge FILTER 1(FILTER 2) $\geq 40^{\circ}\text{C}$

FILTER VLV GRP-2 → PURIFY only on **MCC-M GO**

During regeneration do not touch external surface of cartridge FILTER 1 (FILTER 2) by hand

Brief description of transitions from mode to mode of БМП system:



7.2. PURIFICATION MODE ACTIVATION

418 √ VAC VLV 4 — 3AK (Close)
 √ VAC VLV 5 — 3AK (Close)
 425 √ БМП EMERGENCY VACUUM VALVE — CLOSED

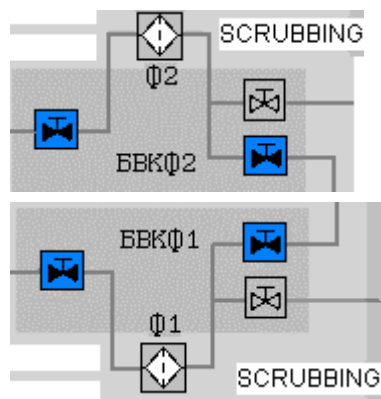
RS Laptop CM : СЖО : СБМП

00:00:00 418 < T136(T137)A,B,B in Φ1 (Φ2) ≤ +40 degC
 on MCC-M GO FILTER VLV GRP-1 → PURIFY (time of position change < 10 sec)
 FILTER VLV GRP-2 → PURIFY (time of position change < 10 sec)

ПСС WARNING
 □ OTHER (red) ЗВУК

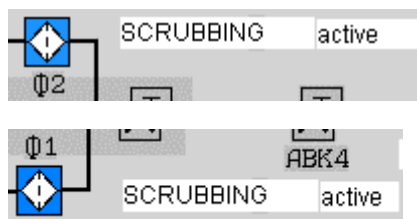
RS Laptop  'Пожароопасное состояние БМП1(2)'

418 FILTER VLV GRP-1(2) → REGEN (time of position change < 10 sec)
 ПСС ■ OTHER
 See 7.6.4



RS Laptop proc F34_BMP_4 (5) (Cartridge 1(2) scrubbing, Start)
 Execute

00:01:00



7.3. REGENERATION MODE

1. FILTER 1 REGENERATION MODE

RS Laptop

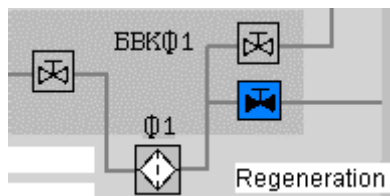
CM : CЖО : СБМП

 БМП power bus1 ON bus2 ON bus3 ON



418

FILTER VLV GRP-1 → REGEN (time of position change < 10 sec)

RS Laptop



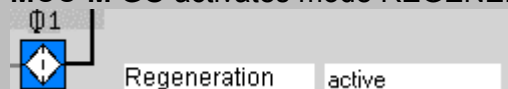
425

БМП EMERGENCY VACUUM VALVE → OPEN  ABK БМП
 outlet air noise


418

VAC VLV-4 → OTKP (Open)  ABK 4

00:00:00

MCC-M GO activates mode REGENERATION of FILTER 1


Timeline of cartridge FILTER 1 mode REGEN (for reference)

Vacuumize FILTER 1	Heat FILTER 1 to T136 = 190°C	Cool FILTER 1
1 hour	5.5 hours or ≤ 5.5 hours (when 190 °C  FILTER 1 is reached)	8 hours

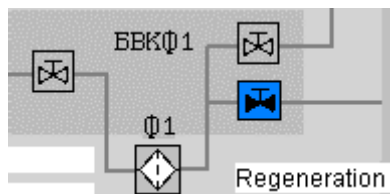
~ 14:30:00 ПСС

 ADVISORY MESSAGE (green)

RS Laptop

 SM Service BMP1-RS

RS Laptop



Perform step 3

2. FILTER 2 REGENERATION MODE (on MCC-M GO)

418 FILTER VLV GRP 2 → REGEN (time of position change < 10 sec)

425 БМП EMERGENCY VACUUM VALVE → OPEN

🔊 outlet air noise

418 VAC VLV-5 → OTKP (Open)

Report to MCC-M

On MCC-M GO perform step 3

3. VACUUM MANIFOLD FILLING WITH AIR

(after cartridge FILTER 1(2) or FILTER 1 (FILTER 2) regeneration is complete)

425 ✓ БМП EMERGENCY VACUUM VALVE — CLOSE  ABK БМП

418 ✓ VAC VLV-4(5) — 3AK (Close)  ABK-4(5)

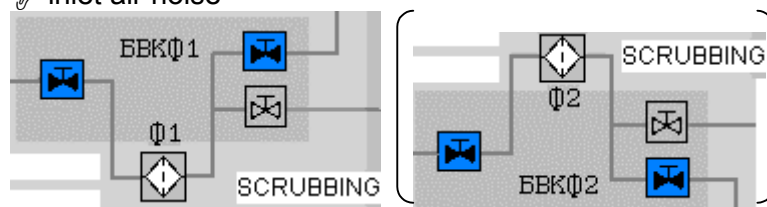
00:00:00

on MCC-M GO

FILTER VLV GRP-1 → PURIFY

FILTER VLV GRP-2 → PURIFY

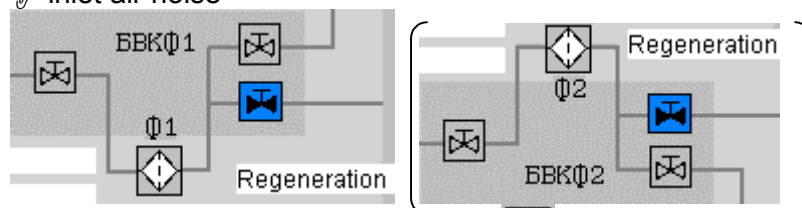
🔊 inlet air noise




00:00:05

FILTER VLV GRP-1(2) → REGEN

🔊 inlet air noise




00:00:00

VAC VLV -4(5) → OTKP (Open)  ABK 4(5)

🔊 inlet air noise

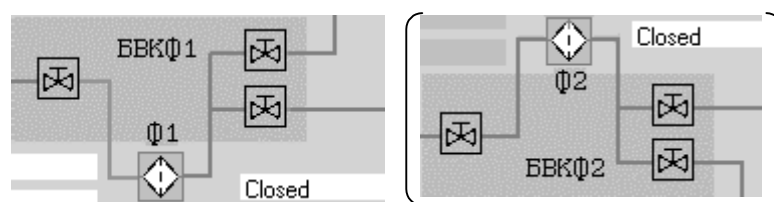
00:00:05

VAC VLV -4(5) → 3AKP (Close)  ABK-4(5)

418

RS Laptop

FILTER VLV GRP-1 (FILTER VLV GRP-2) → CLOSED



Do not perform steps 4, 5 during system deactivation and scheduled maintenance

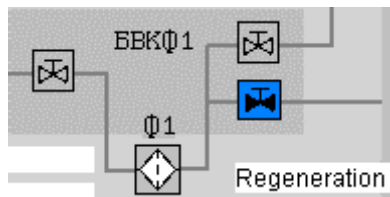
On MCC-M GO perform 7.5

4. TRANSITION TO FILTER 1 PURIFICATION MODE (on MCC-M GO)

◀  ABK-БМП, ABK-4

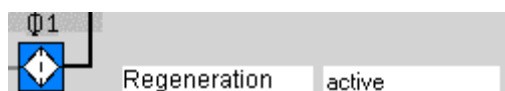
00:00:00 418 FILTER VLV GRP-1 → PURIFY (time of position change < 10 sec)

RS Laptop



ПСС ■ ADVISORY MESSAGE

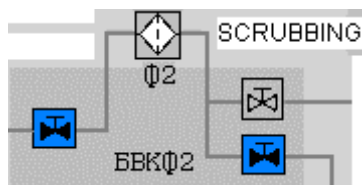
00:01:00 RS Laptop

5. TRANSITION TO FILTER 2 PURIFICATION MODE (on MCC-M GO)

◀  ABK-БМП, ABK-5

only on MCC-M GO FILTER VLV GRP-2 → PURIFY (time of position change < 10 sec)

RS Laptop



7.4. MODE PURIFY HALT

On MCC-M GO

00:00:00

proc F34_BMP_6 (*Scrubbing Halt*)

Execute

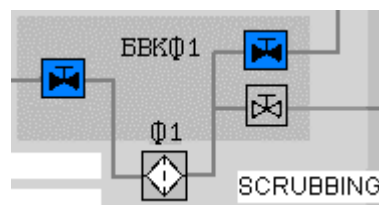
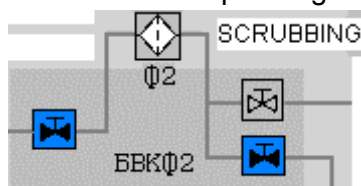
≤ 00:01:00



air flow meter is not operating



fan is not operating



On MCC-M GO perform regeneration of adsorbent cartridges FILTER 1 (FILTER 2) per 7.3

7.5. БМП SYSTEM DEACTIVATION

On MCC-M GO perform regeneration of adsorbent cartridges FILTER 1 (FILTER 2) per 7.3

RS Laptop

CM : СЖО : СБМП

БМП power bus1 ON bus2 ON bus3 ON

T136(T137)A,B,B in FILTER 1 (FILTER 2) $\leq +40$ degC

- 418 ✓ VAC VLV 4 — 3AK (Close) ABK 4
- ✓ VAC VLV 5 — 3AK (Close) ABK 5
- 425 ✓ БМП EMERGENCY VACUUM VALVE — CLOSE ABK БМП

NOTE

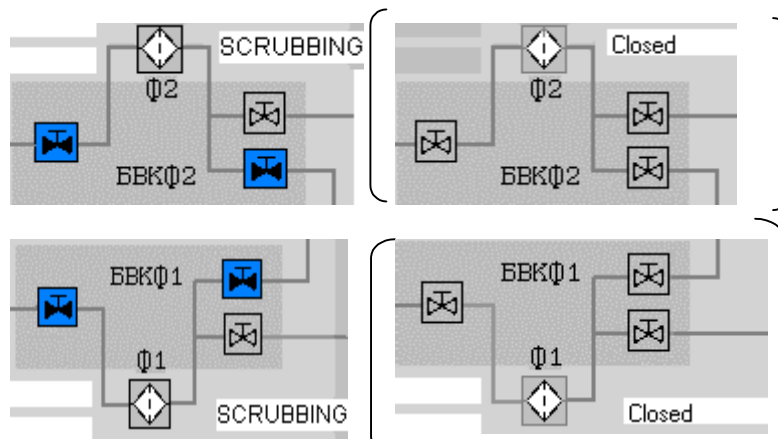
If FILTER VLV GRP-1, FILTER VLV GRP-2 → CLOSED after 1 min the system will shutdown automatically

418

On MCC GO FILTER VLV GRP-1 → PURIFY (Closed) (time of position change < 10 sec)

On MCC GO FILTER VLV GRP-2 → PURIFY (Closed) (time of position change < 10 sec)

RS Laptop



proc F34_BMP_0 (Micropurification unit (БМП) power, Deactivation)

Execute

Control mode Manual

БМП power bus1 OFF bus2 OFF bus3 OFF

ABK-4, ABK-5, ABK-БМП

Φ1, Φ2

БМП



Verify no air flow on the system inlet (fan MLЦ12-4 inlet)

00:00:00

00:01:00

7.6. БМП SYSTEM MALFUNCTION

In case of malfunctions the system switches automatically to manual control mode or its power is shutdown automatically

ПСС ☐ ADVISORY MESSAGE (green)

RS Laptop ☐ CM : СЖО : СБМП

Report to MCC-M failure cause

On MCC-M GO

proc F34_BMP_11 (*Cancel Faults*)

Execute

ПСС ☒ ADVISORY MESSAGE

On MCC-M GO

proc F34_BMP_0 (*Micropurification unit (БМП) power, Deactivation*)

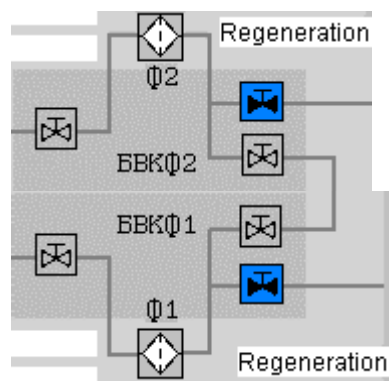
Execute

7.6.1. REGENERATION HALT AT ANY MOMENT

RS Laptop ☐ CM : СЖО : СБМП

proc F34_BMP_8(10) (*Cartridge 1(2) Regeneration, Halt*)

Execute



418

VAC VLV-4 → 3AKP (Close)

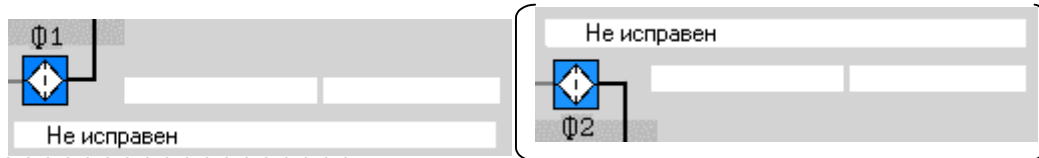
VAC VLV-5 → 3AKP(Close)

☒ ABK 4

☒ ABK-5

7.6.2. FILTER VALVE GROUP 1(2) MALFUNCTION

RS Laptop



On MCC-M GO replace FILTER VLV GRP per RODF: IFM IVA SM

7.6.3. CARTRIDGE FILTER 1(FILTER 2) OVERHEAT

00:00:00 RS Laptop T136A,Б,В (T137A,Б,В) 230 градус

System is shutdown automatically

ABK 4, ABK 5, ABK-БМП – will close automatically

418 ✓ VAC VLV -4 — 3AK (Close)

✓ VAC VLV -5 — 3AK (Close)

425 ✓ БМП EMERGENCY VACUUM VALVE — CLOSED

RS Laptop

CM : СЖО : СБМП

≤ 08:00:00

⚠ T136 (T137) A,Б,В (cartridge FILTER 1(2) cooled to +40 degC)

Report to MCC-M


✓MCC-M

7.6.4. БМП OVERHEAT

ПСС WARNING

☐ OTHER (red)

ЗВУК

RS Laptop  'Пожароопасное состояние БМП1(2)'

The system is shutdown automatically

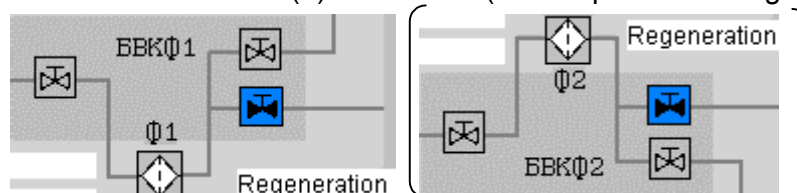
RS Laptop

ABK 4, ABK 5, ABK-БМП – will close automatically

CM : СЖО : СБМП

418

FILTER VLV GRP -1(2) → REGEN (time of position change < 10 sec)



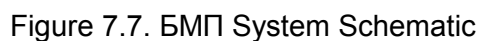
ПСС

■ OTHER

On MCC-M GO

7.7. СБМП SCHEMATIC

ABK	- emergency vacuum valve
БВКФ	- filter valve group
БМП	- micropurification unit
ВИР-1М	- air flow meter
МЦ12-4	- fan
ПКФ	- catalytic cartridge
С1-С4	- first (...fourth) electric heater bank
Ф	- filter
ФПО	- preliminary scrubbing filter
ФОА	- atmospheric scrubbing filter
ЭН	- electrical heater



8. CARBON DIOXIDE (CO₂) ADSORBERS

8.1. CO₂ ADSORBER OPERATION

Activate adsorber on **MCC-M GO** when P.CO₂ (RS Laptop) \geq 6.5 mmHg

NOTE

Use adsorbers only in ascending order of numbers

Use adsorbers with damaged caps first

1. ADSORBER SETUP

Behind 417

✓ adsorber → ← fan hose

Remove cap #10 (foil) from adsorber cartridge
by pulling cord along cartridge

2. ADSORBER ACTIVATION

338, ППС-23

⚙ ВП1(2)

At P.CO₂ (RS Laptop) \geq 6.5 mmHg with one
operating cartridge:

00:00:00

ППС-23

⚙ ВП2 (1)

10:00:00

⚙ ВП1 (2)

3. ADSORBER DEACTIVATION

ППС-23

⚙ ВП1,2

NOTE

In case of simultaneous operation with Vozdukh:
deactivate cartridges when P.CO₂ (RS Laptop) \leq 4.5 mm Hg

8.2. CO₂ ADSORBER FAN REPLACEMENT

(00:40:00)

338, ППС-23

1. FAN REMOVAL

⚙ ВП1(2)

Open panel 417

Duct and ground strap ↔ fan

↔ connector 210Ю=M1-X1

Remove screws M8 (four) securing fan

Remove screws M6 (four) securing switching controller

2. NEW FAN INSTALLATION

Secure fan with screws M8 (four)

Secure switching controller with screws M6 (four)

Ground strap →|← fan
 →|← connector 210Ю=M1-X1
 cap #7 ←|→ fan and → discard
 Duct →|← fan manifold
 ←|→ cap #6 and → discard
 Close panel 417

8.3. ADSORBER REPLACEMENT

ППС-23 ⚙ ВП1(2)
 Open panel 417
 Fan hose ←|→ adsorber
 Remove adsorber by removing bolts M6 (four)
 Install new adsorber by securing it with bolts M6 (four)
 cap # 8 ←|→ adsorber and → discard
 Fan hose →|← adsorber
 Close panel 417

8.4. ADSORBER MALFUNCTION

1. *****

$6.5 \leq P.CO_2 \leq 10$ mmHg when adsorber is activated

1. Adsorber life time is exhausted
 Replace absorber (see 8.3)
2. Hose connection is bad
 ✓ fan hose is connected to adsorber
3. Fan malfunction
 see below

2. *****

Fan failure

ППС-23 1. Bad contact in cnctr 210Ю=M1-X1
 ⚙ ВП1(2)
 ✓ connector 210Ю=M1-X1 connection

ППС-23 2. Foreign object got into the fan
 ⚙ ВП1(2)
 Remove foreign object

3. Motor malfunction
 Replace fan (see 8.2)

9. ATMOSPHERIC SCRUBBING FILTER A-2

NOTE


Filter should be replaced for reuse (see step 3)

1. FILTER ACTIVATION

Unwind cable

Secure filter by pressing its bottom on panel Velcro

Filter connector →|← PBC-10/3

Ground strap →|← screw 

Cap ←|→ filter inlet



PBC-10/3

2. FILTER DEACTIVATION



Filter connector ←|→ PBC-10/3

Wrap cable around filter housing, secure connector in the housing

PBC-10/3

3. FILTER REPLACEMENT

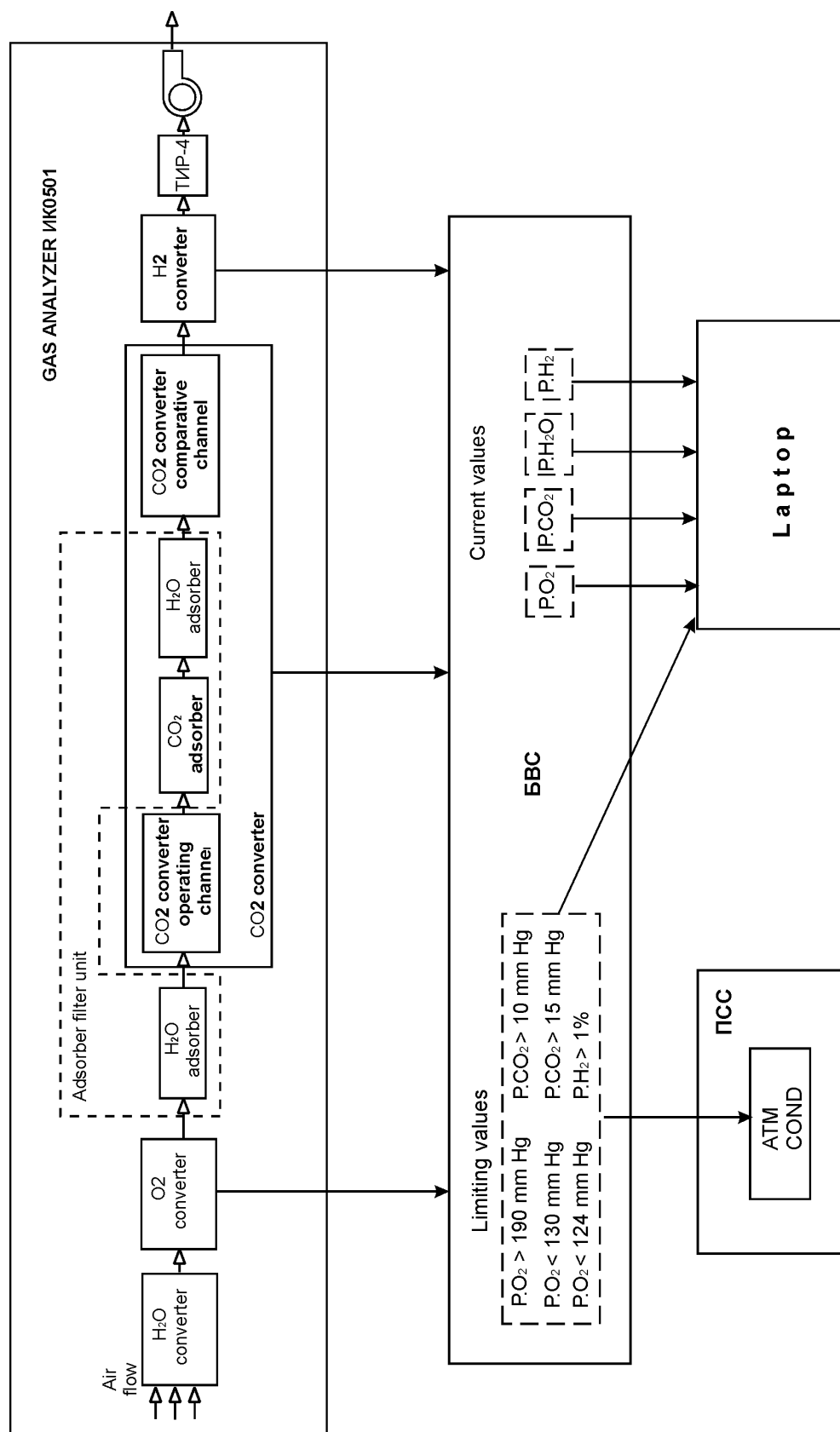
Open quick fasteners (four) on filter housing

Remove used filter and → discard

New filter → on unit by securing it with fasteners (four) and → storage location

10. GAS ANALYZERS

10.1. SM GAS ANALYZER FLOW CHART



10.2. ИК0501 GAS ANALYZER ACTIVATION

NOTE

During gas analyzer activation:
ПСС ☐ ATM COND **ЗВУК**

1. ГАЗ ACTIVATION WITH WARM-UP

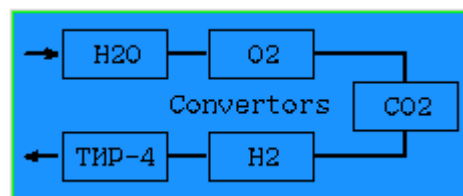
RS Laptop

CM:СЖО:Gas Analyzer

00:00:00

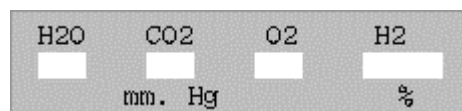
proc F21_APS_6 (*Atmos. monitoring mode, Select*)

Execute



01:00:00

⏮ set values of partial pressures



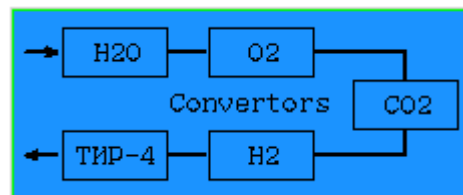
2. ГАЗ ACTIVATION WITHOUT WARM-UP

RS Laptop

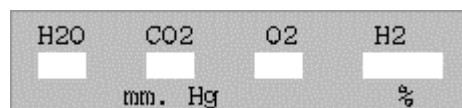
CM:СЖО:Gas Analyzer

proc F21_APS_9 (*CM Gas-Analyzer (ИК0501) ORU Test, without warmup*)

Execute



⏮ set values of partial pressures



10.3. GAS COMPOSITION MONITORING

(00:05:00)

Monitor total pressure and gas composition twice every day

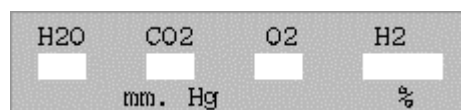
Report to MCC-M:

- P(MB)
- results of gas composition monitoring (in case of abnormality or by request)
- each burning of TFK cartridge, switching and replacement of adsorbers

RS Laptop

CM:СЖО:Gas Analyzer

↖ values of partial pressures:

**10.4. ИК0501 READING MONITORING PER ГА STATUS INDICATOR**

ИК0501 1. Cap ↔ ИГ adapter
 ИГ3 √ sw — 1
 ИГ3 adapter → ИГ ИК0501 adapter
 sw → 2
 ИК V_{power} = _____ V (should be 23 --- 34 V)

ИГ3 2. sw → 3
 ИК0501 sw S1 → H₂O
 ИГ3 H₂O V_{output} = _____ V

ИК0501 sw S1 → H₂
 ИГ3 H₂ V_{output} = _____ V

ИК0501 sw S1 → CO₂
 ИГ3 CO₂ V_{output} = _____ V

ИК0501 sw S1 → Q
 ИГ3 ТИР V_{output} = _____ V

ИК0501 sw S1 → O₂
 ИГ3 O₂ V_{output} = _____ V

Report to MCC-M measurement results

10.5. ИК0501 GAS ANALYZER CHECK USING ГA CALIBRATION ASSEMBLY

(00:45:00)

On MCC-M GO perform checkout during AOS with stable TIm**1. ГA CALIBRATION ASSEMBLY SETUP**

P[MB] = _____ mmHg

Calculate partial P.O₂, CO₂ per formulas:P.O₂ CALC = P[MB] x C.O₂ x 10⁻² = _____ mmHgP.CO₂ CALC = P[MB] x C.CO₂ x 10⁻² / (1 - 0.035 x C.H₂) = _____ mm
Hgwhere C.O₂ - O₂ volume fraction, % (see ГA Cal Assy panel)C.CO₂ - CO₂ volume fraction, % (see ГA Cal Assy panel)Calculate H₂ volume content per formula:C.H₂ CALC = C.H₂ + 0.02 = _____ %where C.H₂ - H₂ volume fraction, % (see ГA Cal Assy panel)

ГA Calibration Assembly vacuum tube → fitting ВХОД ИК0501 (inlet)

БКГА

Release valve K1 handle from safety hook

2. ИК0501 PURGE**NOTE**

1. If during purge:

P.БКГА(MB1) < 70 kg/cm², close valve K1 in 10 min

2. It is possible during purge:

ПСС

☐ ATM COND**ЗВУК**

RS Laptop

**'Водород выше нормы'**

00:00:00

vlv K1 (ГA calibration assembly) → ОТКР (Open)

↖ P.БКГА[MB1]

00:00:30---60

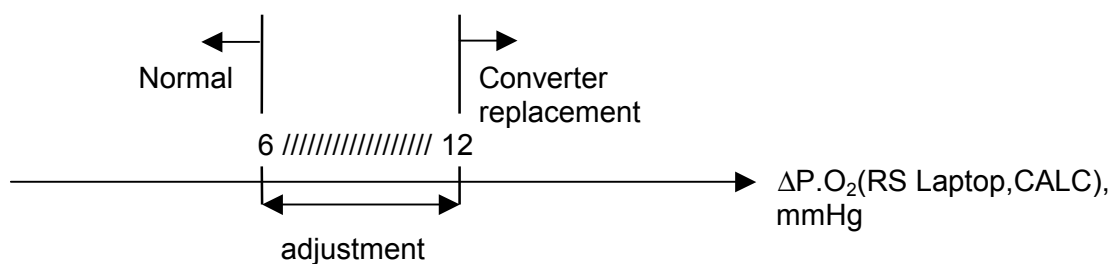
vlv K1 → ЗАКР (Close)

Engage safety hook (do not disconnect ГA Cal Assy tube)

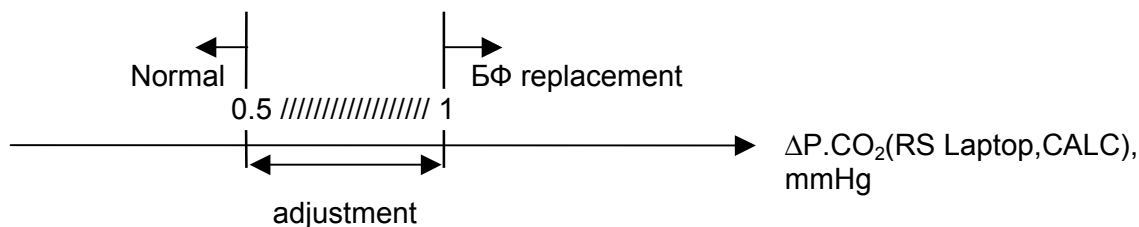
00:30:00

3. CM:СЖО:Gas AnalyzerP.CO₂(RS Laptop) = _____ mmHgP.O₂ (RS Laptop) = _____ mmHgP.H₂ (RS Laptop) = _____ %

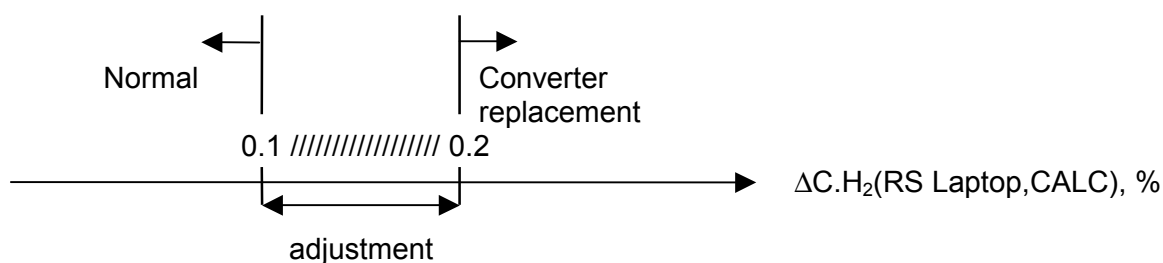
4. Compare P.O₂(RS Laptop) with calculated values:



5. Compare P.CO₂(RS Laptop) with calculated values:



6. Compare C.H₂(RS Laptop) with calculated values:



7. **Report** results to MCC-M

8. RETURN TO INITIAL CONFIGURATION

NOTE

After ГA Cal Assy vacuum tube disconnection, it is possible for ≤ 15 min:

ПСС ☐ ATM COND ЗВУК
RS Laptop  'Углекислый газ выше нормы'

БКГА

ГA Cal Assy vacuum tube ↔ fitting labeled ВХОД ИК0501

Reel vacuum tube on holder

ГA Cal Assy → stowage location

10.6. ИК0501 GAS ANALYZER CHECKOUT USING ГА CALIBRATION ASSEMBLY AND GAS ANALYZER STATUS INDICATOR (ИГЗ)

(00:45:00)

1. SETUP

P[MB] = _____ mmHg

Calculate converter V_{output} per formulas:

$$V.O_2.CALC = 1.71 \times 10^{-4} \times P(MB) \times C.O_2 = \text{_____ } V$$

$$V.H_2.CALC = 2.4 \times C.H_2 + 0.05 = \text{_____ } V$$

$$V.CO_2.CALC = 2 \times C.CO_2 / 1 - 0.035 \times C.H_2 = \text{_____ } V$$

where $C.O_2$ - O_2 volume fraction, % (see ГА Cal Assy pnl) $C.CO_2$ - CO_2 volume fraction, % (see ГА Cal Assy pnl) $C.H_2$ - H_2 volume fraction, % (see ГА Cal Assy pnl)ИК0501
ИГЗ

ГА Cal Assy vacuum tube → ← manifold ВХОД ИК0501

Cap ↔ ИГ adapter

√ sw — 1

ИГЗ adapter → ← ИГ ИК0501 adapter

ИГЗ

sw → 2

ИК $V_{\text{pwr}} = \text{_____ } V$ (must be 23 --- 34 V)

БКГА

Release valve Кл К1 handle from safety hook

2. ИК0501 PURGE

NOTE

1. If during purge:

Р.БКГА(МВ1) < 70 kg/cm², close valve К1 in 10 min

2. It is possible during purge:

ПСС

☐ ATM COND**ЗВУК**

RS Laptop



'Водород выше нормы'

00:00:00

БКГА

vlv К1 → ОТКР (Open)

↖ Р.БКГА(МВ1)

00:00:30---60

vlv К1 → ЗАКР (Close)

Engage safety hook (do not disconnect ГА Cal Assy tube)

00:30:00

ИГЗ

3. sw → 3

ИК0501

sw S1 → H_2 $H_2 V_{\text{output}}(\text{ИГЗ}) = \text{_____ } V$

ИК0501

sw S1 → CO_2 $CO_2 V_{\text{output}}(\text{ИГЗ}) = \text{_____ } V$

ИК0501 sw S1 → Q
 ТИР $V_{\text{output}}(\text{ИГ3}) = \underline{\hspace{2cm}} \text{ V}$

ИК0501 sw S1 → O₂
 $\text{O}_2 V_{\text{output}}(\text{ИГ3}) = \underline{\hspace{2cm}} \text{ V}$
Report V_{output} values to MCC-M

4. Compare V_{output} with calculated values:

If:

$$\text{H}_2 \Delta V_{\text{output}}(\text{ИГ3, CALC}) > 0.25 \text{ V}$$

$$\text{CO}_2 \Delta V_{\text{output}}(\text{ИГ3, CALC}) > 0.15 \text{ V}$$

$$\text{O}_2 \Delta V_{\text{output}}(\text{ИГ3, CALC}) > 0.1 \text{ V}$$

perform adjustment (step 5)

5. READINGS ADJUSTMENT

CAUTION

Start adjustment no earlier than 30 minutes and complete no later than 35 minutes after gas mixture was supplied from ГА Cal Assy

ИК0501 Remove seal from ПЕГ cover on corresponding converter (for the first time)

Unscrew cover (to provide access to control knob)

sw S1 → H₂ (CO₂, O₂)

Smoothly rotate control knob ПЕГ on corresponding converter until:

$$\text{H}_2, \text{CO}_2, \text{O}_2 \Delta V(\text{ИГ3, CALC}) \leq 0.06 \text{ V}$$

6. If after O₂ and H₂ channel adjustment:

O₂, H₂ $\Delta V(\text{ИГ3, CALC}) \geq 0.06 \text{ V}$, on **MCC-M GO** replace corresponding O₂ and H₂ converters

If after CO₂ channel adjustment:

CO₂ $\Delta V(\text{ИГ3, CALC}) \geq 0.06 \text{ V}$, on **MCC-M GO** replace БФ CO₂

If after БФ replacement:

CO₂ $\Delta V(\text{ИГ3, CALC}) \geq 0.06 \text{ V}$, on **MCC-M GO** replace CO₂ converter

7. RETURN TO INITIAL CONFIGURATION

ИК0501 Cover ПЕГ → nominal location (if reading adjustment was performed)

NOTE

After ГА Cal Assy vacuum tube disconnection, it is possible for ≤ 15 min:

ПСС

☐ ATM COND

ЗВУК

RS Laptop



'Углекислый газ выше нормы'

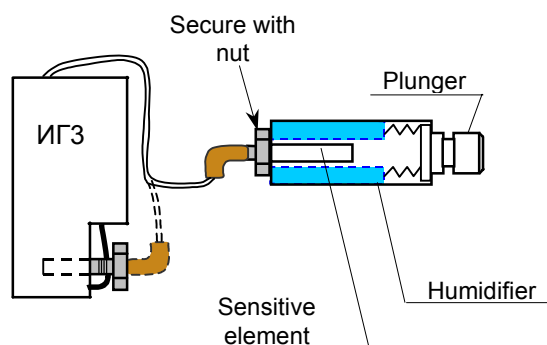
БКГА	ГА Cal Assy vacuum tube ↔ fitting ВХОД ИК0501
ИК0501	Reel vacuum tube on holder
ИГЗ	sw S1 → ОТКЛ (Off)
	sw → 1
	ИГЗ adapter ↔ ИГ adapter and → ИГЗ corresponding socket
ИК0501	Cap → ИГ adapter
	ГА status indicator and ГА calibration assembly → storage location

10.7. ЭП1003 CONVERTER CHECKOUT USING ГА STATUS INDICATOR

(00:45:00)

1. SETUP
 behind 449 Prepare:
 - ГА status indicator
 - adapter, nipple, humidifier (from ИГЗ-УВ accessories)

ИГЗ ↺ coupling nut securing sensitive element
 Unscrew humidifier cover
 Configure equipment:



2. SENSITIVE ELEMENT WATERING
 ↓ humidifier plunger (for 5 sec)
 Disassemble equipment
 Screw in cover on humidifier

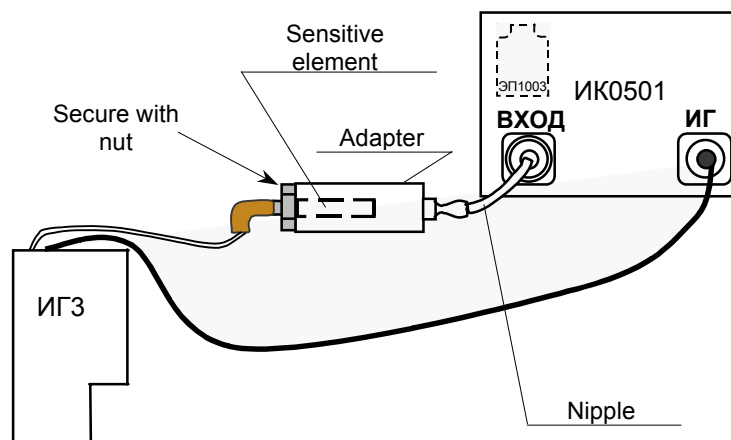
NOTE

To avoid sensitive element desiccation, the time between watering and equipment configuration for ЭП1003 checkout should be minimum

3. ЭП1003 CHECKOUTИГЗ
ИК0501

00:00:00

✓ sw — 1
Cap ↔ ИГ adapter
Configure equipment:

ИК0501
ИГЗ

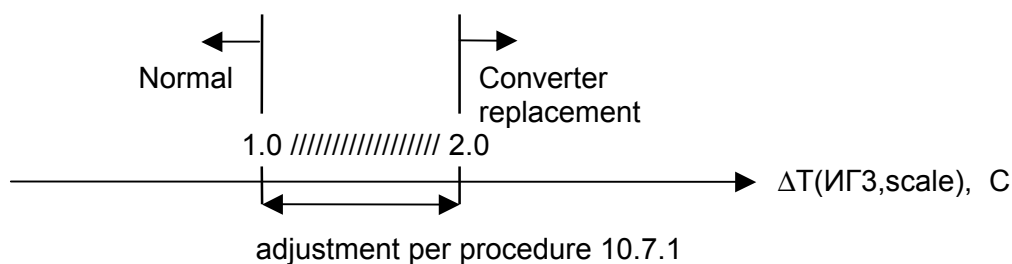
00:30:00

sw S1 → H₂O
sw → 3
H₂O V_{output}(ИГЗ) = _____ V
Determine dew point temperature by scale on
ГA housing:
T (scale) = _____ °C

ИГЗ

sw → 4
Measure sensitive element temperature
per ГA status indicator:
T (ИГЗ) = _____ °C

Compare T (ИГЗ) and T (scale):

4. RETURN TO INITIAL CONFIGURATION

Disassemble equipment
Humidifier, nipple and adapter → cup for
ИГЗ-УВ accessories

ИГЗ

Sensitive element → ГA status indicator
Secure it with coupling nut

sw → 1

ИК0501

sw S1 → ОТКЛ (OFF)

ГA status indicator adapter ↔ ИГ adapter and → ГA status
indicator socket

ИК0501

Cap → ИГ adapter

ГA status indicator adapter → storage location

10.7.1. CONVERTER ЭП1003 ADJUSTMENT

(00:15:00)

CAUTION

Start adjustment no earlier than 30 minutes and complete no later than 40 minutes after sensitive element is installed into adapter connected with converter fitting ВХОД (inlet)

- ЭП1003 Remove seal from cover РЕГ (for the first time)
 Unscrew cover (to provide access to control knob)
- Determine water vapor channel V_{output} per scale on ГА status indicator housing, using Т (ИГЗ), obtained in step 3 of 10.7:
 $\text{H}_2\text{O } V_{\text{output}}(\text{scale}) = \text{_____ V}$
- ИГЗ sw → 3
 Measure water vapor channel V_{output} per ГА status indicator:
 $\text{H}_2\text{O } V_{\text{output}}(\text{ИГЗ}) = \text{_____ V}$
 Smoothly ↻ knob РЕГ until $\text{H}_2\text{O } \Delta V_{\text{output}}(\text{ИГЗ, scale}) \leq 0.06 \text{ V}$
- ИК0501 Cover РЕГ → nominal location
 Perform 10.7, step 4

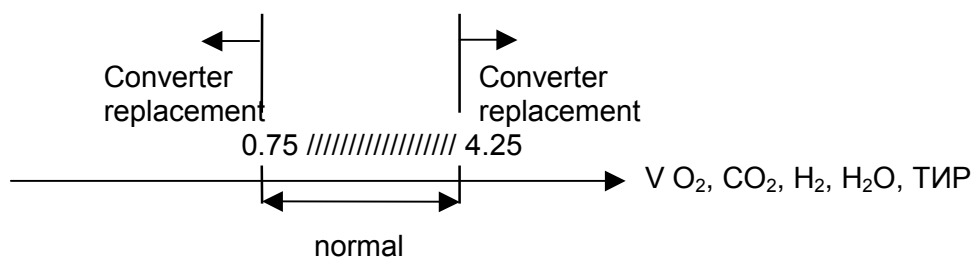
10.8. CONVERTER ИК0501 CIRCUIT INTEGRITY CHECK

- ИК0501 1. Cap ↔ ИГ adapter
 ИГЗ √ sw — 1
 ИГЗ adapter → ← ИГ ИК0501 adapter
2. sw → 2
 ИК $V_{\text{power}}(\text{ИГЗ}) = \text{_____ V}$ (should be 23 --- 34 V)
 sw → 3
- ИК0501 sw S1 → H₂O
 ИГЗ ↓ ПУСК (Activation) □ LED ПРОВЕРКА (Checkout)
 $\text{H}_2\text{O } V_{\text{output}}(\text{ИГЗ}) = \text{_____ V}$
 ↓ СТОП (Stop) ■ LED ПРОВЕРКА (Checkout)
- ИК0501 sw S1 → H₂
 ИГЗ ↓ ПУСК (Activation) □ LED ПРОВЕРКА (Checkout)
 $\text{H}_2 V_{\text{output}}(\text{ИГЗ}) = \text{_____ V}$
 ↓ СТОП (Stop) ■ LED ПРОВЕРКА (Checkout)
- ИК0501 sw S1 → CO₂
 ИГЗ ↓ ПУСК (Activation) □ LED ПРОВЕРКА (Checkout)
 $\text{CO}_2 V_{\text{output}}(\text{ИГЗ}) = \text{_____ V}$
 ↓ СТОП (Stop) ■ LED ПРОВЕРКА (Checkout)

ИК0501 sw S1 → Q
 ИГЗ ↓ ПУСК (Activation) ☐ LED ПРОВЕРКА (Checkout)
 ТИР $V_{\text{output}}(\text{ИГЗ}) = \text{---} V$
 ↓ СТОП (Stop) ☒ LED ПРОВЕРКА (Checkout)

ИК0501 sw S1 → O₂
 ИГЗ ↓ ПУСК (Activation) ☐ LED ПРОВЕРКА (Checkout)
 O₂ $V_{\text{output}}(\text{ИГЗ}) = \text{---} V$
 ↓ СТОП (Stop) ☒ LED ПРОВЕРКА (Checkout)

If:



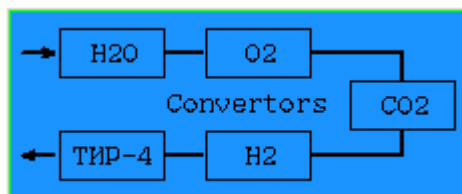
Report to MCC-M check results

10.9. GAS ANALYZER ИК0501 TEST

RS Laptop

CM:СЖО:Газоанализатор

proc F21_APS_8 (CM Gas-Analyzer (ИК0501) ORU Test)
Execute



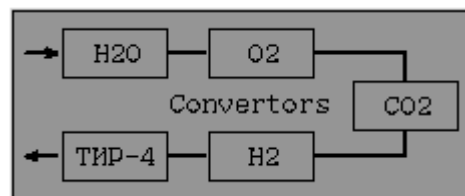
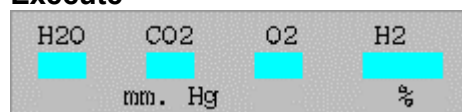
10.10. GAS ANALYZER ИК0501 DEACTIVATION

RS Laptop

CM:СЖО:Gas Analyzer

proc F21_APS_7 (Atmos. monitoring mode, Deselect)

Execute



10.11. ГA UNIT REPLACEMENT

Prepare:

- 10 mm socket wrench
- screwdriver

10.11.1. CONVERTER REPLACEMENT IN ИК0501 (00:15:00)

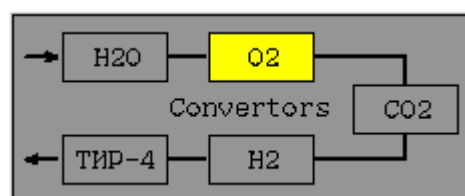
RS Laptop

1. CM:СЖО:Gas Analyzer

proc F21_APS_7 (Atmos. monitoring mode, Deselect)

Execute

Monitor yellow color of defective converter against dark background of ИК0501, e.g. for O₂:



2. Loosen captive screws (four) securing converter to converter baseplate
Remove converter from bottom, pull handle in direction, perpendicular to ИК bottom (take ЭП1003 by inlet manifold)
3. Remove yellow cover from new converter, closing gas adapters (on baseplate bottom surface)

NOTE

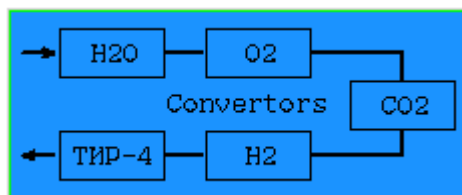
When replacing converter ЭП1003 remove rubber cap from ВХОД (inlet) fitting

Cover → removed converter and secure cover with captive screws (two)

Cap ↔ new converter adapter and →← removed converter adapter

New converter → ИК0501 baseplate
 Tighten captive screws (four)
 Removed converter → storage location

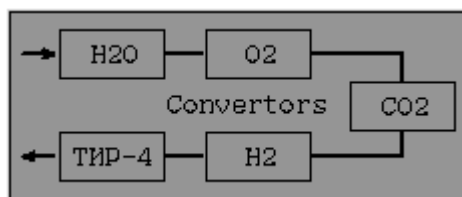
- RS Laptop 4. CM:СЖО:Gas Analyzer
proc F21_APS_6 (*Atmos. monitoring mode, Select*)
Execute



10.11.2. REPLACEMENT OF ИК0501 CO₂ FILTER UNIT (БФ)

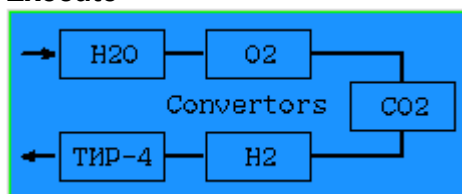
(00:10:00)

- RS Laptop 1. CM:СЖО:Gas Analyzer
proc F21_APS_7 (*Atmos. monitoring mode, Deselect*)
Execute



2. Loosen screw with handle
 Remove БФ from instrument baseplate by pulling screw out
3. Remove БФ 1Г 2.966.297 from ЗИП
 Caps ↔ fittings
 БФ → instrument baseplate
 Secure БФ using screw with handle
4. Caps →← removed БФ fittings
 Removed БФ → storage location

- RS Laptop 5. CM:СЖО:Gas Analyzer
proc F21_APS_9 (*CM Gas-Analyzer (ИК0501) ORU Test, without warmup*)
Execute

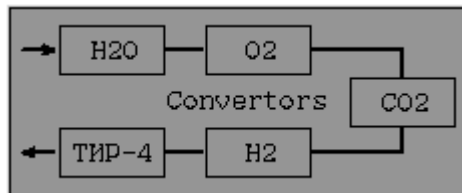


10.11.3. FAN REPLACEMENT IN IK0501

(00:15:00)

RS Laptop

1. CM:CЖO:Gas Analyzer
proc F21_APS_7 (*Atmos. monitoring mode, Deselect*)
Execute

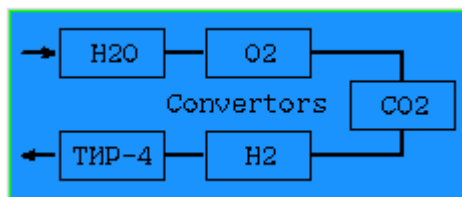


2. Fan adapter \leftrightarrow BEHT (fan) adapter (on instrument baseplate)
 \leftrightarrow fan from socket and \rightarrow storage location
3. Unstow fan 1Г2.964.021 from ЗИП
 Cap \leftrightarrow new fan adapter and \rightarrow removed fan adapter
 Fan \rightarrow socket to stop and \hookrightarrow baseplate (until it is secured)
 Fan adapter \rightarrow BEHT(fan) adapter on the baseplate

IK0501

RS Laptop

4. CM:CЖO:Gas Analyzer
proc F21_APS_9 (*CM Gas-Analyzer (IK0501) ORU Test, without warmup*)
Execute















fan is running

10.12. FA MALFUNCTION

1. Alarm annunciation during gas composition monitoring

Table 10.12

Annunciation on ПСС	Annunciation on RS Laptop	Activation condition	Crew actions
ATM COND (ПРОБЕРЬ АТМОСФЕРУ) ЗВУК	 'Carbon dioxide is abnormally high' CM:СЖО:Gas Analyzer CO2 	$P.CO_2 > 10 \text{ mmHg}$	Report to MCC-M
ATM COND ЗВУК	 'Oxygen pressure is abnormally low' CM:СЖО:Gas Analyzer O2 	$P.O_2 < 130 \text{ mmHg}$	Report to MCC-M
ATM COND ЗВУК	 'Oxygen pressure is abnormally high' CM:СЖО:Gas Analyzer O2 	$P.O_2 > 190 \text{ mmHg}$	Report to MCC-M
ATM COND ЗВУК	 'Oxygen pressure is abnormally low' CM:СЖО:Gas Analyzer O2 	$P.O_2 < 124 \text{ mmHg}$	Report to MCC-M
ATM COND ЗВУК	 'Carbon dioxide is abnormally high' CM:СЖО:Gas Analyzer CO2 	$P.CO_2 > 15 \text{ mmHg}$	Report to MCC-M
ATM COND ЗВУК	 'Hydrogen is abnormally high' CM:СЖО:Gas Analyzer H2 	$P.H_2 > 1 \%$	Report to MCC-M

2. Converter malfunction

RS Laptop

CM:CJO:Gas Analyzer

If **O2** or **H2** or **H2O** or **CO2**
| Replace corresponding converter per 10.11.1

If **ТИР-4**
| Perform converter ТИР-4 checkout per 10.8
| If converter ТИР-4 operates, replace fan
| per. 10.11.3

11. AIR SAMPLE COLLECTION

11.1. AIR SAMPLE COLLECTION USING DRAEGER TUBE AIR SAMPLER (ИПД)

(01:00:00)

1. SETUP

Prepare kits (medicine cabinet container #7):

- ПАТРОНТАШ С ИПД (on **MCC-M GO**)
- НАСОС ДЛЯ ПРОБ (pump for samples)

Unstow air samplers (two for each analyzed component)

↙ air sampler indicator layer color (see Table 11.1)

CAUTION

Do not use air sampler if indicator layer (part of the layer) changes color, **report to MCC-M**

Table 11.1

Air sampler	Label	Initial color	Changed color	Number of pump cycles
Carbonic single-oxide	140-1 --- 140-5 160-1 --- 160-5	white white	green white	10
Carbonic single-oxide	150-1 --- 150-5 160-1 --- 160-5	white white	green white	10
Formaldehyde	250-1 --- 250-5 60-1 --- 60-5	white white	pink white	20
Ammonia	80-1 --- 80-10	yellow	blue	10
Nitrose gases (nitrogen oxides)	170-1 --- 170-10	yellow-green	gray-blue	10
Prussic acid	220-1 --- 220-10	yellow-orange	red	5
Hydrochloric acid	230-1 --- 230-10	blue	yellow	20
Anhydrous hydrogen fluoride	260-1 --- 260-10	light blue	light pink	20

2. ACCURO PUMP LEAK CHECK

Firmly close pump rubber socket with finger

↙ pump indicator color is white

✓ pump cycle counter — 0 (counter may be reset by depressing the pin next to counter window using a felt-tip pen)

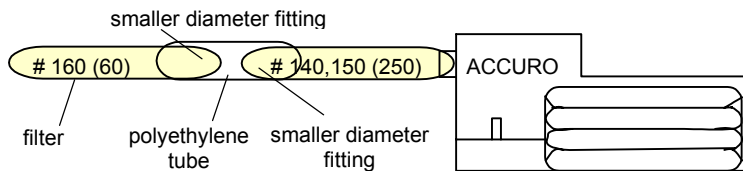
Fully compress pump

00:00:00 < pump indicator color is dark
 cycle counter — 01
 00:02:00 Release pump
 If pump does not change its state and indicator is dark
 Pump does not leak
 Release finger
 < pump indicator color is white
 Cycle counter → 0
 If pump indicator has become white
 Pump leaks
 Use another ACCURO pump
 Report to MCC-M

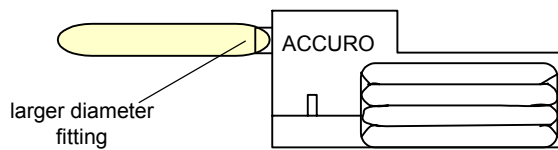
3. AIR SAMPLE COLLECTION

Snap off both tips of air sampler glass tube (snapping sound is heard)
 (snap sample collector #250 in the middle between two white washers)
 Assemble the circuit:

For air samples #140,150, 160, 250, 60 :



For the other air samplers:



√ pump cycle counter — 0
 Fully compress pump
 < cycle counter increased by 1
 pump indicator color is dark
 Release pump
 < pump is fully expanded and indicator color is white
 (after 20—30 sec - for single tubes,
 after 50—60 sec - for double tubes)

√ tube tips are snapped off

< air sampler indicator layer changes color (see Table 11.1)
 Record the length of layer which changed the color (use air sampler scale)

Pump Cycle #										
Scale Increment										

Repeat until counter reading — see Table 11.1 (last column)

Report measurement results **to MCC-M**

On MCC-M GO 4. Perform step 3 with the second air sampler of the given component

Report measurement results to MCC-M

- On MCC-M GO**
5. Perform air sample collection for other components (see steps 3, 4)
 6. Used tubes → discard
The other tubes and pump → kits and → stowage location

11.2. AIR SAMPLE COLLECTION USING AK-1M ADSORBER**1. SETUP**

Prepare kits:

- НАСОС ДЛЯ ПРОБ (pump for samples)
- УКЛАДКА С ПРОБОЗАБОРНИКАМИ АК-1М (kit with AK-1M adsorbers)

Unscrew strap nuts (two) from AK-1M adsorber

←+→ two caps

Adsorber →|← pump

2. AIR SAMPLE COLLECTION

- ✓ pump cycle counter — 0 (counter may be reset by depressing the pin next to the counter window using a felt-tip pen)

Fully compress pump

↖ cycle counter increased by 1

pump indicator color is dark

Release pump

↖↖ pump is fully expanded

pump indicator color is white

NOTE

During Freon sample collection perform only one pumping

Repeat until pump counter reading — 5

3. Adsorber ←+→ pump

Caps (two) →|← adsorber

Secure caps with coupling nuts

Adsorber → pocket of the kit with corresponding #

Record date, time and location of air sample collection on kit pocket label

Pump → kit

12. FIRE DETECTION AND SUPPRESSION SUBSYSTEM

12.1. FIRE DETECTION AND SUPPRESSION SUBSYSTEM LOCATION DIAGRAM

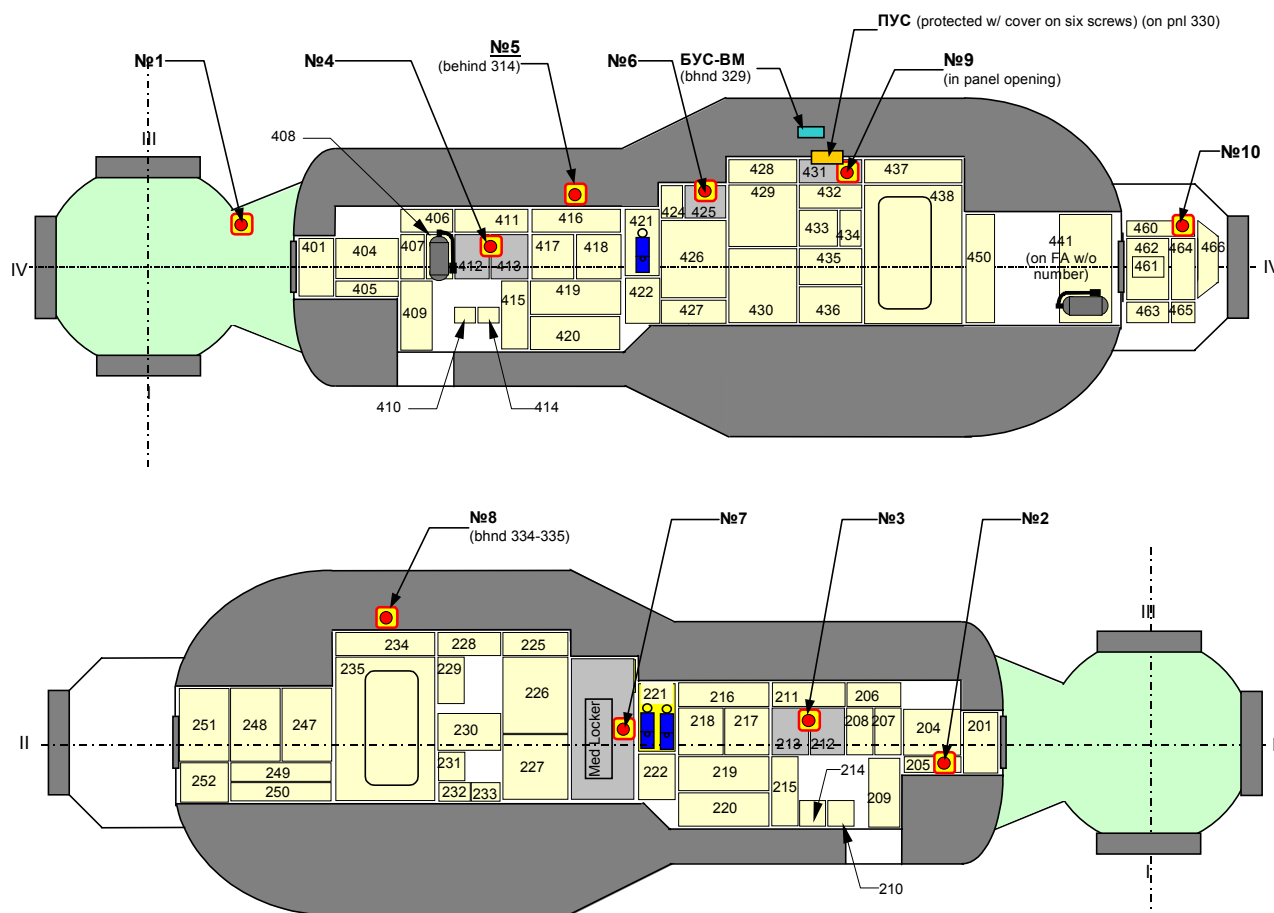


Figure 12.1. SM Smoke Detector, Fire Extinguisher and Gas Mask Locations

LEGEND



Smoke Detector



Fire Extinguisher OCP-4

№7 Smoke Detector #



Gas Mask ИПК-1

Cyan background indicates the component hidden behind the panel.

12.2. SIGNAL-VM

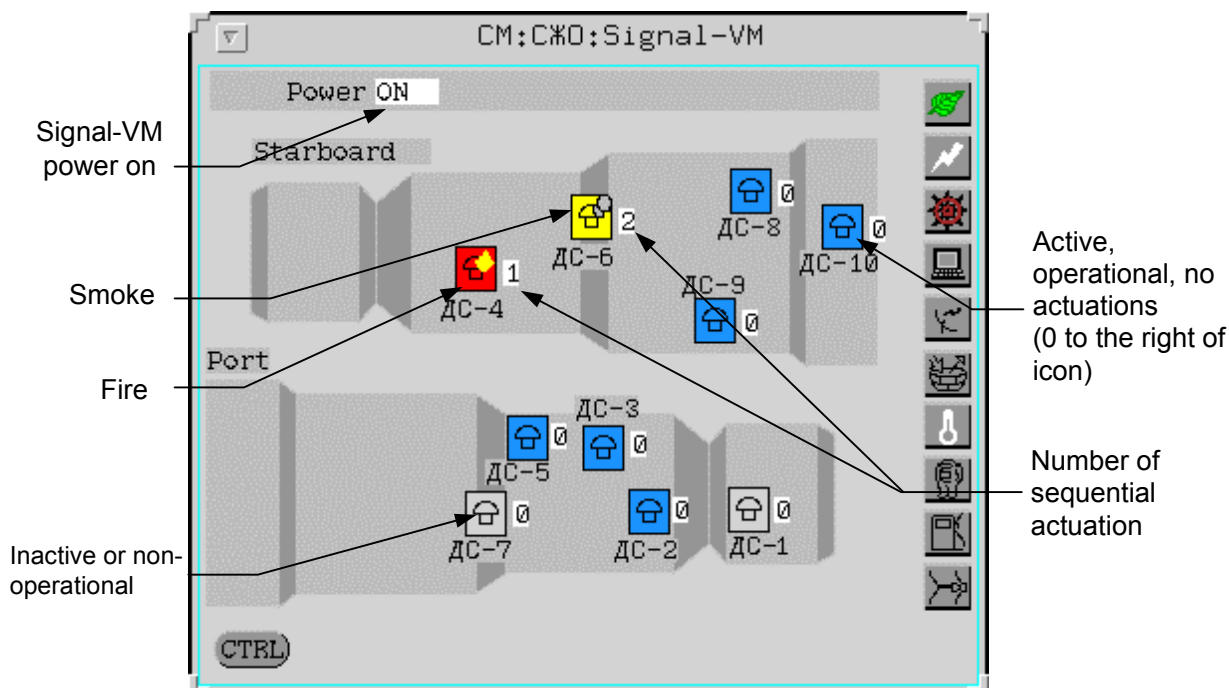


Figure 12.2. RS Laptop Screen Display for powered-up Signal-VM

To determine ДС smoke detector location:

↓ on corresponding ДС icon

Context Info

◀ Датчик_дыма_для_Сигнала '<место размещения>' (Signal-VM smoke detector '<location>')

12.2.1. SIGNAL-VM CONTROL BY ONBOARD COMPUTER SYSTEM (БВС)

Smoke Detector Panel (ПУС) status when controlled by БВС:

ПУС
 Ⓢ PNL PWR — OFF
 sw DETECTOR TEST — OFF
 Ⓢ DETECTOR POWER 1---10

12.2.1.1. POWERUP AND FIRE DETECTION MODE ACTIVATION

RS Laptop

CM:CЖО:Сигнал-ВМ

proc F26_APS_1 (Fire detection mode Deactivation)

Execute

proc F26_APS_0 (Fire detection mode Activation)

Execute

◀ Power ON

◀ ДС (operational)



◀ ДС (non-operational or inactive)



12.2.1.2. POWERDOWN AND FIRE DETECTION MODE DEACTIVATION**NOTE**

After powerdown, all further work with SIGNAL-VM is possible only from Smoke Detector Panel (ПУС) and C&W Panel (ПСС)

RS Laptop

CM:CЖО:Signal-VM

proc F26_APS_1 (Fire detection mode Deactivation)**Execute****cmd** E_OFPSIGN_VM (Signal-VM power OFF)**Execute**

◀ Power OFF

◀ ДС (operational) —

◀ ДС (non-operational and inactive) —

**12.2.1.3. ДС SMOKE DETECTOR TEST****(ON MCC-M GO)****NOTE**

1. Conduct automatic detector test – daily (duration – 35 sec)

2. During test:

ПСС SMOKE and FIRE alarm signal on C&W Panel is inhibited

ПУС ☒ LED DETECTOR SIGNAL (any of ten ДС)☐ LED (the other are operational)☒ LED DETECTOR SIGNAL (non-operational or inactive)

RS Laptop

CM:CЖО:Signal-VM

◀ Power ON

If Power OFF

| Power up system and activate fire detection mode (see 12.2.1.1)

◀ ДС (operational) —

◀ ДС (non-operational or inactive) —

**proc** F26_APS_2 (Fire detection mode test)**Execute**

00:00:00

◀ ДС (non-operational and inactive) —

00:00:35

**Report to MCC-M** Number of newly failed ДС**12.2.1.4. SIGNAL-VM OPERATION AFTER ДС SMOKE DETECTOR ACTUATION****NOTE**

After actuation of ДС when controlled by БВС:

ПУС ☒ ДС (1st actuated)☐ ДС (2nd and next actuated)(may not be monitored)

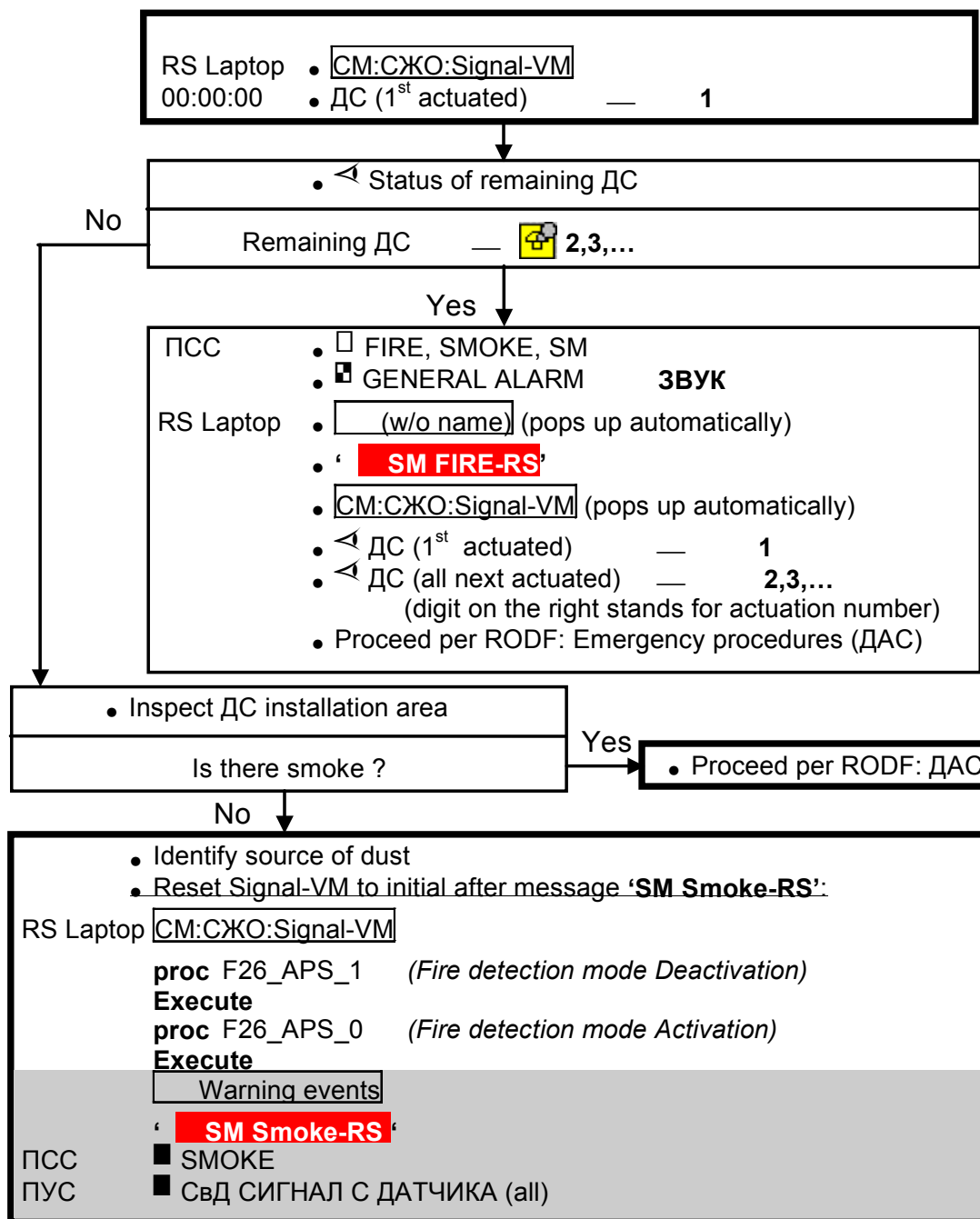
00:00:00 ПСС

◀ ☐ SMOKE☒ General Alarm**3ВУК**

00:00:35 RS Laptop

☐ Warning events

◀ 'X SM Smoke-RS'



12.2.1.5. ONBOARD SYSTEMS AUTOMATIC SHUTDOWN IN THE EVENT OF FIRE (REFERENCE INFORMATION)

Hardware that is shut down:

All fans in SM, FGB, and in modules in X and Y nodes
(ПУБН power and BH1, BH2, BKЮ1, BKЮ2 algorithms are not shut down)
Air conditioning system CKB1 (CKB2)
LIRA
Compressors K1, K2, K3 (ОДУ), valves close
Gas analyzers ИК0501 and ГЛ2106
БМП micropurification unit (fan, БМП emergency vacuum valve closes)
VOZDUKH (COA emergency vacuum valve closes)
ELEKTRON (CT-64, ЭЛБК, ЭЛВ1, ЭЛК1 valves close)

12.2.1.6. ONBOARD SYSTEMS AUTOMATIC REACTIVATION AFTER FIRE IS EXTINGUISHED (REFERENCE INFORMATION)

NOTE

Automatic reactivation is performed if at least one of the following conditions is observed:

- loss of fire signal from ДС smoke detector(s)
- 30 min after fire detection (regardless of crew actions, actual situation onboard, and state of onboard systems)

Hardware that is reactivated:

All SM fans (except BH1, BH2, BKЮ1, BKЮ2, БОЛ and those manually deactivated by the crew from ППС), fans in FGB, in modules in X and Y nodes
БМП micropurification unit
ELEKTRON

12.2.1.7. SIGNAL-VM RESET TO INITIAL STATE AFTER FIRE

After automatic reactivation of ventilation:

RS Laptop

CM:CЖО:Signal-VM

ДС (operational) —

ДС (non-operational or inactive) —

proc F26_APS_1 (Fire detection mode Deactivation)

Execute

proc F26_APS_0 (Fire detection mode Activation)

Execute

ПСС

■ FIRE, SMOKE, SM

ПУС

■ LED DETECTOR SIGNAL (all)

RS Laptop

(w/o name)

‘ **SM FIRE-RS** ‘

Warning events

‘ **SM Smoke-RS** ‘

12.2.1.8. SIGNAL-VM PREPARATION FOR ДC-7A SMOKE DETECTOR AND SIGNAL-VM CONTROLLER (БУС) CHANGEOUT (WHILE CONTROLLED BY ББС)

ПУС

Power down fire detection mode and SIGNAL-VM
(only during changeout of all ДC or БУС BM) (see 12.2.1.2)

✓ ⚙ PNL PWR

✓ sw DETECTOR TEST — OFF

⚙ DETECTOR POWER 1 (2---10)

Replace ДC or БУС BM (see RODF: IFM IVA SM)

⚙ DETECTOR POWER 1 (2---10)

After changeout of all ДC or БУС BM:

Power up system and activate fire detection mode (see 12.2.1.1)

After partial ДC changeout:

Perform ДC test (see 12.2.1.3)

12.2.2. SIGNAL-VM OPERATION WHEN CONTROLLED FROM SMOKE DETECTOR PANEL (ПУС)

(ON MCC-M GO)

12.2.2.1. SWITCHOVER TO CONTROL FROM ПУС

Cancel fire detection mode (see 12.2.1.2)

If RS Laptop cannot be used:

| ✓ **MCC-M** to confirm that fire detection mode was canceled

ПУС	Ⓢ PNL PWR
	✓ Ⓢ DETECTOR POWER 1---10
	✓ sw DETECTOR TEST — OFF
RS Laptop	CM:CЖО:Signal-VM
	⏏
	⏏ ДС (operational) —

12.2.2.2. ДС SMOKE DETECTOR FUNCTIONAL TEST

(T = 00:10:00 x 2 crewpersons)

ПУС	✓ Ⓢ PNL PWR
	✓ Ⓢ DETECTOR POWER 1---10
	✓ sw DETECTOR TEST — OFF

ПУС	<div style="border-left: 1px solid black; padding-left: 10px;"> sw DETECTOR TEST → 1 ↓ DETECTOR TEST (hold for ≥ 5 sec) ⏏ □ SMOKE ⏏ ■ General alarm ЗВУК ⏏ ■ LED DETECTOR SIGNAL1 ↓ DETECTOR RESET ■ LED DETECTOR SIGNAL 1 ⏏ ■ SMOKE </div>
ПСС	
ПУС	
ПСС	

Repeat steps for each ДС smoke detector from 2nd through 10th
sw DETECTOR TEST → OFF
Report to MCC-M

12.2.2.3. SIGNAL-VM DEACTIVATION FROM SMOKE DETECTOR PANEL (ПУС)

ПУС	Ⓢ DETECTOR POWER 1 (2---10)
	Ⓢ PNL PWR
	✓ sw DETECTOR TEST — OFF

12.2.2.4. SIGNAL-VM ACTUATION TEST WHEN CONTROLLED FROM SMOKE DETECTOR PANEL (ПУС)

1. ACTUATION OF ONE ДC SMOKE DETECTOR

ПУС ☒ LED DETECTOR SIGNAL
 Determine ДC installation area (per Table located next to ПУС panel)

ПСС ☐ SMOKE
☒ General Alarm **3ВУК**
 Inspect ДC installation area *****

 If there is fire
 | Proceed per RODF: Emergency procedures

 Identify the source of the dust
 Perform step 3

2. ACTUATION OF TWO OR MORE ДC SMOKE DETECTORS

ПУС ☒ ДC (1st actuated)
☐ ДC (2nd and next actuated)
 Determine ДC installation area (per Table located next to ПУС panel)

ПСС ☐ SMOKE
☒ General Alarm **3ВУК**
 Inspect ДC installation area *****


 If there is fire
 | Proceed per RODF: Emergency procedures



 Identify the source of the dust
 Perform step 3

3. SMOKE SENSOR TRANSITION TO STANDBY MODE AFTER ACTUATION

NOTE

To be performed after atmosphere purification is complete

ПУС √  PNL PWR
 ↓ DETECTOR RESET

ПСС  LED DETECTOR SIGNAL
 SMOKE
 Perform ДC smoke detector(s) functional test (see 12.2.2.2)

Report to MCC-M

12.2.2.5. SIGNAL-VM PREPARATION FOR ДС-7А SMOKE DETECTOR AND SIGNAL-VM CONTROLLER (БУС) CHANGEOUT (WHILE CONTROLLED FROM ПУС)

1. FOR REPLACEMENT OF FAILED ДС 1 (2---10)

ПУС

- ⌚ DETECTOR POWER 1 (2---10)
- Replace ДС (see RODF: IFM IVA SM)
- (ДС locations (see Figure 12.1)
- ⌚ DETECTOR POWER 1 (2---10)
- Perform newly replaced ДС smoke detector functional test (see 12.2.2.2)

2. DURING REPLACEMENT OF ALL EXPIRED ДС SMOKE DETECTORS AND SIGNAL-VM CONTROLLER (БУС BM)

ПУС

- ⌚ DETECTOR POWER 1---10
- ⌚ PNL PWR
- √ sw DETECTOR TEST — OFF
- Replace ДС smoke detectors or БУС BM (see RODF: IFM IVA SM)
- (for ДС and БУС BM locations see Figure 12.1)
- ⌚ PNL PWR
- ⌚ DETECTOR POWER 1---10
- Perform functional test of all ДС smoke detectors (see 12.2.2.2)

12.2.3. SIGNAL-VM OFF-NOMINAL SITUATIONS

12.2.3.1. 'SM FIRE DETECTION SYSTEM POWER OFF-RS'

RS Laptop Warning events
 ' **SM Fire Detection System Power Off-RS** '
CM:CЖО:Signal-VM
 ⏏
 ПСС ■ General Alarm **3БЫК**
□ OTHER (red)
 ПУС √ ⏏ PNL PWR
√ ⏏ DETECTOR POWER 1---10
 Power up system and activate fire detection mode (see 12.2.1.1)
Warning events
 ⏏ ' **SM Fire Detection System Power Off-RS** '
 ПСС ⏏ ■ OTHER (red)
√ MCC-M

12.2.3.2. 'SM SMOKE DETECTOR FAILURE-RS' (РАБОТА С ББС)

RS Laptop Caution events
 ' **SM Smoke Detector Failure-RS** '
CM:CЖО:Signal-VM
 ДС (non-operational and/or inactive) —
 (Failed ДС is excluded from fire detection algorithm)
 ПСС □ OTHER (yellow) **3БЫК**
 ПУС √ ⏏ DETECTOR POWER 1(2---10)
√ sw DETECTOR TEST — OFF
⏏ □ LED DETECTOR POWER Д1 (Д2---Д10) *****

⏏ DETECTOR POWER 1 (2---10)
 Replace ДС (see RODF: IFM IVA SM)
⏏ DETECTOR POWER 1 (2---10)
 Perform ДС test (see 12.2.1.3)

 Power down system and deactivate fire detection mode (see 12.2.1.2)
 Replace fuse Д1 (Д2---Д10) (behind cover labeled 'FUSES')
 ПУС ⏏ ■ LED Д1 (Д2---Д10)
 RS Laptop Caution events
 ⏏ ' **SM Smoke Detector Failure-RS** '
 ПСС ⏏ ■ OTHER (yellow)
Report to MCC-M

12.2.3.3. ПУС □ LED Д1 (Д2---Д10) DETECTOR POWER (OPERATION FROM ПУС)

ПУС

Ⓢ PNL PWR
 √ sw DETECTOR TEST — OFF
 Ⓢ DETECTOR POWER 1---10
 Replace fuses Д1 (Д2---Д10) (behind cover labeled 'FUSES')
 Ⓢ PNL PWR
 Ⓢ DETECTOR POWER 1---10
 ◀ ■ LED Д1 (Д2---Д10)
Report to MCC-M

12.2.3.4. ПУС □ LED 11 PNL PWR**1. OPERATION FROM ONBOARD COMPUTER SYSTEM (БВС)**

ПУС

Deactivate fire detection mode and power down system (see 12.2.1.2)
 √ Ⓢ PNL PWR
 √ sw DETECTOR TEST — OFF
 Replace fuse Д11 (behind cover labeled 'FUSES')
 Power up system and activate fire detection mode (see 12.2.1.1)
 ◀ ■ LED Д11 DETECTOR POWER
Report to MCC-M

2. SMOKE DETECTOR PANEL (ПУС) OPERATION

ПУС

Ⓢ PNL PWR
 √ sw DETECTOR TEST — OFF
 Replace fuse Д11 (behind cover labeled 'FUSES')
 Ⓢ PNL PWR
 ◀ ■ LED Д11
Report to MCC-M

12.3. BACKPACK FIRE EXTINGUISHER ОСП-4

CAUTION

1. If ОСП-4 activation pins are accidentally removed, record the date and **report to MCC-M**
The affected ОСП-4 will remain operational for 90 days
2. Do not use US PFE aboard SM

1. PREPARATION

408,

pl IV, next to ПpK hatch

Release latches

Remove ОСП-4 from bracket (ОСП-4 becomes clogged)

Pull out straps and clasp them around the waist

Secure sliding nozzle under strap

2. FIRE EXTINGUISHING

When extinguishing an open flame:

Sliding nozzle → LIQUID (in direction of arrow LIQUID to the hard stop)

When extinguishing a covered flame:

Sliding nozzle → FOAM (in direction of arrow FOAM to the hard stop)

Push lever

↙ presence of liquid stream (foam spray)

✓ Nozzle- LIQUID (FOAM) to the stop

If there is no foam spray use another ОСП-4

Start putting out the flame

Hold nozzle as close as possible

ОСП-4 should be continuously operated for at least 1 min

3. CLEANUP AFTER FIRE EXTINGUISHER USAGE

Wait for spilled foam to settle down

(at least 10 --- 15 min if one ОСП-4 was used)

Using towels (location TBD), remove water spills and white foam residue

Label used ОСП-4 accordingly and discard

CAUTION

1. Repeated use of ОСП-4 is not allowed
2. Do not disassemble used ОСП-4
(residual pressure – 15 kg/cm²)

Report to MCC-M Serial number of used ОСП-4

12.4. ИПК-1 GAS MASK USAGE**NOTE**

1. Usability time, min:

during considerable workload	20
during medium workload	40
during complete rest (when sitting)	140
2. End of ИПК-1 usability time is indicated by incomplete expansion of rebreather bag and inability of the user to take a full breath

221(two),421 Pull the ring of the tension strap latch (latch opens)

Open shell (use the pull ring)

Extract ИПК-1 working part from case (use belts)

Secure cartridge on the front torso (using belts)

Clasp belts behind the back

Don mask

Starting lever ↺ (180° degrees)

Exhale

Adjust mask straps (if necessary)

00:00:00 Inhale

00:01:00

✓ Cartridge activation (by rebreather bag expansion, heat build-up on the cartridge, O₂ amount sufficient for a full breath)

Use another ИПК-1

CAUTION

1. Do not remove mask for more than 3 min

2. When wearing ИПК-1 gas mask, ensure rebreather bag is not mechanically obstructed