

Approved per signature page

SERVICE MODULE

**EVA from ПхО**  
(ВПхО)

SM.1

2000

## Revision Log

1 E	20 Jun 00	5—1 E	20 Jun 00
2 E	20 Jun 00	5—2 E	20 Jun 00
3 E	20 Jun 00	5—3 E	20 Jun 00
4 E	20 Jun 00	5—4 E	20 Jun 00
5 E	20 Jun 00	5—5 E	20 Jun 00
6 E	20 Jun 00	5—6 E	20 Jun 00
7 E	20 Jun 00	5—7 E	20 Jun 00
		5—8 E	20 Jun 00
1—1 E	20 Jun 00	5—9 E	20 Jun 00
		5—10 E	20 Jun 00
2—1 E	20 Jun 00	5—11 E	20 Jun 00
2—2 E	20 Jun 00	5—12 E	20 Jun 00
2—3 E	20 Jun 00	5—13 E	20 Jun 00
2—4 E	20 Jun 00	5—14 E	20 Jun 00
2—5 E	20 Jun 00	5—15 E	20 Jun 00
		5—16 E	20 Jun 00
3—1 E	20 Jun 00	5—17 E	20 Jun 00
3—2 E	20 Jun 00	5—18 E	20 Jun 00
3—3 E	20 Jun 00	5—19 E	20 Jun 00
3—4 E	20 Jun 00	5—20 E	20 Jun 00
3—5 E	20 Jun 00	5—21 E	20 Jun 00
3—6 E	20 Jun 00		
3—7 E	20 Jun 00		
3—8 E	20 Jun 00		
3—9 E	20 Jun 00		
4—1 E	20 Jun 00		
4—2 E	20 Jun 00		
4—3 E	20 Jun 00		
4—4 E	20 Jun 00		
4—5 E	20 Jun 00		
4—6 E	20 Jun 00		
4—7 E	20 Jun 00		
4—8 E	20 Jun 00		
4—9 E	20 Jun 00		
4—10 E	20 Jun 00		
4—11 E	20 Jun 00		
4—12 E	20 Jun 00		
4—13 E	20 Jun 00		
4—14 E	20 Jun 00		
4—15 E	20 Jun 00		
4—16 E	20 Jun 00		
4—17 E	20 Jun 00		
4—18 E	20 Jun 00		
4—19 E	20 Jun 00		

## TABLE OF CONTENTS

<b>INTRODUCTION .....</b>	<b>5</b>
<b>1. GENERAL INFORMATION .....</b>	<b>1—1</b>
1.1. CREW RESPONSIBILITIES .....	1—1
1.2. SAFETY PRECAUTIONS .....	1—1
<b>2. PRE-EVA CONFIGURATION .....</b>	<b>2—1</b>
2.1. EVA SUPPORT PANEL (ПОВ) CHECK .....	2—1
2.1.1. INDICATORS CHECK .....	2—1
2.1.2. CLOCK CHECK .....	2—1
2.1.3. EVA SUPPORT PANEL (ПОВ) PRESSURE INIDICATOR CHECK .....	2—2
2.2. PORTABLE REPRESS TANK (БНП) PRESSURE CHECKOUT .....	2—2
2.3. ONBOARD OXYGEN TANKS AND PORTABLE REPRESS TANK PRESSURE CHECK... 2—3	2—3
2.4. ORLAN SYSTEMS, БСС AND COMM TELEMETRY CHECKOUT.....	2—4
2.5. КСД AND КВД VALVE ACTIVATION CHECK FROM EVA SUPPORT PANEL (ПОВ) .....	2—5
<b>3. PRE-EVA TRAINING .....</b>	<b>3—1</b>
3.1. ORLAN SYSTEMS CHECKOUT.....	3—1
3.2. ORLAN INTERFACE UNIT (БСС) CHECKOUT.....	3—3
3.3. DONNING EVA GEAR.....	3—4
3.4. COMM CHECK AND MEDICAL PARAMETERS MONITORING.....	3—4
3.5. ENTRY INTO AND SEALING OF ORLANS.....	3—5
3.6. ORLAN SUIT AND ORLAN INTERFACE UNIT (БСС) CONTROLS CHECK.....	3—6
3.7. ORLANS AND БСС PRELIMINARY LEAK CHECK.....	3—6
3.8. ORLAN FIT CHECK AT ORLAN PRESSURE = 0.4.....	3—7
3.9. ORLAN TRANSLATION TRAINING.....	3—7
3.10. EXIT FROM ORLAN .....	3—8
3.11. POST TRAINING ACTIVITIES.....	3—9
<b>4. ACTIVITIES ON DAY OF EVA .....</b>	<b>4—1</b>
4.1. ПхО PREPARATION .....	4—1
4.2. HATCH CONFIGURATION BEFORE EVA .....	4—1
4.3. MEDICAL MONITORING.....	4—2
4.4. COMMUNICATION CHECK .....	4—3
4.5. ORLAN SYSTEMS CHECK .....	4—4
4.6. ORLAN INTERFACE UNIT (БСС) CHECKOUT.....	4—6
4.7. FINAL INSPECTION OF ORLAN AND БСС BEFORE ENTRY INTO ORLAN .....	4—7
4.8. DONNING EVA GEAR.....	4—8
4.9. PRE-EVA A/L OPERATIONS.....	4—9
4.10. POST-EVA A/L OPERATIONS .....	4—15
4.11. CONFIGURING ISS TO INITIAL STATE AFTER EVA.....	4—19

<b>5. OFF-NOMINAL SITUATIONS</b> .....	<b>5—1</b>
5.1. OFF-NOMINAL SITUATIONS PRIOR TO ORLAN ENTRY .....	5—1
5.1.1. NO COMMUNICATION VIA ELECTRICAL UMBILICAL .....	5—1
5.1.2. NO COMMUNICATION VIA KORONA SYSTEM.....	5—1
5.1.3. LEAK ALARM “УТЕЧКА” .....	5—2
5.1.4. FAN(S) OR PUMP(S) FAILURE .....	5—3
5.1.5. NO OXYGEN FLOW (O <sub>2</sub> FLOW SELECTOR— ИИЖ) .....	5—3
5.2. OFF-NOMINAL SITUATIONS DURING A/L OPERATIONS.....	5—4
5.2.1. ORLAN AND БСС LEAK DETECTED DURING PRELIMINARY LEAK CHECK.....	5—4
5.2.2. ORLAN AND БСС LEAK DETECTED DURING FINAL LEAK CHECK.....	5—5
5.2.3. HATCH LEAK PRIOR TO OPENING A/L .....	5—6
5.2.4. ORLAN ABNORMAL PRESSURE DURING ПХО DEPRESSURIZATION TO 5 MM...5—7	
5.2.5. ORLAN POWER FAILURE DUE TO PROBLEM WITH ELECTRICAL UMBILICAL....	5—8
5.2.6. ORLAN FAN(S) FAILURE .....	5—9
5.2.7. ORLAN ABNORMAL PRESSURE DURING TRANSITION TO ORLAN AUTONOMOUS POWER SUPPLY .....	5—10
5.2.8. INSUFFICIENT COOLING.....	5—11
5.2.9. SUBLIMATOR STARTUP FAILURE.....	5—11
5.3. OFF-NOMINAL SITUATIONS DURING EVA .....	5—12
5.3.1. EXPEDITED RETURN .....	5—12
5.3.2. EMERGENCY RETURN .....	5—12
5.3.3. SPECIAL CASES OF ORLAN TEMPERATURE STATUS.....	5—13
5.3.4. INSUFFICIENT OXYGEN SUPPLY ALARM “O <sub>2</sub> МАЛО”.....	5—13
5.3.5. ORLAN PRESSURE SLOWLY DROPS BELOW 0.35.....	5—14
5.3.6. ORLAN PRESSURE QUICKLY DROPS BELOW 0.35.....	5—14
5.3.7. ORLAN PRESSURE INCREASES OVER 0.41 .....	5—15
5.3.8. OXYGEN OVERFLOW WITH INACTIVE INJECTOR ( $\Delta P.O_2 > 25$ OVER 20 MIN)...5—15	
5.3.9. LEAK ALARM “УТЕЧКА” .....	5—16
5.3.10. COMM FAILURE .....	5—17
5.3.11. 25 M ELECTRICAL UMBILICAL IS TANGLED.....	5—18
5.4. OFF-NOMINAL SITUATIONS DURING REVERSE A/L ACTIVITIES.....	5—19
5.4.1. EV HATCH LEAKS AFTER EVA .....	5—19
5.4.2. EMERGENCY A/L ACTIVITIES.....	5—20
5.4.3. PROVISION OF FIRST-AID .....	5—21

## INTRODUCTION

These crew procedures "EVA from ПхО" contain operation information on Orlan-M Space Suit, Orlan Interface Unit, SM and FGB pressure control devices during setup and A/L operations in SM ПхО in SM-FGB-NODE configuration.

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

These crew procedures may be updated pending hardware modifications and procedure validation process.

Duration of operations is approximate.

## ACRONYMS AND ABBREVIATIONS

cb	circuit breaker
EVA	extravehicular activity
LED	light-emitting diode
<b>MCC</b>	mission control center
pb	pushbutton
SM	Service Module
sw	switch
БНП	portable repress tank
БК-3	Orlan oxygen tank
БК-3(1-4)	onboard oxygen tank(s)
БОС	degassing pump unit
БСС	Orlan interface unit
БРТА	Orlan telemetry unit
BC	moisture collector
ЗВЛ	EV hatch closure
ЗвН	continuous sound
ЗвП	intermittent sound
ЗИП	spares kit
ИНЖ	injector
ИНПУ	integrated control panel
ИД	EVA support panel pressure indicator
ИК	Orlan measurement unit

---

КВД	pressure equalization valve
КВО	liquid cooling garment
КОБ	SM internal thermal loop
КСД	depress valve
КСФ	safety tether hook
ЛП	LiOH canister
МВ	pressure gauge
ОРК	Orlan fluid connector
ПА	comm panel
ПГПУ	Orlan pneumohydraulic control panel
ПКО	biomed harness
ПКО-М	Orlan testing unit
ПО-4	Orlan electrical control panel
ПОВ	EVA support panel
ПРБ	accessory
ПРД	transmitter
ПРК-3А	oxygen testing assembly
ПхО	transfer compartment
РБС	power outlet
РО	working compartment
СК	spacesuit
СУ	docking unit
СТТС	SM comm system
ТОУ	thermoelectric cooling device
УДСК	Orlan pressure gauge
УСЭ	Orlan-M ORU kit
ФОР	feedwater line filter
ФР	cuecard

P.БНП(ИД)	portable repress tank pressure measured by ПОВ pressure indicator (ИД)
P.O <sub>2</sub>	O <sub>2</sub> pressure in Orlan tank
P.ПхО(МВ)	ПхО pressure measured by pressure gauge (МВ)
P.РО(ИД)	[РО] pressure measured by ПОВ pressure indicator (ИД)
P.СК	Orlan pressure measured by Orlan pressure gauge (kg/cm <sup>2</sup> )
P.СТ(МВ)	cabin pressure (hatches open) measured by pressure gauge (МВ)
ΔP.СК (00:00:30)	Orlan pressure delta measured over 30 sec
Σ P.БКЗ	Total oxygen tank pressure

## SYMBOLS

	illuminated
	blinking
	not illuminated
	possible false alarm <b>ИНЖ</b>
	check (in case of discrepancy, attempt a corrective action one time only)
	verify
	continuously monitor
	verify aurally
	place physical device in designated state
	connect
	disconnect
	press push button
	press push button to lock
	press push button to release
	switch → On (i.e. up relative to label on panel)
	switch → Off (i.e. down relative to label on panel)
	rotate clockwise
	rotate counterclockwise
	rotate clockwise to stop
	rotate counterclockwise to stop
	adjust by rotating

\*\*\*\*\* ORLAN OPS 2.3.3      an anticipated off-nominal situation, if the condition left of the asterisks on the same line is not met, proceed per indicated reference

\*\*\*\*\*  
 \*\*\*\*\*  
 O<sub>2</sub> flow selector → ИНЖ      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



Position of БСС knob

## 1. GENERAL INFORMATION

In these crew procedures pressure unit of mmHg is indicated for brevity as mm, pressure unit of kgf/cm<sup>2</sup> is not indicated.

Audio alarm indicated as **TONE**.

### 1.1. CREW RESPONSIBILITIES

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

1. Perform operations per these crew procedures and **MCC** instructions (comm passes or radiograms), in accordance with the crew functional responsibilities and current status of the onboard systems.
2. Monitor systems operation per these crew procedures and **MCC** instructions.
3. Prior to operations, perform indicator checks on the control panels to be used (in the event of any deviations - **report to MCC**).
4. Record actual time spent performing operations.
5. **Report to MCC** completed operations and any system problems at earliest available comm pass.

### 1.2. SAFETY PRECAUTIONS

During Orlan operation, take extreme care so as not to damage any glass parts, visor, control handles, front side of ПО-4 control panel and anything containing glass-enclosed instruments.

Observe safety precautions when working with backpack tension line, Orlan external cables and БСС hoses. Avoid mechanical actions that may cause their kinking, over-extension, etc. Avoid sudden movements that may result in hitting any module hardware.

When working with Orlan oxygen equipment and Orlan fluid connector, it is necessary to keep all devices, tubing, БК-3 pressure reducers and others clean. If necessary, use **lubricant** from ЗИП-1 kit. EV crew wears only Orlan-certified accessories, all other items should be doffed prior to donning Orlan.

When issuing command to open (close) КСД and КВД from ПОВ, confirm the command execution by monitoring ПХО pressure change (as seen on the pressure gauge).

If the pressure reading does not change, open (close) the valve manually  
The crew may operate the valves either from the ПОВ, or manually (crew preference).

**False** activation of the БЕHT МАЛ alarm may occur if humidity inside the Orlan is abnormally high.

Before mating the fluid umbilical connector, check the condition of O-rings of Orlan fluid connector [ОПК] (ventilation valves) and that of O-rings of fluid umbilical connector (water valves). If there are traces of water on Orlan fluid connector or fluid umbilical connector surface, remove them using a clean wipe. If leakage is detected, **report to MCC**.

Restart Orlan fan and pump only after they have completely stopped.

The initial position of sw ПИТАНИЕ is БОПТ. Change position of this switch only after switches О.НАС (primary pump), Р.НАС (reserve pump), О.БЕHT (primary fan), Р.БЕHT (reserve fan) have been set to off.

Orlan leak check is performed by monitoring the position of the **red** arrow on Orlan pressure gauge (УДСК).

If pressure drop because of leak is abnormally great, **repeat** the check.

Do not open Orlan backpack when positive pressure delta exceeds 0.05 (if it is necessary to completely equalize Orlan pressure with the ambient pressure, use the Connector to ss depressurization from ЗИП-1 kit).

## 2. PRE-EVA CONFIGURATION

On **MCC GO** perform Progress deactivation (RODF: IRS ACTIVATION/DEACTIVATION)  
Clean КСД ПхО, КВД РО-ПхО and КВД ПГО-СМ mesh screens using **vacuum cleaner**

### 2.1. EVA SUPPORT PANEL (ПОВ) CHECK

(00:10:00)

#### 2.1.1. INDICATORS CHECK

- ПОВ
1. ↓ PANEL ON (□ LED)    ■ all indicator lights
  2. ↓ and hold LAMP TEST    □ all indicator lights and LED of pushbuttons, **ТОНЕ**  
Release pb LAMP TEST
  3. ↓ MTR TEST    □ scale indicators (in middle position)    \*\*\*\*\*  
\*\*\*\*\*  
sw PRESSURE (any) from OFF → any other position  
↓ to the right of indicator  
\*\*\*\*\*  
↓ SUIT 1,2 ON (□ LED)  
↓ SUIT 1,2 OFF (■ LED)  
↓ PANEL OFF (■ LED)

#### 2.1.2. CLOCK CHECK

1. CLOCK SETUP  
[ТВ] ↻ (do not depress)  
↖ wind-up indicator → to the extreme position in the white field  
ПУСК ↻ until it clicks (do not depress)    ↖ blinker above "6" starts rotating  
↓ ↓ ПУСК  
↖ central second hand and stopwatch minute hand start moving  
↓ ПУСК    ↖ both hands stop  
↓ ПУСК    ↖ second hand → 12, stopwatch minute hand → 0  
ПВ ↻ → П    ↖ minute hand moves  
ПВ ↻ → О    ↖ minute hand stops  
ПВ ↻ → С    ↖ clock hands → 12

\*\*\*\*\*

\*\*\*\*\*

↻, ↻ ПВ

\*\*\*\*\*

ПУСК ↻ until it clicks (do not depress)    ↖ blinker stops  
↓ ↻ [ТВ] to set current time  
↘ [ТВ]

2. CLOCK SYNC-UP USING REFERENCE CLOCK BEEP

ПУСК ↻ until it clicks    ↖ blinker stops  
↓ ↻ [ТВ] to set current time  
When beep sounds, ПУСК ↻ until it clicks    ↖ hands are rotating

**2.1.3. EVA SUPPORT PANEL (ПОВ) PRESSURE INIDICATOR CHECK**

(00:15:00)

ПОВ      ↓ PANEL ON (□ LED)  
 sw LOW/MODULE PRESSURE (successively)  
 → PO = \_\_\_\_\_  
 → ПхО = \_\_\_\_\_  
 → ПГО = \_\_\_\_\_  
 Compare pressure readings with those on pressure gauge [MB]  
 (pressure measurement error  $\leq \pm 50$  mm)  
 sw LOW/MODULE PRESSURE → OFF  
 ↓ PANEL OFF (■ LED)

**Report results to MCC****2.2. PORTABLE REPRESS TANK (БНП) PRESSURE CHECKOUT**

(00:35:00)

ПОВ      1. Transfer БНП into ПхО  
 ↓ PANEL ON (□ LED)  
 √ sw HIGH/TANK PRESSURE — OFF  
 Cap ↔ connector БНП-Х

БНП      Connector ≠210Ю=BP1-Х1 ↔ sensor 2МД-400ТС  
 (located under НАДДУВ valve bracket in ПхО)  
 Connector ≠210Ю=BP1-Х1 →|← connector БНП-Х

ПОВ      sw HIGH/TANK PRESSURE → AUX  
 ↙ P.БНП(ИД) = \_\_\_\_\_ (240---400)      **\*\*\*\*\* Report to MCC**  
 sw HIGH/TANK PRESSURE → OFF  
 Connector ≠210Ю=BP1-Х1 ↔ connector БНП-Х  
 Connector ≠210Ю=BP1-Х1 →|← sensor 2МД-400ТС  
 ↓ PANEL OFF (■ LED)

БНП      Cap →|← connector БНП-Х  
 2. Assemble ПхО repress circuit (see RODF:SM IFM IVA)

**2.3. ONBOARD OXYGEN TANKS AND PORTABLE REPRESS TANK PRESSURE CHECK**


(00:15:00)

- ПОВ
1. ↓ PANEL ON (□ LED)  
sw HIGH/TANK PRESSURE (successively)  
→ БК1 = \_\_\_\_\_  
→ БК2 = \_\_\_\_\_  
→ БК3 = \_\_\_\_\_  
→ БК4 = \_\_\_\_\_  
→ AUX = \_\_\_\_\_  
↓ PANEL OFF (■ LED)
  2. total БК-3 (1-4) pressure = \_\_\_\_\_ ≥ 950

\*\*\*\*\* Report to MCC

**2.4. ORLAN SYSTEMS, БСС AND COMM TELEMETRY CHECKOUT**

(00:10:00 during comm pass)

1. Establish EVA Comm (see RODF: SM COMMUNICATION SYSTEM)
- ПГПУ 2. √ O<sub>2</sub> flow selector — ИНЖ  
 √ ТО — ОТКЛ  
 √ Temperature control handle — 6  
 √ БАЛЛОН — РЕЗ  
 √ РЕГУЛЯТОР — ОСН
- ПО-4 √ Ⓢ О.НАС, Р.НАС, О ВЕНТ, Р ВЕНТ and ПИТАНИЕ — БОРТ  
 √ √ ТАНГ, ОСНОВ and РЕЗЕРВ (КОРОНА)
- backpack √ Valves of primary and reserve БК-3 — **closed**  
 √ Orlan water connectors for liquid cooling garment are looped together  
 √ Orlan measurement unit filter tubes are connected as shown in decal  
 ХРАНЕНИЕ  
 √ Comm cap and biomed harness connectors are routed out through the arm  
 Close Orlan backpack  
 √ Fluid umbilical →|← Orlan  
 √ Electrical umbilical →|← Orlan  
 (caps for Orlan X6K connectors are stowed in ЗИП-1 kit)
- БРТА 3. Ⓢ ОРЛАН  
 БСС  O<sub>2</sub> CLOSED ■ O<sub>2</sub> OPEN  
 ■ НАДДУВ ПРОДУВКА ОРЛАН I, II
- √ БК-3(1-4) valves — **closed**
- ПОВ ↓ PANEL ON (□ LED)  
 ↓ SUIT 1,2 ON (□ LED)
- ПО-4 ■ УТЕЧ, ИНЖ, ВЕНТ МАЛ, TONE
- Comm cap connector →|← Orlan X3 connector  
 Biomed harness connector →|← Orlan X9 connector
4. **On MCC GO**
- ПО-4 Successively Ⓢ, Ⓢ О.НАС, О.ВЕНТ, Р.НАС, Р.ВЕНТ  
 ПГПУ O<sub>2</sub> flow selector → ОТКЛ  
 БАЛЛОН → ОСН  
 Fluid umbilical ←|→ Orlan
- БСС Successively set handle into all positions  
 ПО-4 Ⓢ ПИТАНИЕ → АВТ  
 ПОВ ↓ SUIT 1,2 OFF (■ LED)  
 ПО-4 ↓ ОСНОВ  
 Electrical umbilical ←|→ Orlan 1, 2  
 Check comm with MCC and intercom (Orlan 1 — Orlan 2) with both  
 primary and reserve transmitter (checking both VOX and PTT)
- ПО-4 5. Ⓢ О.ВЕНТ, О.НАС  
 ↓ U/TONE < U ≥ 26 V  
 Ⓢ О.ВЕНТ, О.НАС
- ПО-4 6. Electrical umbilical →|← Orlan  
 ПГПУ Ⓢ ПИТАНИЕ → БОРТ  
 O<sub>2</sub> flow selector → ИНЖ  
 БАЛЛОН → РЕЗ  
 Temperature control handle → 3

БРТА  
 ПОВ      Ⓢ ОРЛАН  
           ↓ SUIT 1,2 OFF (■ LED)  
           ↓ PANEL OFF (■ LED)      ■ all annunciators

## 2.5. КСД AND КВД VALVE ACTIVATION CHECK FROM EVA SUPPORT PANEL (ПОВ)

(during comm pass)

	1.	√ КСД ПхО — CLOSED	
		√ КВД РО-ПхО — ELECTRIC	
		√ КВД ПхО-РО — CLOSED	
		√ КВД ПГО-СМ — ELECTRIC	
		√ КВД ПхО-СУ (FGB) — CLOSED	
	2.	<b>On MCC GO</b>	
ПОВ		↓ PANEL ON (□ LED)	■ all annunciators
		Close РО-ПхО hatch	□ ЛЮК РО-ПхО ЗАКРЫТ (HAT CL)
		↓ КСД ПхО ENA (□ LED)	
00:00:00		↓ КСД ПхО ОР	
≤ 00:00:13			□ КСД ПхО ОТКРЫТ (DEPR ОР)
00:00:35		↓ КСД ПхО CL	
≤ 00:00:48			■ КСД ПхО ОТКРЫТ (HAT CL)
		↓ КСД ПхО INHIB (■ LED)	
		Open РО-ПхО hatch	■ ЛЮК РО-ПхО ЗАКРЫТ (DEPR ОР)
	3.	↓ КВД РО-ПхО ENA (□ LED)	
00:00:00		↓ КВД РО-ПхО ОР	
≤ 00:00:13			□ КВД РО-ПхО ОТКРЫТ (PEV ОР)
00:00:35		↓ КВД РО-ПхО CL	
≤ 00:00:48			■ КВД РО-ПхО ОТКРЫТ (PEV ОР)
		↓ КВД РО-ПхО INHIB (■ LED)	
	4.	↓ КВД ПГО-СМ ENA (□ LED)	
00:00:00		↓ КВД ПГО-СМ ОР	
≤ 00:00:13			□ КВД ПГО-СМ ОТКРЫТ (PEV ОР)
00:00:35		↓ КВД ПГО-СМ CL	
≤ 00:00:48			■ КВД ПГО-СМ ОТКРЫТ (PEV ОР)
		↓ КВД ПГО-СМ INHIB (■ LED)	
		↓ PANEL OFF (■ LED)	

### 3. PRE-EVA TRAINING

#### 3.1. ORLAN SYSTEMS CHECKOUT

(00:20:00)

- |                           |    |  |  |
|---------------------------|----|--|--|
|                           | 1. | <ul style="list-style-type: none"> <li>√ Fluid umbilical ↔ Orlan1, 2</li> <li>Secure Orlan using Orlan restraint probe</li> <li>Cap ↔ Orlan X6K connector and stow in ЗИП-1 kit</li> <li>Electrical umbilical →← Orlan1, 2</li> <li>√ Orlan pressure gauge →← Orlan</li> <li>Remove protective cap from Orlan pressure gauge and stow into ЗИП-1 kit</li> </ul>  |  |
| ПГПУ                      |    | <ul style="list-style-type: none"> <li>√ ТО — ОТКЛ</li> <li>√ Temperature control handle — 3</li> </ul>  |  |
| ПО-4                      |    | <ul style="list-style-type: none"> <li>√ ⚙ О.НАС, О.ВЕНТ, Р.ВЕНТ, ПИТАНИЕ — БОРТ, Р.НАС</li> <li>√ √ ОСНОВ, РЕЗЕРВ</li> </ul>  |  |
|                           | 2. | <ul style="list-style-type: none"> <li>Open Orlan backpack</li> <li>√ Water connectors of liquid cooling garment are looped together</li> <li>√ Measurement unit filter tubes — РАБОТА</li> <li>√ Water bladder ↔ backpack connector</li> <li>√ Respective fitting on backpack is capped</li> <li>√ Valves of primary and reserve БК-3 — <b>closed</b></li> <li>√ Suit drying handle — along Orlan cuirass</li> <li>Unstow special screwdriver from ЗИП-1 kit for water flow rate measuring</li> </ul> |  |
| ПОВ                       | 3. | <ul style="list-style-type: none"> <li>↓ PANEL ON (□ LED)</li> <li>↓ SUIT 1,2 ON (□ LED)</li> </ul>  |  |
| ПО-4<br>Orlan1, 2<br>ПГПУ | 4. | <ul style="list-style-type: none"> <li><b>In turn</b></li> <li>O<sub>2</sub> flow selector → ОТКЛ</li> <li>√ РЕГУЛЯТОР — ОСН</li> <li>√ БАЛЛОН — ОСН</li> <li>Temperature control handle → 6</li> </ul>  | <ul style="list-style-type: none"> <li>■ УТЕЧ, ИНЖ, <b>ТОНЕ</b></li> <li>■ УТЕЧ, ИНЖ</li> </ul>  |
| ПО-4<br>backpack          |    | <ul style="list-style-type: none"> <li>⚙ О.НАС</li> <li>↓ ЗАМЕР РАСХОДА</li> </ul>   | <ul style="list-style-type: none"> <li>🔊 pump operation</li> <li>⚡ water flow rate &gt; 1.5 l/min</li> </ul>   |
| ПО-4<br>backpack          |    | <ul style="list-style-type: none"> <li>⚙ Р.НАС</li> <li>↓ ЗАМЕР РАСХОДА</li> <li>⚡ no gas in separator</li> </ul>  | <ul style="list-style-type: none"> <li>🔊 pump operation</li> <li>⚡ water flow rate &gt; 1.5 l/min</li> </ul>   |
| ПО-4<br>ПГПУ              |    | <ul style="list-style-type: none"> <li>⚙ Р.НАС</li> <li>Temperature control handle → 3</li> <li>Close backpack internal cover</li> <li>Backpack tension line ring → onto hook</li> <li>Seal Orlan by locking <b>handle</b></li> </ul>  |  |
| ПО-4                      | 5. | <ul style="list-style-type: none"> <li>⚙ О.ВЕНТ</li> <li>⚙ О.ВЕНТ</li> <li>After fan stops</li> <li>⚙ Р.ВЕНТ</li> <li>⚙ Р.ВЕНТ</li> <li>After fan stops</li> </ul>   | <ul style="list-style-type: none"> <li>■ ВЕНТ МАЛ</li> <li>🔊 fan operation</li> <li>■ ВЕНТ МАЛ</li> <li>■ ВЕНТ МАЛ</li> <li>🔊 fan operation</li> <li>■ ВЕНТ МАЛ</li> </ul> |

\*\*\*\*\* ORLAN OPS 2.3.4

6. БРТА OPERATION CHECKБРТА  
ПО-4

⤵ ОРЛАН

⤵ ПИТАНИЕ → АВТ

↓ ОСНОВ

⤵ О.ВЕНТ, О.НАС

↓ U/TONE  $\angle U = \text{_____} \geq 26 \text{ V}$ 

⊕ О.ВЕНТ

After fan stops

⤵ Р.ВЕНТ

⊕ Р ВЕНТ

Open Orlan backpack, open backpack internal cover

ПГПУ  
backpack

Temperature control handle → 6

👂 pump operation

 $\angle$  water flow rate > 1.5 l/min

ПО-4

⊕ О.НАС

⤵ Р.НАС

backpack

👂 pump operation

 $\angle$  water flow rate > 1.5 l/minПО-4  
ПГПУ  
ПОВ

⊕ Р.НАС, ПИТАНИЕ → БОРТ

Temperature control handle → 3

↓ SUIT 1,2 OFF (■ LED)

■ ВЕНТ МАЛ, УТЕЧ, ИНЖ, **TONE**

■ ВЕНТ МАЛ

👂 fan operation

■ ВЕНТ МАЛ






■ ВЕНТ МАЛ

👂 fan operation

■ ВЕНТ МАЛ

**3.2. ORLAN INTERFACE UNIT (БСС) CHECKOUT**

(00:15:00)

- |                                 |    |  |  |
|---------------------------------|----|--|--|
| Orlan1, 2                       | 1. | <ul style="list-style-type: none"> <li>√ Fluid umbilical connector caps secured to ПхО handrails using Velcro</li> <li>√ БСС O<sub>2</sub> tubing → ← onboard БК-3</li> <li>Metal caps → ← open ends of БСС O<sub>2</sub> tubing</li> <li>(if less than four onboard БК-3 are connected to БСС)</li> <li>√ Fluid umbilical O<sub>2</sub> tubing → ← БСС</li> <li>√ Fluid umbilical water hoses → ← thermoelectric cooling device hoses</li> </ul>                  |  |
| ПГПУ                            | 2. | <ul style="list-style-type: none"> <li>Launch cap ↔ Orlan fluid connector, then stow in ЗИП-1 kit</li> <li>Fluid umbilical → ← Orlan</li> <li>Temperature control handle → 6</li> <li>Open Orlan backpack</li> <li>Open backpack internal cover</li> <li>√ Liquid cooling garment → ← Orlan</li> </ul>   |  |
| ПО-4<br>backpack                |    | <ul style="list-style-type: none"> <li>⊕ O.НАС</li> <li>🌀 pump operation</li> <li>⚠ water flow rate &gt; 1.5 l/min</li> <li>⚠ water level indicator — normal</li> <li>⚠ no gas in separator</li> </ul>   | <p>***** ORLAN OPS 2.3.3</p> <p>***** ORLAN OPS 2.3.4</p>  |
| ПО-4<br>backpack                |    | <ul style="list-style-type: none"> <li>⊕ O.НАС, ⊕ P.НАС</li> <li>🌀 pump operation</li> <li>⚠ water flow rate &gt; 1.5 l/min</li> <li>⚠ no gas in separator</li> </ul>  | <p>***** ORLAN OPS 2.3.4</p>   |
| ПО-4<br>backpack<br>ПГПУ<br>БСС |    | <ul style="list-style-type: none"> <li>⊕ P.НАС</li> <li>⚠ water level indicator — normal</li> <li>Temperature control handle → 3</li> </ul>  | <p>***** ORLAN OPS 2.3.3</p>   |
|                                 | 3. | <ul style="list-style-type: none"> <li> <b><u>O<sub>2</sub> OPEN-EVA</u></b></li> <li>Unstow special wrench from ЗИП-1 kit</li> <li>Open valve on one of БК-3(1-4)</li> </ul>   | <ul style="list-style-type: none"> <li>■ O<sub>2</sub> OPEN</li> <li>■ НАДДУВ ПРОДУВКА ОРЛАН I, II</li> </ul>  |
| ПО-4                            |    | <ul style="list-style-type: none"> <li>Tether special wrench on cord next to onboard БК-3</li> </ul>   | <ul style="list-style-type: none"> <li>□ O<sub>2</sub> OPEN</li> <li>■ УТЕЧ</li> </ul>   |
| БСС                             | 4. | <ul style="list-style-type: none"> <li><b>Momentarily:</b></li> <li> <b><u>PRESS</u></b></li> <li>Retainer → UNLK</li> <li> <b><u>PURGE</u></b></li> <li> <b><u>O<sub>2</sub> OPEN-EVA</u></b></li> </ul> | <ul style="list-style-type: none"> <li>□ НАДДУВ ПРОДУВКА ОРЛАН I, II</li> <li>🌀 O<sub>2</sub> flow</li> <li>□ НАДДУВ ПРОДУВКА ОРЛАН I, II</li> <li>🌀 O<sub>2</sub> flow</li> <li>■ НАДДУВ ПРОДУВКА ОРЛАН I, II</li> <li>🌀 no O<sub>2</sub> flow</li> </ul> |
| Orlan1, 2<br>ПГПУ<br>ПО-4       | 5. | <ul style="list-style-type: none"> <li><b>In turn</b></li> <li>O<sub>2</sub> flow selector → ИНЖ</li> </ul>  | <ul style="list-style-type: none"> <li>☑ ИНЖ</li> <li>🌀 O<sub>2</sub> flow</li> <li>■ ИНЖ</li> </ul>   |
| ПГПУ<br>00:00:00<br>00:00:30    |    | <ul style="list-style-type: none"> <li>O<sub>2</sub> flow selector → ОТКЛ</li> <li> <b><u>O<sub>2</sub> CLOSED</u></b></li> <li>Close backpack internal cover</li> </ul>  | <ul style="list-style-type: none"> <li>■ O<sub>2</sub> OPEN</li> </ul>   |

**3.3. DONNING EVA GEAR**

(00:30:00)

Don biomed harness

Unstow liquid cooling garment from inside of Orlan, demate water connectors

Open liquid cooling garment zipper

Remove liquid cooling garment from the mannequin

Stow mannequin into bag

Doff flight clothes, undergarments, socks and stow into personal gear bag

Don cotton briefs, socks, biomed harness, Orlan undergarment

Route X9 connector into opening in undergarment and close zippers

Don body temperature sensor on the right ear so that sensing element is placed right behind the earlobe (i.e. in parotid pit)

Body temperature sensor connector →← X9 connector of biomed harness

Don liquid cooling garment

Take straps of undergarment from hands and feet

Hide straps under cuffs

Route X9 connector into opening on liquid cooling garment,

Close liquid cooling garment zippers

Secure safety belt on liquid cooling garment

Don comm cap so that the flap of body temperature sensor (behind earlobe) completely fits into speaker recess of comm cap

Pull liquid cooling garment cap over comm cap and secure with Velcro strap

Stow comm cap connector into liquid cooling garment breast pocket

√ Correct position of comm cap microphones at 1.0--1.5 cm from lip corners

**3.4. COMM CHECK AND MEDICAL PARAMETERS MONITORING**

(during comm pass)

- |              |   |
|--------------|---|
|              | 1. Establish EVA comm (see RODF: SM COMMUNICATION SYSTEM) |
|              | 2. Close ПО-ПхО and ПГО-СУ hatches                        |
|              | Comm cap connector →← Orlan X3 connector                  |
|              | Biomed harness connector →← Orlan X9 connector            |
| ПхО comm pnl | ↓ CHANNEL 3 (□ LED)                                       |
|              | ↓ XMIT □ LED XMIT 3                                       |
|              | Check comm with MCC and intercomm (Orlan 1 — Orlan 2)     |
|              | Volume → zero Ⓢ Volume change                             |
| ПО-4         | 3. √ Ⓢ О.НАС, О.ВЕНТ, Р.ВЕНТ, ПИТАНИЕ — БОРТ, Р.НАС       |
|              | Ⓢ ПИТАНИЕ → АВТ   |
|              | Electrical umbilical ↔ Orlan                              |
|              | ↓ РЕЗЕРВ, Check comm                                      |
|              | ↓ ОСНОВ, Check comm                                       |
|              | ↓ ТАНГ, Check comm  |
| ПОВ          | ↓ SUIT 1,2 OFF (■ LED)                                    |
|              | Ⓢ Sound volume is sufficient                              |
|              | Electrical umbilical →← Orlan                             |
| Comm pnl     | 4. Return volume knob to initial position                 |
| ПО-4         | √ ОСНОВ, ТАНГ   |
| ПОВ          | ↓ SUIT 1,2 ON (□ LED)                                     |
| ПО-4         | Ⓢ ПИТАНИЕ → БОРТ  |

### 3.5. ENTRY INTO AND SEALING OF ORLANS

#### EV1, EV2 (in turn)

- ПОВ
1.  HX ON     HX PWR, HX
  2. Secure Orlan using Orlan restraint probe
  3.  Orlan leg and arm bladders are fully unfolded inside (by feel)
    - Watch and mirrors — on arm
    - Cotton undergloves are stowed into breast pocket inside Orlan
    - Comm cap and biomed harness connectors →← Orlan X3 and X9 connectors
- ПА ПхО
4.   CHANNEL 3     LED)
    - XMIT     LED XMIT 3
    - Other comm cap →← other Orlan
    - Establish intercomm
  5. Insert legs into Orlan leg bladder
    - Liquid cooling garment →← Orlan
    - Secure connectors onto liquid cooling garment
    - Secure connectors X3 and X9 in liquid cooling garment breast pocket
    - Correct position of comm cap microphones
    - Don cotton undergloves
    - Enter Orlan completely (the other EV monitors that liquid cooling garment hoses are not kinked after entry into Orlan)
- ПО-4
6.  O.НАС, O.БЕHT
    - ◀ normal operation of water cooling system
- БСС
- O<sub>2</sub> OPEN-EVA**     O<sub>2</sub> OPEN
- The other EV ◀ Orlan **sealing interface**
- Backpack tension line ring → onto hook
- Seal Orlan by locking **handle**
- Open Orlan attachment central lock and move off attachment assembly

Orlan1 closure time = \_\_\_\_\_

Orlan2 closure time = \_\_\_\_\_

**WARNING**

If air inside Orlan feels stuffy:

ПО-4      Ⓢ O.ВЕНТ, Ⓢ P.ВЕНТ

If ventilation does not return to normal, discontinue training session.

**CAUTION**

Do not simultaneously operate primary and reserve fans.

**3.6. ORLAN SUIT AND ORLAN INTERFACE UNIT (БСС) CONTROLS CHECK**

(00:05:00)

- ПО-4      EV2 translates toward EV hatch and tethers there  
 EV1 translates toward ПОВ and tethers there  
 ✓ Ⓢ ПИТАНИЕ — БОРТ  
 ⚡ P.O<sub>2</sub> ≥ 360  
 ↓ U/TONE    ⚡ U = 23---34 V  
 ✓ Ⓢ O.ВЕНТ, O.НАС, Ⓢ P.ВЕНТ, P.НАС  
 ■ status messages
- ПГПУ      ✓ O<sub>2</sub> flow selector— ОТКЛ  
 ✓ БАЛЛОН — ОСН  
 ✓ РЕГУЛЯТОР — ОСН
- БСС      ⚙ **O<sub>2</sub> OPEN-EVA**    □ O<sub>2</sub> OPEN  
 ПГПУ      Temperature control handle → adjust (maintain the temperature at comfortable level)

**3.7. ORLANS AND БСС PRELIMINARY LEAK CHECK**

(00:05:00)

- БСС      ⚙ **PRESS** until Orlan pressure = 0.12    □ НАДДУВ ПРОДУВКА ОРЛАН I, II  
 00:00:00    ⚙ **LEAK CHECK**                                    ■ НАДДУВ ПРОДУВКА ОРЛАН I, II  
 00:01:00    ■ O<sub>2</sub> OPEN

✓ Orlan pressure ≥ 0.08

⚡ Δ Orlan pressure (00:00:30) < 2.5 increments

\*\*\*\*\* 5.2.1

**3.8. ORLAN FIT CHECK AT ORLAN PRESSURE = 0.4**

(≤ 00:15:00)

БСС

 **PRESS**

When Orlan pressure = 0.35---0.4

 **O<sub>2</sub> OPEN-EVA**

◀ Orlan pressure &lt; 0.45

 НАДДУВ ПРОДУВКА ОРЛАН I, II НАДДУВ ПРОДУВКА ОРЛАН I, II O<sub>2</sub> OPEN

\*\*\*\*\*

\*\*\*\*\*

БСС retainer → UNLK

 **SUIT DEPRESS**


√MCC

\*\*\*\*\*

Evaluate Orlan fit

If fit quality **impedes** training session

БСС retainer → UNLK

 **SUIT DEPRESS**

Exit from Orlan

Make adjustments **per MCC instructions****3.9. ORLAN TRANSLATION TRAINING****NOTE**


During training, monitor pressure in the open БК-3(1-4) by pressure indicator (ИД) on ПОВ.  
If oxygen pressure < 20, open valve on the next БК-3.

1. If Orlan pressure > 0.15

БСС retainer → UNLK

 **SUIT DEPRESS** until Orlan pressure = 0.1---0.15

If Orlan pressure &lt; 0.1

 **PRESS** until Orlan pressure = 0.1---0.15 **O<sub>2</sub> OPEN-EVA** НАДДУВ ПРОДУВКА ОРЛАН I, II НАДДУВ ПРОДУВКА ОРЛАН I, II O<sub>2</sub> OPEN

- Check comm via umbilical, both primary and reserve transmitters
- Sequentially translate to all work stations in ПхО (with connected fluid umbilical)  
Check Orlan fit  
Check onboard cooling system operation  
Evaluate how interior influences the conditions of working with БСС, ПОВ, КСД, КВД,  
НАДДУВ valve
- Evaluate stowage convenience of hardware to be taken out during EVA

**CAUTION**

1. Time of stay inside Orlan while detached from fluid umbilical and with activated fan shall **not exceed 6 min** (there is no water cooling and oxygen supply)

2. Do not operate primary and reserve fans at the same time

**EV1, 2 4. In turn**

Fluid umbilical ↔ Orlan


Fluid umbilical →← onboard plug

Secure fluid umbilical to handrails with Velcro strap

Evaluate convenience of moving without fluid umbilical

Fluid umbilical →← Orlan

БСС 5. Retainer → UNLK

 **SUIT DEPRESS**

**3.10. EXIT FROM ORLAN**

(00:15:00)

**EV1, EV2 1.** < Orlan pressure ≤ 0.04

\*\*\*\*\*

\*\*\*\*\*

Fluid umbilical →← Orlan

Depress Orlan via connector to ss depressurization

\*\*\*\*\*

Secure Orlan using Orlan restraint probe

Exit from Orlan without disconnecting electrical umbilical

☉ О.ВЕНТ, О.НАС, ПИТАНИЕ → БОРТ

ПО-4

**EV1 2.** Open Orlan of EV2 and evaluate possibility of getting the "disabled" EV2 from his Orlan. Pay special attention to: securing of self; securing of limbs of "disabled" EV2; ease of EV2 Orlan opening; your grip on EV2 while removing head and arms; grip on safety belt on liquid cooling garment

Do not perform actual removal of the "disabled" crewmember from his Orlan

**EV2 3.** Secure Orlan using Orlan restraint probe

Exit from Orlan without disconnecting electrical umbilical

ПОВ


4. ↓ HX OFF ■ HX PWR, HX

↓ SUIT 1,2 OFF (■ LED)

↓ PANEL OFF (■ LED)

Using special wrench, **close** the valves of the onboard БК-3, which had been opened for the training session

БСС

 **PURGE** ■ O<sub>2</sub> OPEN

 **O<sub>2</sub> CLOSED**

Metal cap ↔ free end of БСС O<sub>2</sub> tubing

Rubber cap →← free end of БСС O<sub>2</sub> tubing

Orlan1, 2

5. Open and secure Orlan backpack (using ПРБ-11 accessory from ЗИП-1 kit)

Measurement unit filter tubes → ХРАНЕНИЕ (as shown in decal)

ПГПУ

БАЛЛОН → РЕЗ

O<sub>2</sub> flow selector → ИНЖ

БРТА

☉ ОРЛАН, УСК

### 3.11. POST TRAINING ACTIVITIES

(02:00:00)

1. Return comm systems to their initial configuration  
(see RODF: SM COMMUNICATION SYSTEM)
2. Hang out for drying: liquid cooling garment, undergarment, socks, cotton undergloves, cotton briefs and comm caps  
Put cloth covers on helmet visors
3. Remove LiOH canister and moisture collector (see . 2.4.12 ORLAN OPS)  
Estimate necessity of drying Orlan  
During dryout, do not remove feedwater line filter, do not dry water supply line in heat exchanger  
After drying is complete, leave backpacks in the open position (with ПРБ-11) for natural airing
4. Install into Orlan LiOH canister and moisture collector that were removed prior to dryout or new ones (**per MCC instructions**)  
Inspect tubing inside Orlan backpack  
If necessary, clean the mesh screen on the backpack vent intake nozzle  
Stow dried cotton undergloves into Orlan internal lining pocket  
Dried liquid cooling garment →|← Orlan and stow into Orlan  
Backpack tension line ring → onto hook (**do not close** handle)

## 4. ACTIVITIES ON DAY OF EVA

### 4.1. ПхО PREPARATION

1.  КСД ПхО — CLOSED  
 КВД РО-ПхО — ELECTRIC  
 КВД ПхО-РО — CLOSED  
 КВД ПхО-СУ (ФГБ) — CLOSED  
 КВД ПГО-СМ — ELECTRIC
2. Secure in ПхО:
  - pressure gauge [МВ]
  - portable light
  - first-aid kit
  - ЗИП-2 spares kit (with gloves)
  - Fluid umbilical connector caps secured in ПхО on handrails
  - БСС emergency hose secured to the handrail next to EV hatch
3. **On MCC GO:**
  - pressure alarm sensor → 630 mm;
  - deactivate induction pressure sensor ДДИ-1;
  - disconnect air ducts and cables in ПхО-РО and ПГО-СМ hatchways;
  - remove air flow sensors ИП from hatchways and take them off-line

### 4.2. HATCH CONFIGURATION BEFORE EVA

If Soyuz is docked to the FGB port:

- Close ПрК-СУ and ТКГ-СУ hatches (if Progress →|← SM);
- Remaining hatches between RS compartments — Open
- Close NODE1 aft hatch per decal
- NODE1 aft hatch MPV closed and uncapped

If Soyuz is docked to ПрК port:

- Close ГА-СУ (DSM) and ТКГ-СУ hatches (if Progress →|← FGB);
- Remaining hatches between RS compartments — Open



**4.4. COMMUNICATION CHECK**

(during comm pass)

1. Don comm cap
- √ Correct position of comm cap microphones
  - √ Comm cap connector →|← Orlan X3 connector
  - √ Electrical umbilical →|← Orlan
  - √ Ⓞ О.НАС, О.ВЕНТ, Р.ВЕНТ, ПИТАНИЕ — БОРТ, Р.НАС
- ПО-4  
ПОВ  
ПО-4  
ПА ПхО
2. ↓ SUIT 1,2 ON (□ LED)      ■ ИНЖ, ВЕНТ МАЛ, УТЕЧ, **TONE**
- ↓ CHANNEL 3 (□ LED)
- ↓ XMIT                      □ LED XMIT 3
- ПОВ
- Check comm with **MCC** and intercomm (via electrical umbilical)
- ↓ SUIT 1,2 OFF (■ LED)
3. Performed for EVA with БРТА
- √ Hatch РО-ПхО closed
  - Ⓞ ОРЛАН, Ⓞ УСК
  - √ Ⓞ О.НАС, Р.НАС, О ВЕНТ, Р ВЕНТ
  - Ⓞ ПИТАНИЕ → АВТ
  - ↓ ОСНОВ                      In both comm caps **TONE** (long beeps)
  - ↓ ОСНОВ                      In both comm caps **TONE** (short beeps)
  - Electrical umbilical ←|→ Orlan
  - Check comm with **MCC** and between Orlans
  - ↓ РЕЗЕРВ
  - Check comm with **MCC** and between Orlans
  - Electrical umbilical →|← Orlan
  - Ⓞ ПИТАНИЕ → БОРТ
  - ↓ РЕЗЕРВ
- БРТА  
ПО-4
- EV2**  
**EV1**  
**EV1, 2**

**4.5. ORLAN SYSTEMS CHECK**

(00:35:00)

**EV1, EV2**

1. Secure transport tether small hook onto Orlan backpack loop  
Stow large transport tether hook into pocket on Orlan left leg  
Stow safety tether hooks into pocket on Orlan right leg
2. √ Fluid umbilical connector ↔ Orlan  
√ Orlan fluid connector and fluid umbilical connector do not leak  
√ РЕГУЛЯТОР — ОСН  
√ БАЛЛОН — ОСН  
√ O<sub>2</sub> flow selector — ИНЖ  
√ ТО — ОТКЛ  
√ Electrical umbilical →← Orlan  
√ Gloves →← Orlan
3. Open backpack and secure it in the open position (using ПРБ-11 accessory)  
Open backpack internal cover  
Orlan measurement unit tubes → РАБОТА  
Feedwater bladder connector →← connector of backpack  
√ Moisture collector →← Orlan  
√ LiOH canister →← Orlan  
√ Feedwater line filter →← Orlan  
√ Suit drying handle — along cuirass (“operation”)
4. Wipe down Orlan helmet glass surface inside with anti-fog paste  
(stowed in ЗИП-1 kit pocket or in ORLAN-M ORU kit)  
Use separate wipe for each Orlan
5. √ Ⓞ О.НАС, О.ВЕНТ, Р.ВЕНТ, ПИТАНИЕ — БОРТ, Р.НАС  
↓ PANEL ON (□ LED)  
↓ SUIT 1,2 ON (□ LED)  
PO-4 ■ УТЕЧ, ИНЖ, ВЕНТ МАЛ, **TONE**  
POB ↓ U/TONE < U = 27.5---28.5 V

**EV1,2 (in turn):**

6. PO-4 POB PO-4
 

O <sub>2</sub> flow selector → ОТКЛ	■ ИНЖ
√ БАЛЛОН — ОСН	
Close backpack internal cover	
Backpack tension line ring → onto hook	
Seal Orlan by locking <b>handle</b>	
Ⓞ О.ВЕНТ	■ ВЕНТ МАЛ
	🌀 fan operation
Ⓞ О.ВЕНТ	■ ВЕНТ МАЛ
	🌀 fan stops completely
Ⓞ Р.ВЕНТ	■ ВЕНТ МАЛ
	🌀 fan operation
Ⓞ Р.ВЕНТ	■ ВЕНТ МАЛ
Ⓞ СВЕТ	□ helmet lights
Ⓞ СВЕТ	■ helmet lights

- |              |    |  |  |
|--------------|----|--|--|
| БРТА<br>ПО-4 | 7. | <ul style="list-style-type: none"> <li><input type="checkbox"/> ОРЛАН</li> <li><input type="checkbox"/> ПИТАНИЕ → АВТ</li> <li><input type="checkbox"/> О.ВЕНТ</li> <br/> <li>↓ U/TONE    <math>\angle U = \text{_____} \geq 26 V</math></li> <li><input type="checkbox"/> О.ВЕНТ</li> <br/> <li><input type="checkbox"/> Р.ВЕНТ</li> <br/> <li><input type="checkbox"/> Р.ВЕНТ</li> <li><input type="checkbox"/> СВЕТ</li> <li><input type="checkbox"/> СВЕТ, ПИТАНИЕ → БОРТ</li> </ul> | <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> ИНЖ, ВЕНТ МАЛ, УТЕЧ, <b>TONE</b></li> <li><input checked="" type="checkbox"/> ВЕНТ МАЛ</li> <li><input type="checkbox"/> fan operation</li> <br/> <li><input checked="" type="checkbox"/> ВЕНТ МАЛ</li> <li><input type="checkbox"/> fan stops completely</li> <li><input checked="" type="checkbox"/> ВЕНТ МАЛ</li> <li><input type="checkbox"/> fan operation</li> <li><input checked="" type="checkbox"/> ВЕНТ МАЛ</li> <li><input type="checkbox"/> helmet lights</li> <li><input checked="" type="checkbox"/> helmet lights</li> </ul> |
|              | 8. | <ul style="list-style-type: none"> <li>Open Orlan backpack</li> <li>Open (with special wrench) valve on reserve БК-3</li> </ul>  |  |

**NOTE**

To save oxygen in reserve БК-3, keep O<sub>2</sub> flow selector in positions ИНЖ and АВАР only to monitor audio alarm and oxygen flow

- |                  |     |  |  |
|------------------|-----|--|--|
| ПГПУ             | 9.  | <ul style="list-style-type: none"> <li>БАЛЛОН → РЕЗ</li> <li>O<sub>2</sub> flow selector → ИНЖ</li> <br/> <li>O<sub>2</sub> flow selector → АВАР</li> <li>O<sub>2</sub> flow selector → ОТКЛ</li> <li>O<sub>2</sub> flow selector safety pin → nominal position</li> </ul>   | <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> УТЕЧ</li> <li><input checked="" type="checkbox"/> ИНЖ</li> <li><input type="checkbox"/> O<sub>2</sub> flow</li> <li><input type="checkbox"/> O<sub>2</sub> flow</li> <li><input checked="" type="checkbox"/> ИНЖ</li> </ul>   |
| ПО-4<br>ПГПУ     | 10. | <ul style="list-style-type: none"> <li><math>\angle P.O_2 \geq 360</math></li> <li>БАЛЛОН → ОСН</li> <li>O<sub>2</sub> flow selector → ИНЖ</li> <li>O<sub>2</sub> flow selector → ОТКЛ</li> <li>Open valve on primary БК-3</li> <li>O<sub>2</sub> flow selector → ИНЖ</li> <br/> <li>O<sub>2</sub> flow selector → ОТКЛ</li> </ul>   | <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> ИНЖ, УТЕЧ, ВЕНТ МАЛ, <b>TONE</b></li> <li><input checked="" type="checkbox"/> ИНЖ</li> <br/> <li><input checked="" type="checkbox"/> УТЕЧ</li> <li><input checked="" type="checkbox"/> ИНЖ</li> <li><input type="checkbox"/> O<sub>2</sub> flow</li> <li><input checked="" type="checkbox"/> ИНЖ</li> </ul> |
| ПГПУ             | 11. | <ul style="list-style-type: none"> <li>Untie fluid umbilical</li> <li>Launch cap ↔ Orlan fluid connector and stow in ЗИП-1 kit</li> <li>Fluid umbilical →← Orlan</li> <li>O<sub>2</sub> flow selector → ИНЖ</li> <li>O<sub>2</sub> flow selector → ОТКЛ</li> </ul>   | <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> ИНЖ, УТЕЧ, <b>TONE</b></li> <li><input checked="" type="checkbox"/> ИНЖ</li> </ul>  |
| ПО-4             | 12. | <ul style="list-style-type: none"> <li><math>\angle P.O_2 \geq 360</math></li> <li>Loop Orlan water connectors together</li> </ul>   |  |
| ПГПУ<br>backpack | 12. | <ul style="list-style-type: none"> <li>Temperature control handle → 6</li> <li>Release tubing plate and move it to clear access to separator</li> </ul>  |  |
| ПО-4             |     | <ul style="list-style-type: none"> <li><input type="checkbox"/> О.НАС</li> <li><math>\angle</math> Water flow rate &gt; 1.5 l/min</li> <li><input type="checkbox"/> О.НАС, <input type="checkbox"/> Р.НАС</li> <li><math>\angle</math> Water flow rate &gt; 1.5 l/min</li> <li><math>\angle</math> No gas in separator</li> <li><math>\angle</math> Water system refill indicator position — normal</li> </ul> | <ul style="list-style-type: none"> <li><input type="checkbox"/> pump operation</li> <br/> <li><input type="checkbox"/> pump operation</li> </ul>   |
|                  |     |  | <ul style="list-style-type: none"> <li>***** ORLAN OPS 2.3.4</li> <li>***** ORLAN OPS 2.3.3</li> </ul>   |




- ПО-4            ⚙ P.HAC  
Reinstall tubing plate, lock
- ПГПУ            Temperature control handle → 3 (ТО-ОТКЛ)

**4.6. ORLAN INTERFACE UNIT (БСС) CHECKOUT**

(00:25:00)

- |                                    |  |  |
|------------------------------------|--|--|
| ПОВ<br>БСС                         | 1. √ БСС O <sub>2</sub> tubing → ← onboard БК-3(1-4)<br>√ Metal cap → ← free end of БСС tubing (if three БК-3 are connected to БСС)<br>√ Total pressure in БК-3(1-4) (by pressure indicator) > 950 | ***** √МСС   |
|                                    | ⚙ <b>O<sub>2</sub> OPEN-EVA</b>  |  |
| ПО-4                               | 2. БК-3(1) --- БК-3(4) (in turn)<br>Open БК-3 valve<br>(use special wrench)  | <input type="checkbox"/> O <sub>2</sub> OPEN<br><br>■ УТЕЧ   |
| ПГПУ<br>ПО-4<br>БСС<br>ПГПУ        | Close БК-3 valve<br>O <sub>2</sub> flow selector → ИНЖ (in one of Orlans)<br><br>O <sub>2</sub> flow selector → ОТКЛ   | ■ ИНЖ, УТЕЧ, <b>TONE</b><br>■ O <sub>2</sub> OPEN<br>■ ИНЖ   |
| БСС<br>ПО-4                        | 3. Open all БК-3(1-4) valves   | <input type="checkbox"/> O <sub>2</sub> OPEN<br>■ УТЕЧ   |
| EV1                                | 4. O <sub>2</sub> flow selector → ИНЖ (momentarily)  | ■ ИНЖ<br>🗣 O <sub>2</sub> flow<br>■ ИНЖ  |
| EV2                                | O <sub>2</sub> flow selector → ОТКЛ<br>Repeat step 4   |  |
| БСС                                | 5. ⚙ <b>PRESS</b> (momentarily)  | <input type="checkbox"/> НАДДУВ ПРОДУВКА ОРЛАН I, II<br>🗣 O <sub>2</sub> flow<br>■ НАДДУВ ПРОДУВКА ОРЛАН I, II |
| ПГПУ<br>ПО-4<br>БСС<br>ПГПУ<br>БСС | ⚙ <b>LEAK CHECK</b><br>O <sub>2</sub> flow selector → ИНЖ<br><br>O <sub>2</sub> flow selector → ОТКЛ<br>Retainer → UNLK<br>⚙ <b>PURGE</b> (momentarily)  | ■ ИНЖ, УТЕЧ, <b>TONE</b><br>■ O <sub>2</sub> OPEN<br>■ ИНЖ   |
|                                    | <input type="checkbox"/> НАДДУВ ПРОДУВКА ОРЛАН I, II<br><input type="checkbox"/> O <sub>2</sub> OPEN<br>🗣 O <sub>2</sub> flow<br>■ УТЕЧ<br>■ НАДДУВ ПРОДУВКА ОРЛАН I, II                           |  |
| 00:00:00<br>00:00:30<br>ПОВ        | ⚙ <b>PREBREATHE-A/L DEPRESS</b><br>⚙ <b>O<sub>2</sub> OPEN-EVA</b><br>⚙ <b>O<sub>2</sub> CLOSED</b><br><br>↓ HX ON   | ■ O <sub>2</sub> OPEN<br><input type="checkbox"/> HX PWR, HX   |

**4.7. FINAL INSPECTION OF ORLAN AND БСС BEFORE ENTRY INTO ORLAN**

- БСС
- √ Connector to ss depressurization is tethered to БСС
  - √ Special wrench for БК-3 is secured near onboard БК-3
  - √  **O<sub>2</sub> CLOSED**
  - √ Onboard БК-3 valves — **open**
  - √ Total pressure in БК-3(1-4)  $\geq 950$
- БРТА
- √ Emergency hoses are secured to handrail next to EV hatch
  - √  ОРЛАН
  - √  УСК
- backpack
- √ Orlan measurement unit tubes — РАБОТА
  - √ Moisture collector →|← Orlan
  - √ LiOH canister →|← Orlan
  - √ Feedwater line filter →|← Orlan
  - √ Feedwater bladder →|← corresponding connector of backpack
  - √ Primary and reserve БК-3 valves — **open**
  - √ Water system refill indicator position — normal
- Orlan
- √ Suit drying handle — along cuirass (“operation”)
  - √ Visors are wiped down
  - Mount mirrors and watch on Orlan arms
  - Close backpack internal covers
  - Backpack tension line ring → on hook
  - √ Gloves are connected correctly (ensure uniform clearance at glove-arms interface and that approximately 1 mm motion is observed when compressing glove and arm rings where indicated by four yellow marks on glove ring)
  - √ ЗИП-2 kit (with gloves) is secured in ПхО

#### 4.8. DONNING EVA GEAR

(00:30:00)

1. Don biomed harness
2. Unstow liquid cooling garment from Orlan
  - Demate water connectors
  - Secure safety belt on liquid cooling garment
  - Open liquid cooling garment zipper
  - Take liquid cooling garment off the mannequin
  - Stow the mannequin into personal gear bag
3. Doff flight clothes, undergarment, socks and stow into personal gear bag
  - Don body temperature sensor on right ear so that sensing element is placed right behind the earlobe (i.e. in parotid pit)
  - Body temperature sensor connector →|← X9 connector of biomed harness
  - Don cotton briefs (or pampers), socks, then undergarment
  - Route biomed harness X9 connector out through opening in undergarment and close zippers on undergarment
  - Don liquid cooling garment
  - Take straps of undergarment from hands and feet. Hide straps under cuffs
  - Route X9 connector out through opening in liquid cooling garment, close liquid cooling garment zippers and clasp safety belt
  - Don comm caps so that the flap of body temperature sensor (behind earlobe) completely fitted into speaker recess of comm cap
  - Don liquid cooling garment cap over comm cap and secure it with Velcro
  - √ Comm cap microphones are on mouth level at 1.0---1.5 cm from lip corners
4. Stow personal gear bag into [PO]
  - Low-noise headset ←+→ from comm panel in ПхО and stow into [PO]
  - Communicate via comm cap

ФР1

**4.9. PRE-EVA A/L OPERATIONS****1. РО-ПхО AND ПГО-СУ HATCH CLOSURE**

Remove safety lock ring from РО-ПхО hatch

Temp stow in [РО]

√ КВД ПхО-РО — CLOSED

РО √ КВД РО-ПхО — ELECTRIC

ПГО √ КВД ПГО-СМ — ELECTRIC

Close РО-ПхО and ПГО-СУ hatches

ПОВ □ ЛЮК РО-ПхО ЗАКРЫТ (HAT CL)

■ КВД РО-ПхО ОТКРЫТ (PEV OP)

■ КВД ПГО-СМ ОТКРЫТ (PEV OP)

**2. ENTRY INTO ORLAN AND BACKPACK CLOSING**

√ Watch and mirrors are mounted on Orlan arms

√ Arm and leg bladders are unfolded

ПО-4 √ ⚡ ПИТАНИЕ — БОРТ

ПГПУ Temperature control handle → 3

Comm cap connector →|← Orlan X3 connector

Biomed harness connector →|← Orlan X9 connector

ПОВ ↓ SUIT 1,2 ON (□ LED)

√ Correct position of comm cap microphones

Establish comm

**EV1,2 In turn**

Insert legs into Orlan leg bladder

Liquid cooling garment →|← Orlan and secure water connector on liquid cooling garment

X3 and X9 connectors secure into breast pockets of liquid cooling garment

Don cotton undergloves

Completely enter into Orlan

ПО-4 ⚡ О.НАС ⚡ Cooling

⚡ О.ВЕИТ ⚡ Fan operation

БСС ⚡ O<sub>2</sub> OPEN-EVA**Other EV ⚡ No foreign objects on Orlan sealing interfaces**

Backpack tension line ring → onto hook

Seal Orlan by locking **handle** ■ БЕИТ МАЛ**Other EV ⚡ locking handle is reliably secured to the mounting rod**

Orlan 1 closure time = \_\_\_\_\_

Orlan 2 closure time = \_\_\_\_\_

ФР2

3. ORLAN CONTROLS CHECK**CAUTION**

In the event of difficult breathing or high air temperature inside Orlan,  
check fan operation.

If necessary, ☺ P.ВЕНТ and **Report to MCC.**

ПО-4 √ ☺ ПИТАНИЕ — БОРТ

◁ P.O<sub>2</sub> > 360

√ ☺ О.ВЕНТ, О.НАС

√ ☺ Р.ВЕНТ, Р.НАС

■ status messages

√ √ ОСНОВ, РЕЗЕРВ, ТАНГ

ПГПУ √ O<sub>2</sub> flow selector — ОТКЛ

√ БАЛЛОН — ОСН

√ РЕГУЛЯТОР — ОСН

√ ТО — ОТКЛ

БСС √ **O<sub>2</sub> OPEN-EVA** ☐ O<sub>2</sub> OPEN

ПГПУ Temperature control handle → 6

◁ Cooling system is operating

Temperature control handle → adjust

(maintain the temperature inside Orlan at a comfortably cool level)

4. ORLANS AND БСС PRELIMINARY LEAK CHECK

БСС **PRESS** until Orlan pressure = 0.12 ☐ НАДДУВ ПРОДУВКА ОРЛАН I, II

☐ O<sub>2</sub> OPEN

00:00:00 **LEAK CHECK** ■ НАДДУВ ПРОДУВКА ОРЛАН I, II

☑ УТЕЧ, **TONE**

00:01:00 ■ O<sub>2</sub> OPEN

If Orlan pressure < 0.08, repress Orlan again

◁ Δ Orlan pressure (00:00:30) < 2.5 incr

\*\*\*\*\* 5.2.1 ФР11

Δ Orlan1 pressure = \_\_\_\_\_ Δ Orlan 2 pressure = \_\_\_\_\_

**ФРЗ**

5. ORLANS AND БСС FINAL LEAK CHECK

БСС **PRESS** until Orlan pressure = 0.42  НАДДУВ ПРОДУВКА ОРЛАН I, II  
 O<sub>2</sub> OPEN  
 00:00:00 **LEAK CHECK**  НАДДУВ ПРОДУВКА ОРЛАН I, II  
 УТЕЧ, **ТОНЕ**  
 00:01:00  O<sub>2</sub> OPEN  
 If Orlan pressure < 0.38, repress Orlan again  
 <math>\Delta</math> Orlan pressure (over 00:01:00) < 4 incr \*\*\*\*\* 5.2.2 ФР12  
 Δ Orlan 1 pressure = \_\_\_\_\_ Δ Orlan 2 pressure = \_\_\_\_\_  
 БСС Retainer → UNLK  
**SUIT DEPRESS**  O<sub>2</sub> OPEN  
 <math>\Delta</math> Orlan pressure ≤ 0.04

6. ПхО DEPRESSURIZATION TO 550 MM

ПОВ  ЛЮК РО-ПхО ЗАКРЫТ (HAT CL)  
 00:00:00 КСД ПхО → OPEN (manually)  КСД ПхО ОТКРЫТ (DEPR OP)  
 When ПхО pressure reaches 550 mm, but no later  
 00:01:00 КСД ПхО → CLOSED (manually)  КСД ПхО ОТКРЫТ (DEPR OP)  
 00:00:00 P.ПхО[МВ] = \_\_\_\_\_  
 00:05:00 P.ПхО[МВ] = \_\_\_\_\_  
 <math>\Delta</math> P.ПхО [МВ] (00:05:00) ~ 30 mm (increase) \*\*\*\*\*

<math>\Delta</math> P.ПхО(МВ) (over 00:05:00) < 2 mm  
 If <math>\Delta</math> P.ПхО > 2 mm

Evaluate sealing onboard БК-3

	00:00:00	00:10:00	ΔP
P.БК3(1)			
P.БК3(2)			
P.БК3(3)			
P.БК3(4)			
Σ P.БК3			
P.ПхО			

If Σ ΔP.БК3(over 00:10:00) > 15 (decrease)

**БК-3 are leaking — EVA is cancelled**  
 ПОВ ↓ КВД РО-ПхО ENA ( LED)  
 ↓ КВД РО-ПхО OP

√MCC

If Σ ΔP.БК3 ≤ 15 — **hatches are leaking**  
 Perform . 5.2.3 ФР13

Proceed as required

\*\*\*\*\*

**ФР4**

**7. ORLAN PURGE AND ПхО PRELIMINARY LEAK CHECK**

Record in table: P.ПхО(MB), P.БК-3(1-4) (before and after purge)

	before purge	after purge	ΔP
P.БК-3(1)			
P.БК-3(2)			
P.БК-3(3)			
P.БК-3(4)			
Σ P.БК-3			
P.ПхО			

БСС  
00:00:00

**PURGE**  
Prebreathe start time = \_\_\_\_\_  
◀◀ P.СК = 0.02---0.06

☐ НАДДУВ, ПРОДУВКА ОРЛАН I, II

00:05:00

**PREBREATHE-A/L DEPRESS**  
Calculate O<sub>2</sub> volume required for Orlan purge  
If Δ ΣP.БК-3 < 250  
| Repeat purge for 1 min  
| √ Δ ΣP.БК-3 > 250

■ НАДДУВ, ПРОДУВКА ОРЛАН I, II

00:10:00

End of of ПхО pressure stabilization  
Record in table: P.ПхО [MB], P.БК-3(1-4)

	before leak check	after 10 min	ΔP
P.БК-3(1)			
P.БК-3(2)			
P.БК-3(3)			
P.БК-3(4)			
Σ P.БК-3			
P.ПхО			

◀ ΔP.ПхО(MB) (00:05:00) < 2 mm (increase) \*\*\*\*\*

\*\*\*\*\*

If Σ ΔP.БК3 (over 00:10:00) > 15 (decrease)

**БК-3 are leaking — EVA is CANCELLED**

ПОВ ↓ КВД РО-ПхО ENA (☐ LED)

↓ КВД РО-ПхО ОР

√ МСС

If Σ ΔP.БК3 ≤ 15

**Hatches are leaking**

Perform 5.2.3 ФР13

\*\*\*\*\*

00:30:00

Prebreathe is complete

**ФР5**

**8. ПХО DEPRESSURIZATION TO 5 MM**

- ПГПУ √ O<sub>2</sub> flow selector — ОТКЛ
- √ РЕГУЛЯТОР — ОСН
- √ БАЛЛОН — ОСН

ПО-4 < P.O<sub>2</sub> > 360

√ O.НАС, O.ВЕНТ

< Orlan pressure < 0.06

√ **PREBREATHE-A/L DEPRESS**

ПГПУ O<sub>2</sub> flow selector → ИНЖ

O<sub>2</sub> flow

O<sub>2</sub> OPEN

ИНЖ

\*\*\*\*\*

\*\*\*\*\*

**EVA IS CANCELLED**

Perform ПхО repress per ФР9

\*\*\*\*\*

00:00:00 КСД ПхО → OPEN (manually)

ПОВ

КСД ПхО ОТКРЫТ (DEPR OP)

When P.ПхО(MB) = 350---300 mm

< Orlan pressure = 0.35---0.4

\*\*\*\*\*

\*\*\*\*\*

When P.ПхО(MB) = 300 mm

КСД ПхО → CLOSED

√ **PREBREATHE-A/L DEPRESS**

See 5.2.4 ФР14

\*\*\*\*\*

00:05:00

ПГПУ O<sub>2</sub> flow selector → ОТКЛ

When P.ПхО [MB] = 20 mm

БСС **O<sub>2</sub> OPEN-EVA**

When P.ПхО [MB] = 5 mm

ПОВ КСД ПхО → CLOSED (manually)  КСД ПхО ОТКРЫТ (DEPR OP)

**9. ПхО FINAL LEAK CHECK**

< ΔP.ПхО [MB] (00:05:00) < 2 mm

\*\*\*\*\*

\*\*\*\*\*

**EVA IS CANCELLED**

Perform reverse air lock sequence per ФР7

\*\*\*\*\*

**ФР6**10. TRANSITION TO ORLAN AUTONOMOUS POWER SUPPLY

- ПО-4      ⚙ О.НАС, О.ВЕНТ  
 ⚙ ПИТАНИЕ → АВТ, О.НАС, О.ВЕНТ (sequentially)  
 ↓ ОСНОВ
- ПОВ      ↓ SUIT 1,2 OFF (■ LED)  
 ↓ HX OFF      ■ HX PWR, HX  
 Electrical umbilical ↔ Orlan  
 (cover Orlan connector with multilayer insulation)
- УДСК      ⚠ Orlan pressure = 0.35---0.4      \*\*\*\*\* 5.2.7 ФР17  
 Fluid umbilical ↔ Orlan  
 Fluid umbilical connector →|← onboard cap  
 Cover Orlan fluid connector with multilayer insulation flaps
- ПО-4      ⚠ P.O<sub>2</sub> > 360  
 Time of transition to autonomous power supply = \_\_\_\_\_

**On MCC GO**11. EV HATCH OPENING

- УДСК      ⚠ Orlan pressure = 0.35---0.4      \*\*\*\*\* √MCC  
 Attach safety tether hook to handrails in ПхО  
 Lower Orlan sun visor  
 Open EV hatch  
 EV hatch opening time = \_\_\_\_\_

12. SUBLIMATOR ACTIVATION

- ПГПУ  
 00:00:00      Temperature control handle → 6, move down to stop and → 3---4  
 √ TO — ОТКЛ indicator is sunk (depressed)
- 00:03:00      Ensure sublimator is operating      \*\*\*\*\* 5.2.9 ФР18  
 Temperature control handle → adjust (as comfortable)

## ФР7

## 4.10. POST-EVA A/L OPERATIONS

1. EV HATCH CLOSURE

ПГПУ No later than 10 min prior to EV hatch closure  
 Sublimator → Off  
 Temperature control handle → 3---6  
 √ No foreign objects on EV hatch sealing interface  
 Close EV hatch

EV hatch closure time = \_\_\_\_\_

2. ПХО REPRESS TO 270 MM

ПОВ √ КСД ПхО — CLOSED  
 [PO] pressure measured by pressure indicator = \_\_\_\_\_  
 ◀ Total БК-3(1-4) pressure ≥ 150 \*\*\*\*\*  
 \*\*\*\*\*  
 Do not activate thermoelectric cooling device  
 Resume nominal operations per step 2  
 Omit step 3 (ФР8) (do not perform)  
 In step 4 (ФР9), repressurize using injector until Orlan pressure = 0.4  
 \*\*\*\*\*

00:00:00 ↓ НХ ON       НХ PWR, НХ  
 ↓ КВД РО-ПхО ЕНА ( сВД)  
 ↓ КВД РО-ПхО ОР       КВД РО-ПхО ОТКРЫТ (РЕV ОР) \*\*\*\*\*  
 \*\*\*\*\*  
 Open КВД ПхО-РО using extension handle  
 \*\*\*\*\*


≤ 00:03:00 When P.ПхО [МВ] = 230 mm, but no later than three (3) minutes  
 00:00:00 ↓ КВД РО-ПхО СL       КВД РО-ПхО ОТКРЫТ (РЕV ОР)  
 Begin ПхО pressure stabilization



## ФР9

4. REPRESSURIZING ПхО TO 600 MM FROM [PO] AND ORLAN EXITING

If fluid umbilical connector  $\leftrightarrow$  Orlan, then repress Orlan using injector

БСС  **PRESS** until Orlan pressure = 0.4  НАДДУВ ПРОДУВКА ОРЛАН I, II

 **O<sub>2</sub> OPEN-EVA**  НАДДУВ ПРОДУВКА ОРЛАН I, II

ПОВ  $\downarrow$  КВД РО-ПхО ОР  КВД РО-ПхО ОТКРЫТ

If Orlan feels too compressed, briefly activate  **PRESS**

$\lll$  Р.ПхО [МВ]

When Р.ПхО [МВ] = 590 mm

ПОВ  $\downarrow$  КВД РО-ПхО CL  КВД РО-ПхО ОТКРЫТ

00:00:00 Р.ПхО stabilization start time = \_\_\_\_\_

БСС Retainer  $\rightarrow$  UNLK

 **SUIT DEPRESS**

## EV1, 2 In turn

If Orlan pressure > 0.04

Fluid umbilical  $\leftrightarrow$  Orlan

Depressurize Orlan pressure using Connector to ss depressurization

ПО-4  О.НАС, О.БЕИТ

Open Orlan

Water connector of liquid cooling garment  $\leftrightarrow$  Orlan water connector


Exit Orlan

Comm cap and biomed harness connectors  $\leftrightarrow$  Orlan X3 and X9 connectors

Stow connectors X3 and X9 into pockets on Orlan internal lining

**Close** primary, reserve and onboard БК-3 valves

Feedwater bladder  $\leftrightarrow$  backpack connectors

БСС  **PURGE**  O<sub>2</sub> OPEN

 **O<sub>2</sub> CLOSED**  УТЕЧ (ПО-4)

ПГПУ БАЛЛОН  $\rightarrow$  РЕЗ  УТЕЧ


O<sub>2</sub> flow selector  $\rightarrow$  ИНЖ  УТЕЧ


Fluid umbilical connector  $\leftrightarrow$  Orlan  УТЕЧ

Fluid umbilical connector  $\rightarrow$  plug  УТЕЧ

ПОВ  $\downarrow$  SUIT 1,2 OFF ( LED)

$\downarrow$  НХ OFF  НХ PWR, НХ

БРТА  ОРЛАН, УСК

ПО-4  ПИТАНИЕ  $\rightarrow$  БОРТ

Orlan measurement unit tubes  $\rightarrow$  ХРАНЕНИЕ

00:10:00 Р.ПхО stabilization end time = \_\_\_\_\_

$\Delta$ Р.ПхО [МВ] (over 00:10:00) ~ 10 mm (drop)

## ФР10

5. ПхО FINAL LEAK CHECK

00:00:00

&lt; P.ПхО [МВ] = \_\_\_\_\_

00:05:00

&lt; ΔP.ПхО [МВ] (00:05:00) &lt; 2 mm

\*\*\*\*\*

\*\*\*\*\*

ПхО comm pnl  ХМИТ

If Soyuz → ← ПрК

ПОВ

↓ КВД РО-ПхО ОР

When P.ПхО [МВ] = P.РО(ИД) — open РО-ПхО hatch

↓ КВД РО-ПхО СL

↓ КВД РО-ПхО INHIB (■ LED)

↓ PANEL OFF (■ LED)

Take pressure gauge and first-aid kit

Translate into РО

Close РО-ПхО hatch

If Soyuz → ← FGB

ПОВ

↓ КВД ПГО-СМ ENA (□ LED)

↓ КВД ПГО-СМ ОР

When P.ПхО [МВ] = P.ПГО(ИД) — open ПГО-СУ hatch

↓ КВД ПГО-СМ СL

↓ КВД ПГО-СМ INHIB (■ LED)

↓ PANEL OFF (■ LED)

Take pressure gauge and first-aid kit

Translate into ПГО

Close ПГО-СУ hatch

 МСС

\*\*\*\*\*

6. РО-ПхО AND ПГО-СУ HATCH OPENINGS

ПОВ

↓ КВД РО-ПхО ОР    □ КВД РО-ПхО ОТКРЫТ

When P.РО(ИД) = P.ПхО [МВ] — open РО-ПхО hatch

↓ КВД РО-ПхО СL    ■ КВД РО-ПхО ОТКРЫТ

↓ КВД РО-ПхО INHIB (■ LED)

 КВД ПхО-РО — CLOSED

↓ КВД ПГО-СМ ENA (□ LED)

↓ КВД ПГО-СМ ОР    □ КВД ПГО-СМ ОТКРЫТ

When P.ПГО(ИД) = P.ПхО [МВ] open ПГО-СУ hatch

↓ КВД ПГО-СМ СL    ■ КВД ПГО-СМ ОТКРЫТ

↓ КВД ПГО-СМ INHIB (■ LED)

↓ PANEL OFF (■ LED)

**4.11. CONFIGURING ISS TO INITIAL STATE AFTER EVA**

1. Install protective frame ring onto PO-ПхО hatch  
(see RODF: IRS ACTIVATION/DEACTIVATION)
  2. Connect air ducts and cables in hatchways
  3. Return comm systems to their initial configuration  
(see RODF: SM COMMUNICATION SYSTEM)
- pnl 228  
Pressure alarm sensor → 690 mm  
Activate induction pressure sensor ДДИ-1  
Mount air flow sensors, removed prior to EV, into hatchways and return on-line
4. НАДДУВ valve → ЗАКР (Close)  
НАДДУВ valve → ОТКР (Open)  
When Р.БНП (by pressure indicator) = 0  
НАДДУВ valve → ЗАКР (Close)  
Disassemble the ПхО repressurization configuration (see RODF:SM IFM IVA)
    - √ КСД ПхО — CLOSED
    - √ КВД РО-ПхО — ELECTRIC
    - √ КВД ПхО-РО — CLOSED
    - √ КВД ПхО-СУ (FGB) — CLOSED
    - √ КВД ПГО-СМ — ELECTRIC
  5. Hang out for drying: liquid cooling garment, undergarment, socks, cotton  
undergloves, cotton briefs and comm caps  
Put cloth covers on helmet visors
  6. **On MCC GO:**  
Remove LiOH canister, moisture collector and feedwater line filter  
(see RODF:ORLAN OPS 2.4.12)  
Estimate necessity of drying Orlan  
After drying is complete, secure backpacks in the open position for natural airing  
using ПРБ-11  
Install into Orlan LiOH canister and moisture collector that were removed prior to  
dryout or new ones (**per MCC instructions**)  
Inspect tubing inside Orlan backpack  
Check and, if necessary, clean the mesh screen on the backpack vent intake nozzle  
Stow dried cotton undergloves into Orlan internal lining pocket  
Dried liquid cooling garment →|← Orlan and stow into Orlan  
Backpack tension line ring → onto hook (**do not close** handle)
  7. After Orlan and БСС are reconfigured for storage, stow Orlan along ПхО planes  
I and III, secure with bungees

## 5. OFF-NOMINAL SITUATIONS

### 5.1. OFF-NOMINAL SITUATIONS PRIOR TO ORLAN ENTRY

#### 5.1.1. NO COMMUNICATION VIA ELECTRICAL UMBILICAL

- ПОВ             LED SUIT 1, 2 ON  
 ✓ onboard radio communication equipment is powered and standing by
- ПО-4            ✓  $\text{Ⓢ}$  ПИТАНИЕ — БОРТ  
 ✓ electrical umbilical X6K connector →|← Orlan  
 ✓ comm cap X3 connector →|← Orlan  
 If the problem persists  
 | Check comm via Korona system  
 | If the problem persists  
 |    Replace comm cap  
 |    Repeat check  
**Report to MCC**

#### 5.1.2. NO COMMUNICATION VIA KORONA SYSTEM

- БРТА            ✓ connector X21/1 →|← БРТА  
 ✓  $\text{Ⓢ}$  ОРЛАН
- ПО-4            ✓  $\text{Ⓢ}$  ПИТАНИЕ — АВТ  
 ✓  $\text{Ⓢ}$  ОСНОВ  
 ✓ Orlan backpack is closed (but **not sealed**)  
 ✓ comm cap is connected through the Orlan arm  
 ✓ electrical umbilical ←|→ Orlan  
 ↓ U/TONE     $\angle U = 26\text{---}28\text{ V}$   
 If the problem persists  
 |    ↓ РЕЗЕРВ  
 |    Check comm  
 | If the problem persists  
 |    ↓ ТАИГ  
 |    Check comm  
 | If the problem persists  
 |    see RODF:SM COMMUNICATION SYSTEM:OFF-NOMINAL SITUATIONS  
**Report to MCC**



#### 5.1.4. FAN(S) OR PUMP(S) FAILURE

- ПОВ  
ПО-4
- √ Electrical umbilical →|← Orlan  
 LED SUIT1, 2 ON  
 √ Ⓢ ПИТАНИЕ — БОРТ  
 <math>U = 28 \pm 0.5 V</math>
  - Toggle corresponding sw off and after 30 sec back on  
  
 If one of the fans (pumps) is operational — √MCC  
 If both fans (pumps) are not operational — discontinue further Orlan operations  
**Report to MCC**

#### 5.1.5. NO OXYGEN FLOW (O<sub>2</sub> FLOW SELECTOR— ИИЖ)

##### 1. ORLAN IS CONNECTED TO БСС

- БСС  
ПО-4  
БСС
- √ Onboard БК-3 valves are open
  - √  **O<sub>2</sub> OPEN-EVA**  O<sub>2</sub> OPEN  
 УТЕЧ
  - PRESS** momentarily  
  
 If injector does not work — √MCC  
 If injector works but  ИИЖ — proceed and **report to MCC**

##### 2. ORLAN IS DISCONNECTED FROM БСС

- ПО-4  
ПГПУ
- √ Primary БК-3 valve is fully open
  - <math>P.O\_2 > 360</math>
  - √ БАЛЛОН — ОЧН  
 Fluid umbilical →|← Orlan and then <math>\leftrightarrow</math> Orlan  
 If injector does not work — √MCC  
 If injector works but  ИИЖ — proceed and **report to MCC**

Oxygen flow from reserve БК-3 may be checked in a similar fashion  
 (with the exception of mating/demating fluid umbilical connector)

## ФР11

## 5.2. OFF-NOMINAL SITUATIONS DURING A/L OPERATIONS

## 5.2.1. ORLAN AND БСС LEAK DETECTED DURING PRELIMINARY LEAK CHECK

- БСС
1. **PRESS** until Orlan pressure = 0.12  
**LEAK CHECK**  
 Fluid umbilical connector ↔ Orlan  
 When Orlan pressure  $\geq 0.1$   
 $\triangleleft \Delta$  Orlan pressure (00:00:30) < 3 increments  
 If  $\Delta$  Orlan pressure > 3 increments  
     Fluid umbilical connector →|← Orlan  
     Retainer → UNLK  
     **SUIT DEPRESS** until Orlan pressure < 0.04
- leaking Orlan
2. When Orlan pressure < 0.04 exit Orlan (if necessary)  
 Open backpack internal cover  
 ✓ Moisture collector →|← tubing in Orlan backpack  
 ✓ Feedwater line filter is installed correctly  
 Close backpack internal cover  
 ✓ Pressurized gloves are properly attached (replace if necessary)  
 Inspect Orlan backpack sealing interfaces  
 Enter Orlan  
**Other EV**  $\triangleleft$  condition of Orlan sealing interfaces  
 Seal Orlan with locking handle  
  
 Repeat Orlan leak check  
 If  $\Delta$  Orlan pressure(over 00:00:30) > 3 increments  
     Fluid umbilical connector →|← Orlan  
     Retainer → UNLK  
     **SUIT DEPRESS**  
     When Orlan pressure < 0.04, exit Orlan  
     ✓**MCC**
3. Fluid umbilical connector →|← Orlan  
 Proceed as required



## ФР12

## 5.2.2. ORLAN AND BCC LEAK DETECTED DURING FINAL LEAK CHECK

- BCC
1. **PRESS** until Orlan pressure = 0.42  
**LEAK CHECK**  
 Fluid umbilical connector  $\leftrightarrow$  Orlan  
 $\triangleleft$  Orlan pressure  $\geq$  0.38  
 $\triangleleft$   $\Delta$  Orlan pressure (over 00:01:00) < 4.5 increments  
 If  $\Delta$  Orlan pressure > 4.5 increments  
     Fluid umbilical connector  $\rightarrow\leftarrow$  Orlan  
     Retainer  $\rightarrow$  UNLK  
     **SUIT DEPRESS**
- leaking Orlan
2. When Orlan pressure < 0.04, exit Orlan (if necessary)  
 Open Orlan backpack internal cover  
 $\checkmark$  moisture collector  $\rightarrow\leftarrow$  tubing in Orlan backpack  
 $\checkmark$  Feedwater line filter is installed correctly  
 Close backpack internal cover  
 $\checkmark$  Gloves are properly attached (replace if necessary)  
 Inspect Orlan backpack sealing interfaces  
 Enter Orlan  
**Other EV**  $\triangleleft$  Orlan sealing interfaces  
 Repeat Orlan leak check  
 If  $\Delta$  Orlan pressure (over 00:01:00) > 5 increments  
     Fluid umbilical connector  $\rightarrow\leftarrow$  Orlan  
     Retainer  $\rightarrow$  UNLK  
     **SUIT DEPRESS**  
     When Orlan pressure < 0.04, exit Orlan  
      $\checkmark$ MCC
3. Fluid umbilical connector  $\rightarrow\leftarrow$  Orlan  
**PRESS** until Orlan pressure =0.42  
**LEAK CHECK**
- НАДДУВ ПРОДУВКА ОРЛАН I,II  
 O<sub>2</sub> OPEN  
 НАДДУВ ПРОДУВКА ОРЛАН I,II  
 УТЕЧ, TONE  
 O<sub>2</sub> OPEN
- $\triangleleft$  Orlan pressure  $\geq$  0.38  
 If  $\Delta$  Orlan pressure (over 00:01:00) > 6 increments  
     Retainer  $\rightarrow$  UNLK  
     **SUIT DEPRESS**  
     When Orlan pressure < 0.04, exit Orlan  
      $\checkmark$ MCC  
 Proceed per ФР3

## ФР13

## 5.2.3. HATCH LEAK PRIOR TO OPENING A/L

- БСС 1.  **PRESS** until Orlan pressure = 0.3
- ПОВ  **O<sub>2</sub> OPEN-EVA**
- ↓ КВД РО-ПхО ENA (□ LED)
  - ↓ КВД РО-ПхО ОР □ КВД РО-ПхО ОТКРЫТ (PEV ОР)
  - ↓ КВД ПГО-СМ ENA (□ LED)
  - ↓ КВД ПГО-СМ ОР □ КВД ПГО-СМ ОТКРЫТ (PEV ОР)

**WARNING**

In the event of Orlan compression, momentarily  **PRESS**


- БСС When P.ПхО [МВ] = P.РО (by pressure indicator) = P.ПГО (by pressure indicator)  
Retainer → UNLK

 **SUIT DEPRESS** until Orlan pressure < 0.04

- EV2** 2. <math>P.СК < 0.04</math>  
Exit Orlan (if necessary)  
Open РО-ПхО and ПГО-СУ hatches  
<math>\sphericalangle</math> Hatch sealing interfaces  
Close РО-ПхО and ПГО-СУ hatches

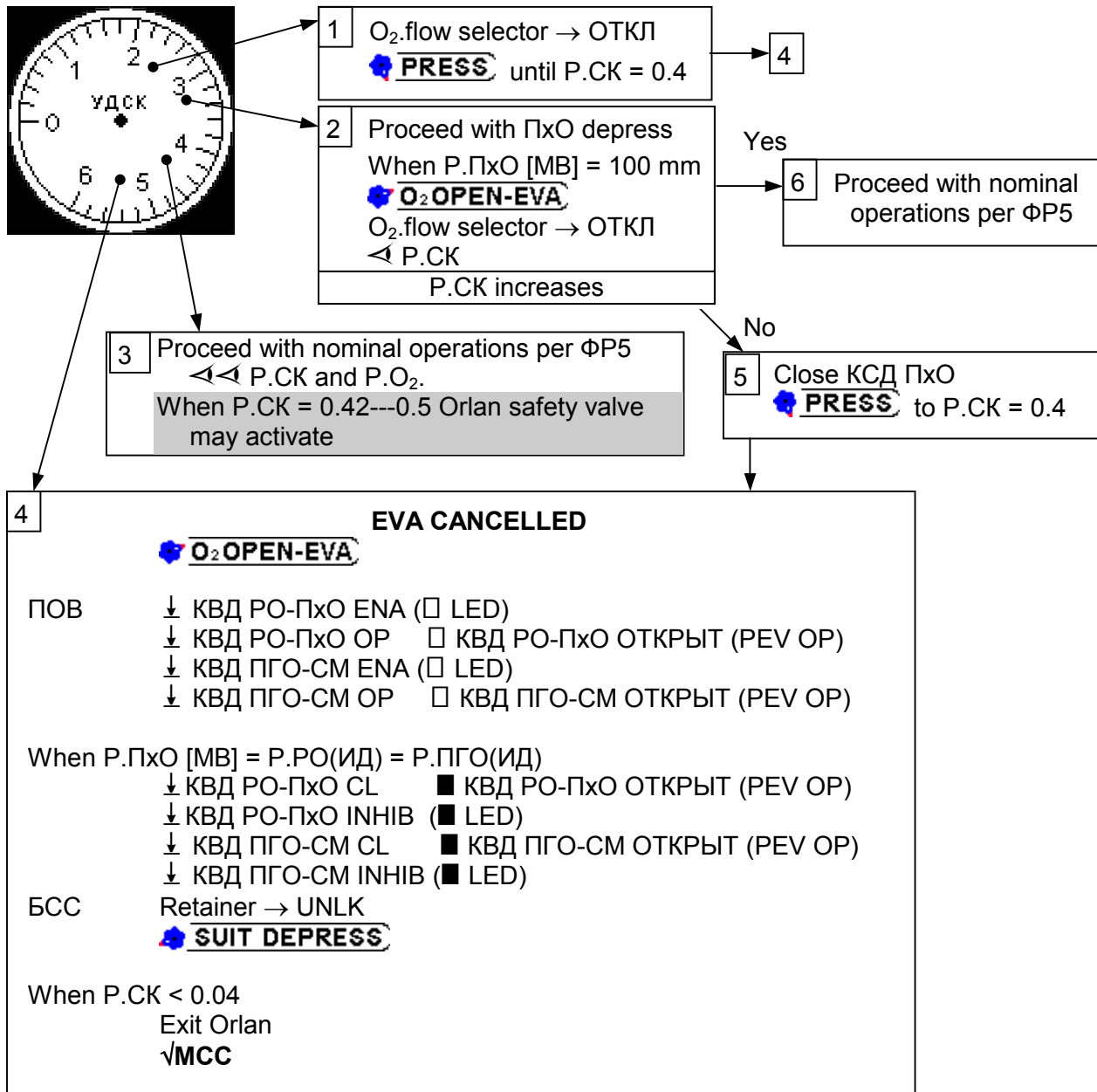
- EV1**
- ↓ КВД РО-ПхО CL ■ КВД РО-ПхО ОТКРЫТ (PEV ОР)
  - ↓ КВД РО-ПхО INHIB (■ LED)
  - ↓ КВД ПГО-СМ CL ■ КВД ПГО-СМ ОТКРЫТ (PEV ОР)
  - ↓ КВД ПГО-СМ INHIB (■ LED)

- EV2** If EV crew member has already exited Orlan  
| Enter Orlan, and seal it  
| Proceed with Orlans And БСС Preliminary Leak Check per ФР2

- БСС  **PREBREATHE-A/L DEPRESS**  
Proceed with ПхО Depressurization To 550 mm per ФР3  
In ФР 4 do not repeat Orlan purge

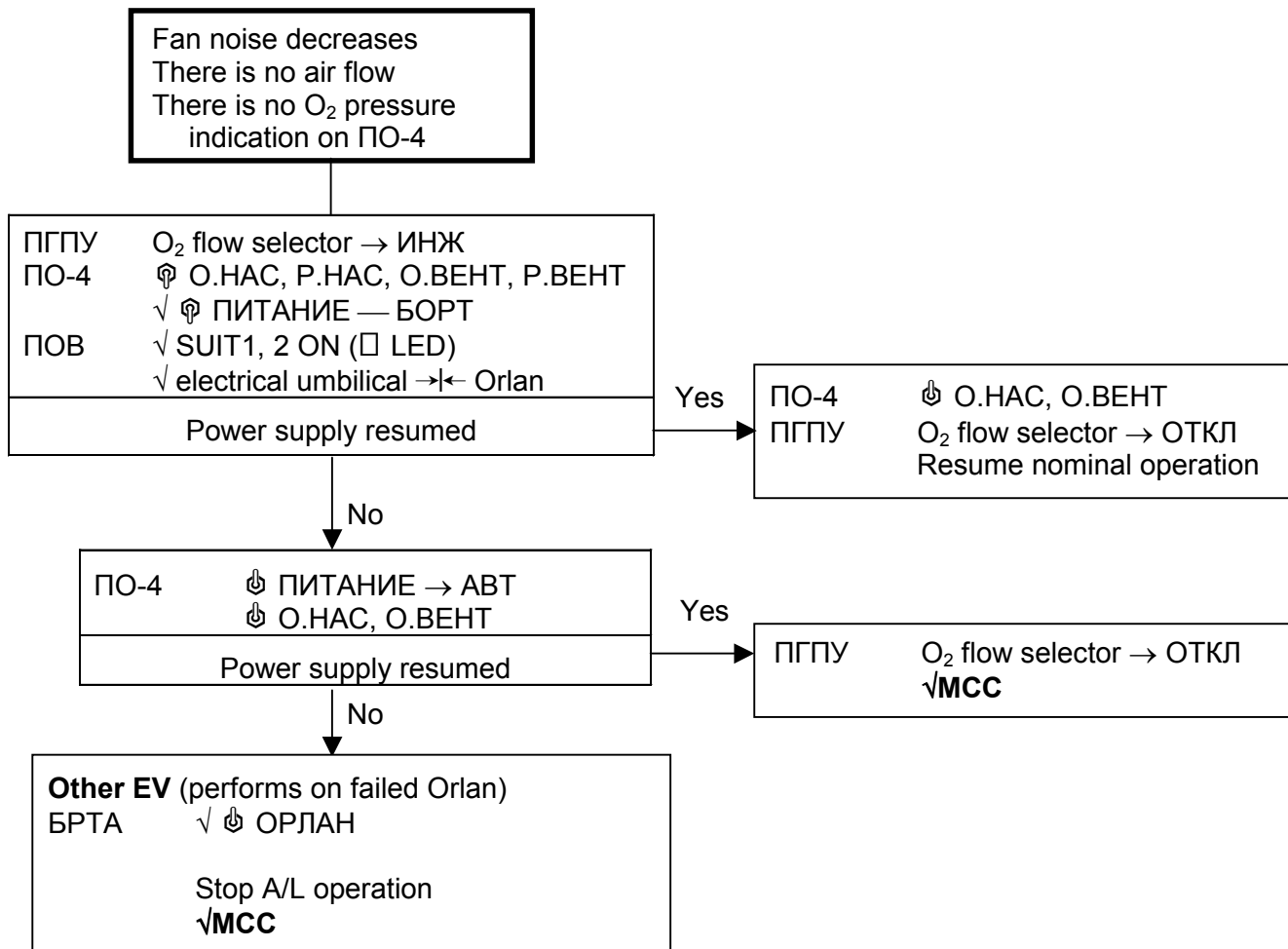
## ФР14

## 5.2.4. ORLAN ABNORMAL PRESSURE DURING ПхО DEPRESSURIZATION TO 5 MM



ФР15

5.2.5. ORLAN POWER FAILURE DUE TO PROBLEM WITH ELECTRICAL UMBILICAL



**ФР16**

**5.2.6. ORLAN FAN(S) FAILURE**

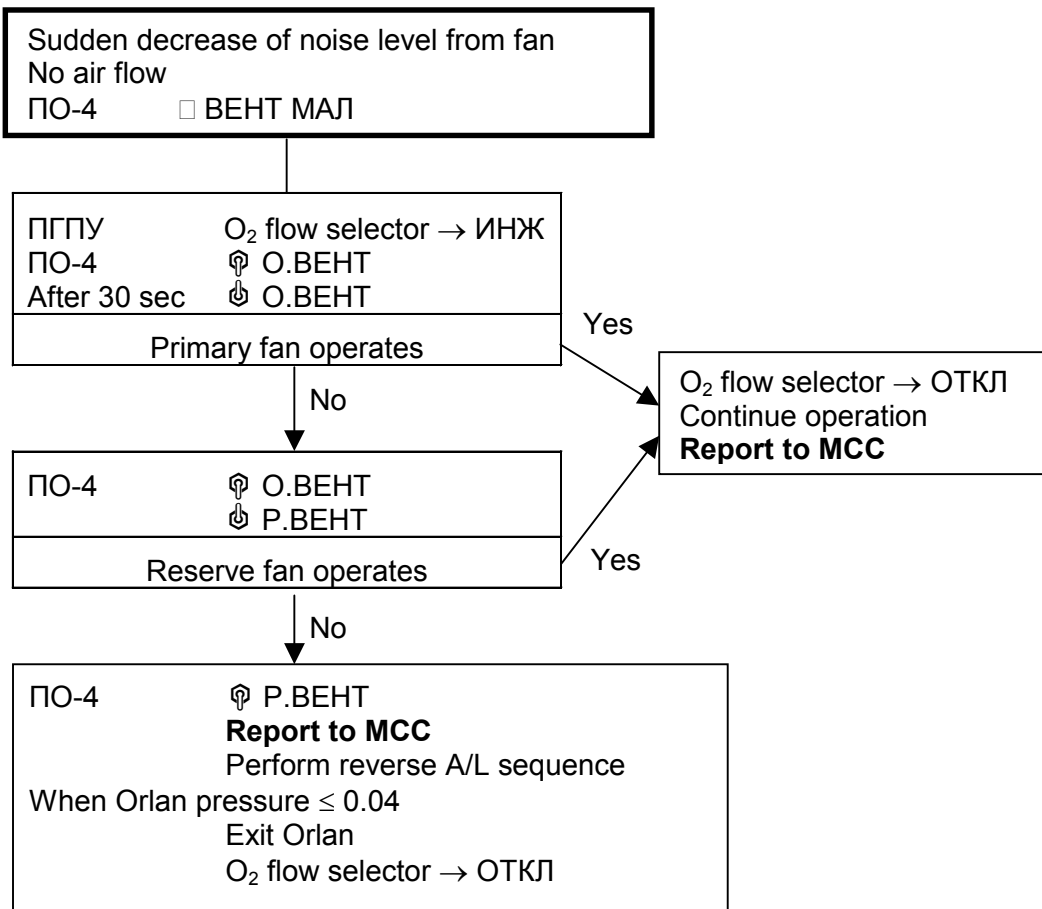
**1. PRIMARY FAN FAILURE WITH AUTOMATIC SWITCHOVER TO RESERVE FAN**

NOTE

In case of primary fan failure, system automatically switches over to using reserve fan. In such a case, reserve fan can be controlled both from O.BEHT and P.BEHT switches.

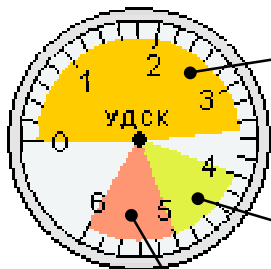
- ПО-4      ⚡ P.BEHT  
 ⚡ Reserve fan activation  
 If reserve fan did not activate (in addition to primary fan)  
     ⚡ O.BEHT  
     Continue operation  
     **Report to MCC**  
 If reserve fan did activate  
     ⚡ P.BEHT  
     Continue operation

**2. PRIMARY FAN FAILURE WITHOUT AUTOMATIC SWITCHOVER TO RESERVE FAN**



ФР17

### 5.2.7. ORLAN ABNORMAL PRESSURE DURING TRANSITION TO ORLAN AUTONOMOUS POWER SUPPLY



Repress ПхО from [РО] until  $P.ПхО[МВ] = 270 \text{ mm}$

In the event of Orlan compression, momentarily  
O<sub>2</sub> flow selector → ИНЖ

√MCC

Proceed with nominal operations    ⏪ P.СК and P.O<sub>2</sub>.

When  $P.СК = 0.42\text{---}0.5$  Orlan safety valve may activate

#### EVA CANCELLED

ПОВ    ↓ КВД РО-ПхО ЕНА (□ LED)  
          ↓ КВД РО-ПхО ОР    □ КВД РО-ПхО ОТКРЫТ (PEV ОР)  
          ↓ КВД ПГО-СМ ЕНА (□ LED)  
          ↓ КВД ПГО-СМ ОР    □ КВД ПГО-СМ ОТКРЫТ (PEV ОР)

When  $P.ПхО [МВ] = P.РО(ИД) = P.ПГО(ИД)$

         ↓ КВД РО-ПхО СЛ        ■ КВД РО-ПхО ОТКРЫТ (PEV ОР)  
          ↓ КВД РО-ПхО INHIB (■ LED)  
          ↓ КВД ПГО-СМ СЛ        ■ КВД ПГО-СМ ОТКРЫТ (PEV ОР)  
          ↓ КВД ПГО-СМ INHIB (■ LED)

БСС    Retainer → UNLK

   ✚ **SUIT DEPRESS**

When  $P.СК < 0.04$

Exit Orlan

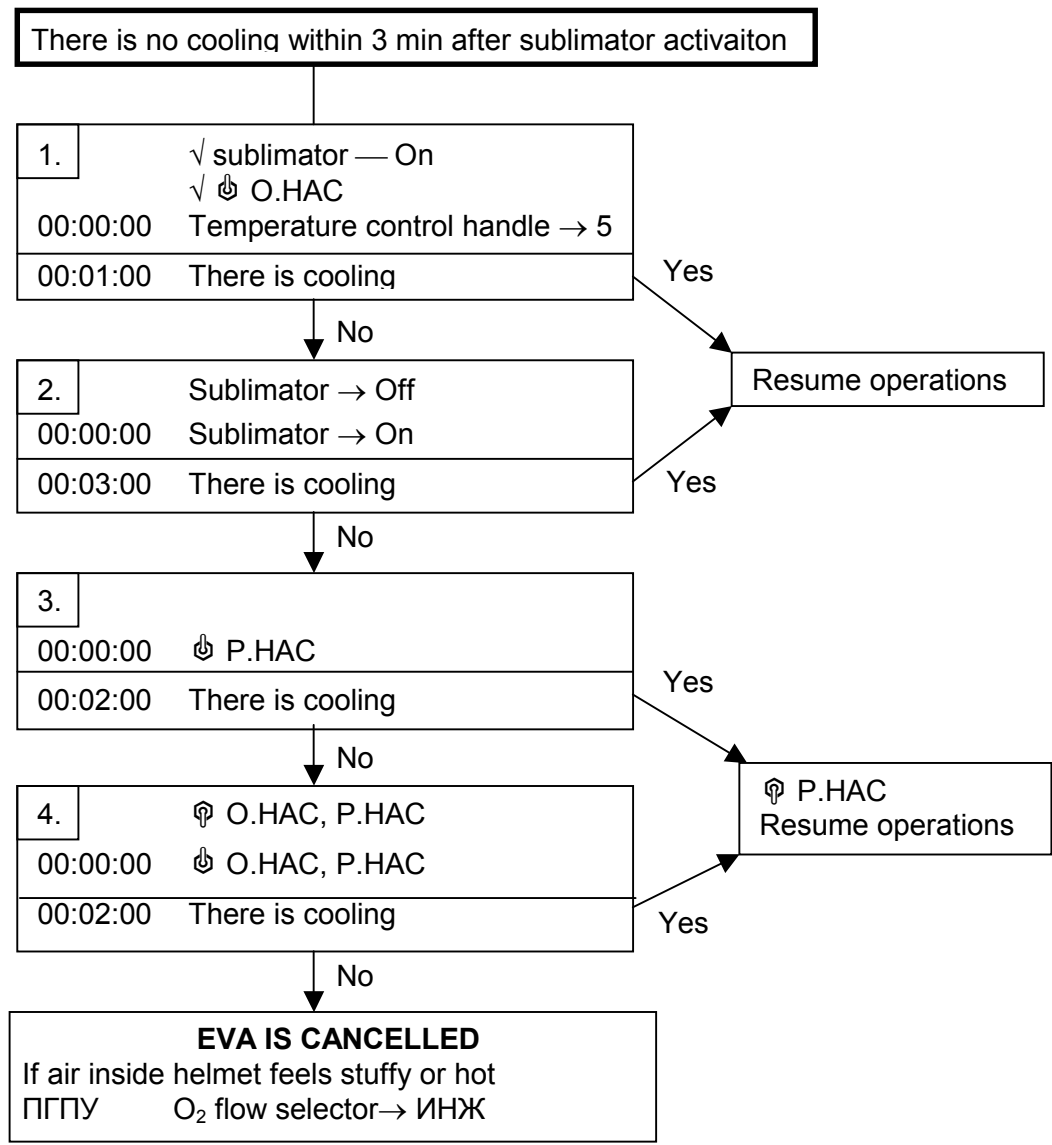
√MCC

**ФР18**

**5.2.8. INSUFFICIENT COOLING**

ПГПУ Temperature control handle → 6  
 Halt current activity  
 ПО-4 √ Ⓞ O.HAC  
 If there is no cooling  
 Ⓞ P.HAC  
 If there is cooling  
 Ⓞ O.HAC  
 Continue operation  
**Report to MCC**  
 If there is no cooling  
 Perform reverse A/L operation  
 O<sub>2</sub> flow selector → ИНЖ  
**Report to MCC**

**5.2.9. SUBLIMATOR STARTUP FAILURE**



### 5.3. OFF-NOMINAL SITUATIONS DURING EVA

#### 5.3.1. EXPEDITED RETURN

Expedited return to ПхО is performed in any of the following cases:

- Injector is active in one of the Orlans due to Orlan leak or loss of power;
- Orlan pressure regulator in one of Orlans is operating at abnormally high O<sub>2</sub> supply rate (☒ УТЕЧ (Leak) on ПО-4);
- Appearance of decompression symptoms (pains) ;
- Loss of comm by one or both EV crew members;
- Orlan safety valve opening caused by increased pressure in Orlan;
- Orlan water cooling system failure;
- P.CO<sub>2</sub> > 10 mm.

NOTE

Reserve time is determined by the table located on Orlan glove

Work sequence according to expedited return scenario:

1. Complete only mandatory activities;
2. Sublimator → Off (immediately before closure of EV hatch);
3. Perform nominal A/L operations

#### 5.3.2. EMERGENCY RETURN

Emergency return to ПхО is performed in the following cases:

- On simultaneous occurrence of two and more situations, each of which requires expedited return;
- O<sub>2</sub> flow selector — ABAP on any Orlan (Orlan pressure < 0.32 with injector running);
- ☒ O<sub>2</sub> МАЛО (oxygen low) on ПО-4;
- P.CO<sub>2</sub> > 20 mm

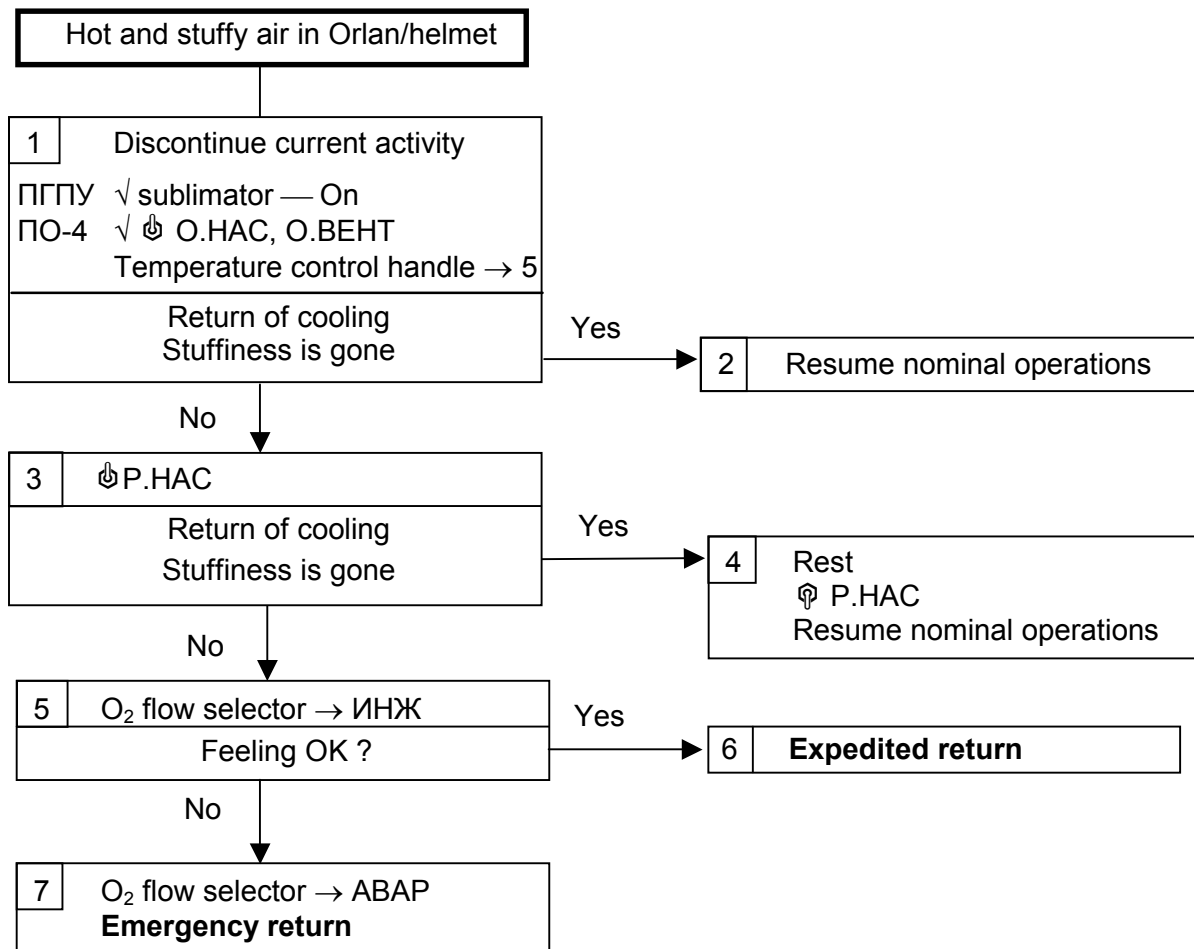
NOTE

Time for emergency return — no more than 30 min.  
Reserve time determined by the table located on Orlan glove.

Work sequence according to emergency return scenario:

1. Immediately discontinue all nominal activities;
2. Sublimator → Off (immediately before closure of EV hatch);
3. Perform nominal A/L operations

### 5.3.3. SPECIAL CASES OF ORLAN TEMPERATURE STATUS

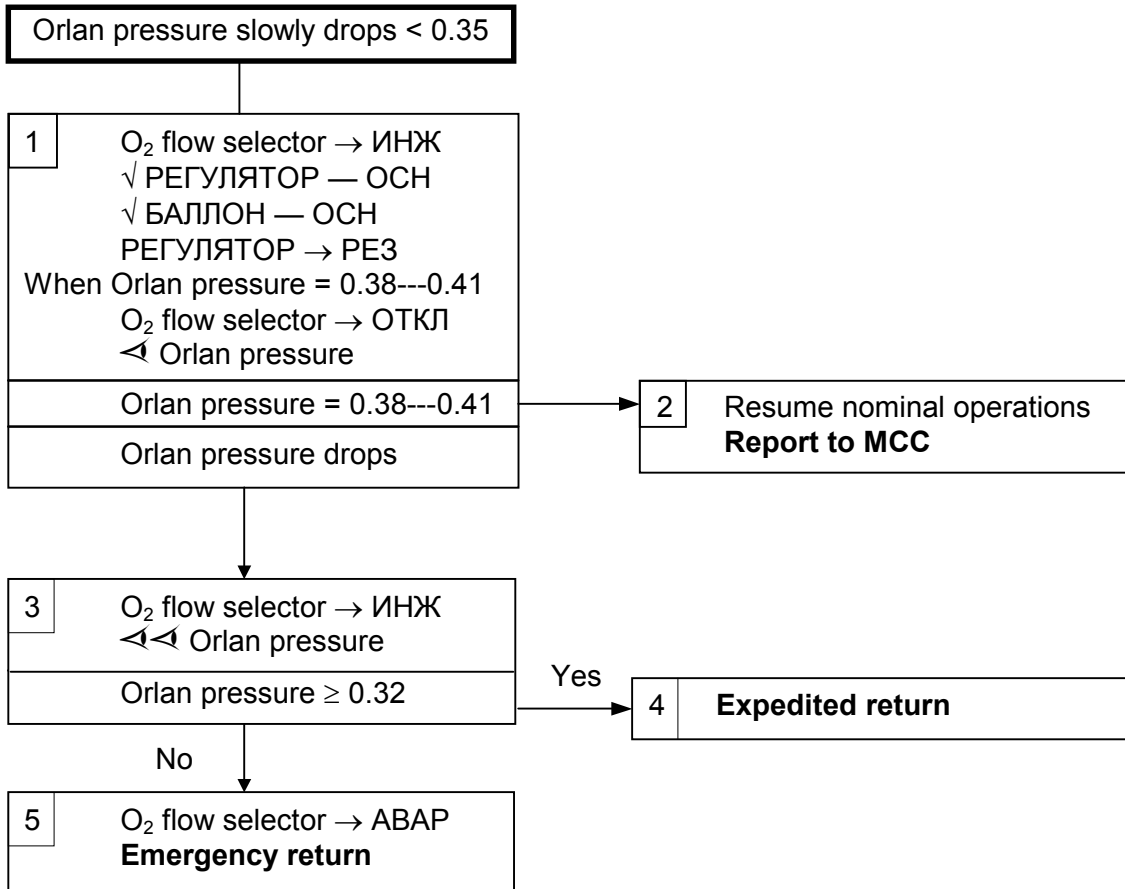


### 5.3.4. INSUFFICIENT OXYGEN SUPPLY ALARM “O<sub>2</sub> МАЛО”

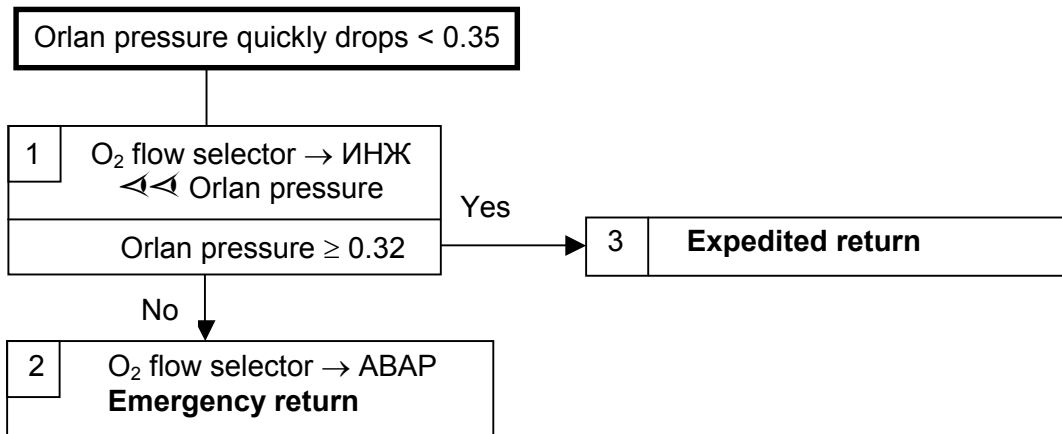
ПО-4 ⚡ P.O<sub>2</sub>  
 Proceed until P.O<sub>2</sub> = 50

ПГПУ БАЛЛОН → РЕЗ  
 ■ O<sub>2</sub> МАЛО  
 Emergency return

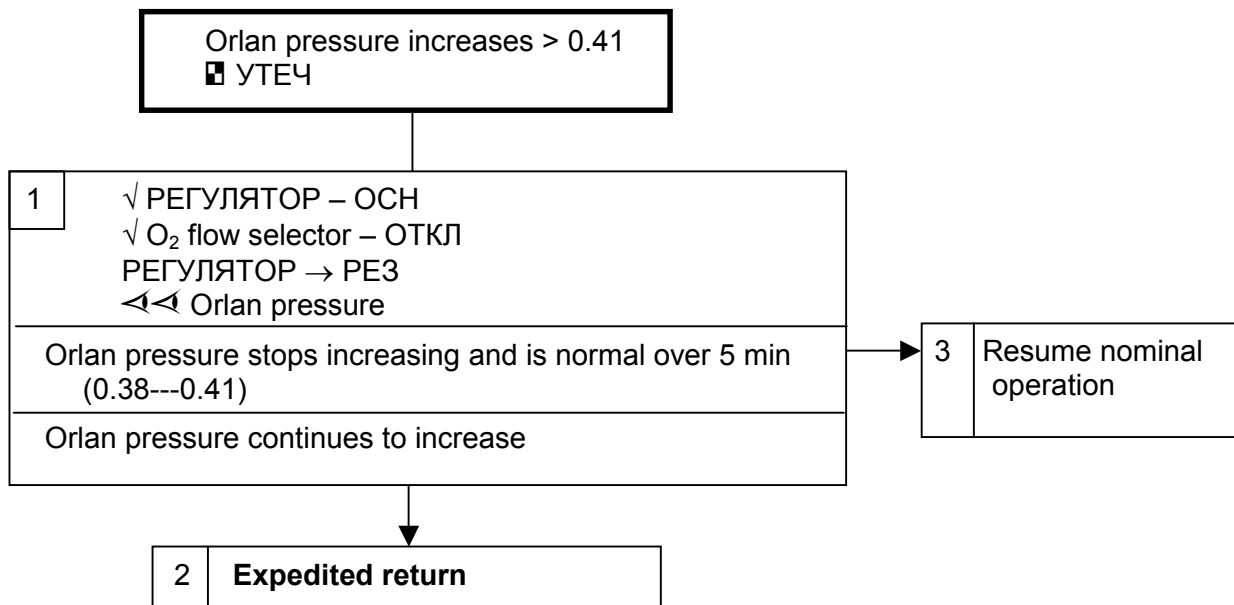
**5.3.5. ORLAN PRESSURE SLOWLY DROPS BELOW 0.35**



**5.3.6. ORLAN PRESSURE QUICKLY DROPS BELOW 0.35**



### 5.3.7. ORLAN PRESSURE INCREASES OVER 0.41



### 5.3.8. OXYGEN OVERFLOW WITH INACTIVE INJECTOR ( $\Delta P.O_2 > 25$ OVER 20 MIN)

ПГПУ

- √ РЕГУЛЯТОР – ОСН
- √ O<sub>2</sub> flow selector – ОТКЛ
- √ БАЛЛОН – ОСН
- УТЕЧ
- <<< Orlan pressure = 0.35---0.4

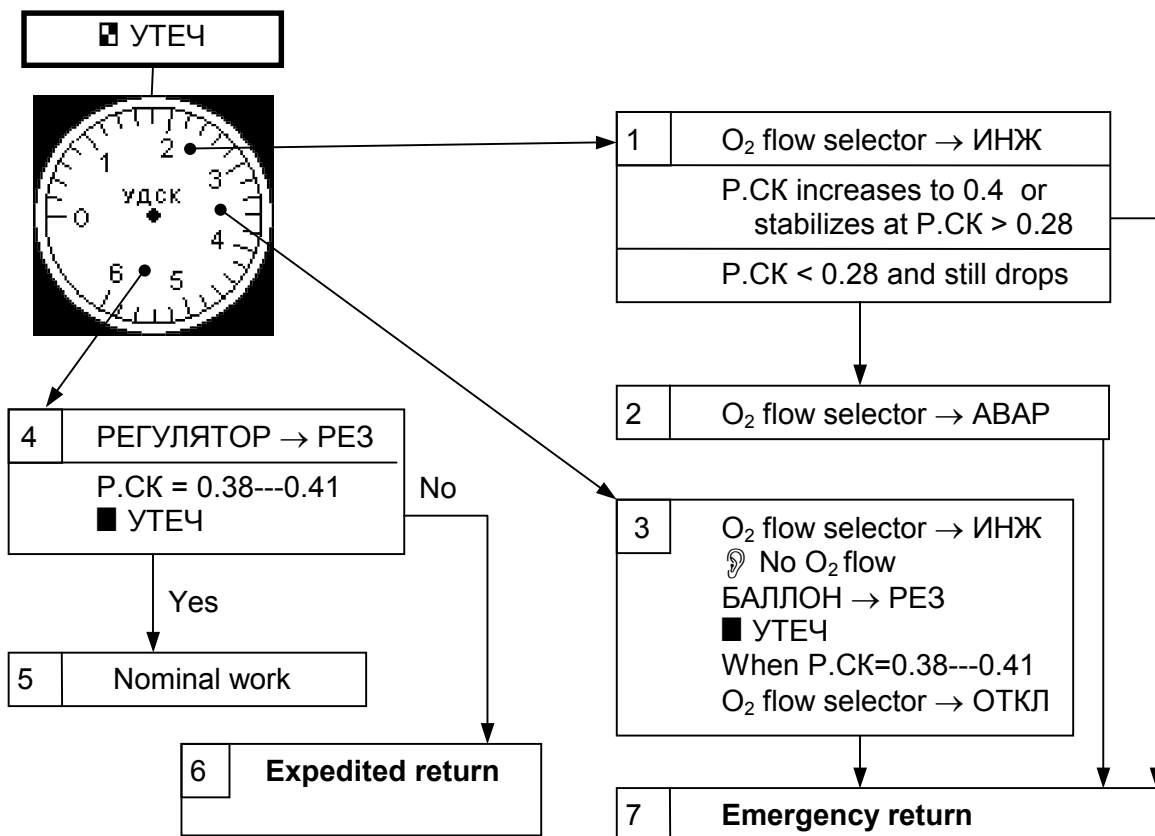
**Report to MCC**

If □ O<sub>2</sub> МАЛО (oxygen low) or P.O<sub>2</sub> < 50

- БАЛЛОН → РЕЗ
- O<sub>2</sub> МАЛО

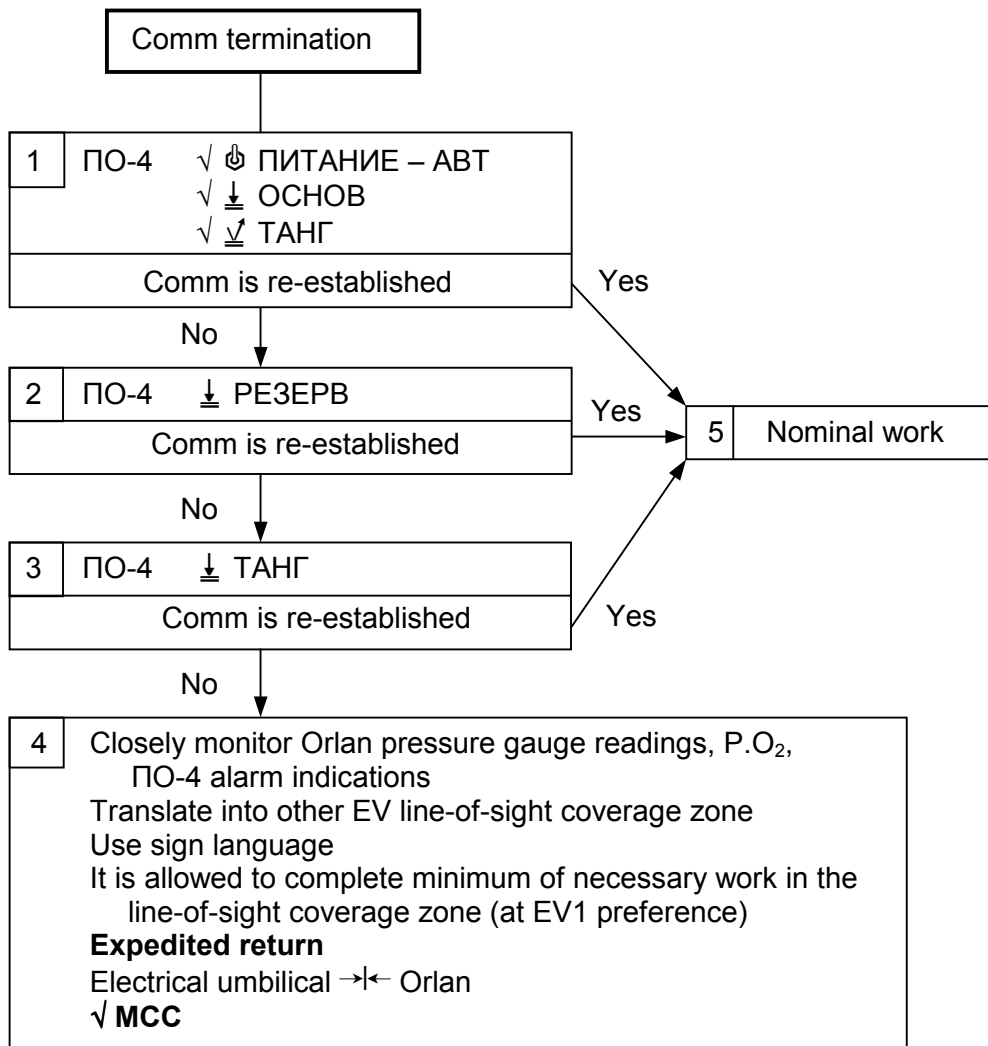
**Emergency return**

5.3.9. LEAK ALARM “УТЕЧКА”



### 5.3.10. COMM FAILURE

During EVA with БРТА :



During EVA with 25 m electrical umbilical:

1. √ electrical umbilical X6K connector →← Orlan
2. Closely monitor Orlan pressure gauge readings, P.O<sub>2</sub>, ПО-4 alarm annunciators
3. Translate into other EV line-of-sight coverage zone  
Use sign language  
It is allowed to complete minimum of necessary work in the line-of-sight coverage zone  
(at EV1 preference)
4. **Expedited return**

**5.3.11. 25 M ELECTRICAL UMBILICAL IS TANGLED**

- ПГПУ      Temperature control handle → 5  
            O<sub>2</sub> flow selector → ИНЖ
- ПО-4      ⚙ O.НАС, P.НАС, O.БЕHT, P.БЕHT  
            ⚡ O<sub>2</sub> pressure, determine reserve time from table on glove  
            √ Safety tether is secured to handrails, etc  
            Electrical umbilical ↔ Orlan  
            Translate to EV hatch (secure with tethers)  
            Ingress ПхО
- ПОВ      ↓ SUIT 1,2 OFF  
            Electrical umbilical ↔ ПхО connector, translate outside of ПхО, and secure externally  
            Perform reverse A/L operation

**ФР19**

**5.4. OFF-NOMINAL SITUATIONS DURING REVERSE A/L ACTIVITIES**

**5.4.1. EV HATCH LEAKS AFTER EVA**

БСС	1. <b>O<sub>2</sub> OPEN-EVA</b> КСД ПхО → OPEN When P.ПхО [МВ] = 5 mm КСД ПхО → CLOSED Open EV hatch ◀ EV hatch sealing interfaces Close EV hatch √ КСД ПхО — CLOSED																
00:00:00	2. КВД РО-ПхО → OPEN When P.ПхО [МВ] = 270 mm, but no later than three (3) minutes																
≤ 00:03:00	КВД РО-ПхО → CLOSED																
00:00:00	Beginning of P.ПхО stabilization If Δ P.ПхО [МВ] (over 00:01:00) > 2 mm																
БСС	<b>PRESS</b> until Orlan pressure = 0.4 <input type="checkbox"/> НАДДУВ ПРОДУВКА ОРЛАН I, II																
ПОВ	<b>O<sub>2</sub> OPEN-EVA</b> <input checked="" type="checkbox"/> НАДДУВ ПРОДУВКА ОРЛАН I, II ↓ КВД РО-ПхО ENA ( <input type="checkbox"/> LED) ↓ КВД РО-ПхО ОР <input type="checkbox"/> КВД РО-ПхО ОТКРЫТ (PEV ОР) ↓ КВД ПГО-СМ ENA ( <input type="checkbox"/> LED) ↓ КВД ПГО-СМ ОР <input type="checkbox"/> КВД ПГО-СМ ОТКРЫТ (PEV ОР)																
ПхО	valve НАДДУВ → ОТКР																
<div style="background-color: red; color: white; padding: 5px; border: 2px solid black; margin-bottom: 5px;"><b>WARNING</b></div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Avoid compression of Orlan (close valve НАДДУВ when necessary)</div>																	
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #d9ead3; width: 50%;">Soyuz → FGB</th> <th style="background-color: #d9ead3; width: 50%;">Soyuz → SM</th> </tr> </thead> <tbody> <tr> <td style="background-color: #d9ead3;">When P.ПхО [МВ] = P.ПГО(ИД)</td> <td style="background-color: #d9ead3;">When P.ПхО [МВ] = P.РО(ИД)</td> </tr> <tr> <td style="background-color: #d9ead3;">Open ПГО-СМ hatch</td> <td style="background-color: #d9ead3;">Open РО-ПхО hatch</td> </tr> <tr> <td style="background-color: #d9ead3;">Close valve НАДДУВ</td> <td style="background-color: #d9ead3;">Close valve НАДДУВ</td> </tr> <tr> <td style="background-color: #d9ead3;">↓ КВД ПГО-СМ CL <input checked="" type="checkbox"/> КВД ПГО-СМ ОТКРЫТ</td> <td style="background-color: #d9ead3;"></td> </tr> <tr> <td style="background-color: #d9ead3;">↓ КВД ПГО-СМ INHIB (<input checked="" type="checkbox"/> LED)</td> <td style="background-color: #d9ead3;"></td> </tr> <tr> <td style="background-color: #d9ead3;">↓ КВД РО-ПхО CL <input checked="" type="checkbox"/> КВД РО-ПхО ОТКРЫТ</td> <td style="background-color: #d9ead3;"></td> </tr> <tr> <td style="background-color: #d9ead3;">↓ КВД РО-ПхО INHIB (<input checked="" type="checkbox"/> LED)</td> <td style="background-color: #d9ead3;"></td> </tr> </tbody> </table>	Soyuz → FGB	Soyuz → SM	When P.ПхО [МВ] = P.ПГО(ИД)	When P.ПхО [МВ] = P.РО(ИД)	Open ПГО-СМ hatch	Open РО-ПхО hatch	Close valve НАДДУВ	Close valve НАДДУВ	↓ КВД ПГО-СМ CL <input checked="" type="checkbox"/> КВД ПГО-СМ ОТКРЫТ		↓ КВД ПГО-СМ INHIB ( <input checked="" type="checkbox"/> LED)		↓ КВД РО-ПхО CL <input checked="" type="checkbox"/> КВД РО-ПхО ОТКРЫТ		↓ КВД РО-ПхО INHIB ( <input checked="" type="checkbox"/> LED)	
Soyuz → FGB	Soyuz → SM																
When P.ПхО [МВ] = P.ПГО(ИД)	When P.ПхО [МВ] = P.РО(ИД)																
Open ПГО-СМ hatch	Open РО-ПхО hatch																
Close valve НАДДУВ	Close valve НАДДУВ																
↓ КВД ПГО-СМ CL <input checked="" type="checkbox"/> КВД ПГО-СМ ОТКРЫТ																	
↓ КВД ПГО-СМ INHIB ( <input checked="" type="checkbox"/> LED)																	
↓ КВД РО-ПхО CL <input checked="" type="checkbox"/> КВД РО-ПхО ОТКРЫТ																	
↓ КВД РО-ПхО INHIB ( <input checked="" type="checkbox"/> LED)																	
БСС	Retainer → UNLK <b>SUIT DEPRESS</b> Exit Orlan Take pressure gauge and first-aid kit																
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="background-color: #d9ead3;">Translate to ПГО</td> <td style="background-color: #d9ead3;">Translate to РО</td> </tr> <tr> <td style="background-color: #d9ead3;">Close ПГО-СМ hatch</td> <td style="background-color: #d9ead3;">Close РО-ПхО hatch</td> </tr> </tbody> </table>	Translate to ПГО	Translate to РО	Close ПГО-СМ hatch	Close РО-ПхО hatch												
Translate to ПГО	Translate to РО																
Close ПГО-СМ hatch	Close РО-ПхО hatch																
	√MCC																
00:05:00	3. ПхО pressure stabilization is complete ◀ Δ P.ПхО [МВ] (over 00:05:00) < 2 mm If Δ P.ПхО > 2 mm — <b>Report to MCC</b> Proceed with Repressurizing ПхО To 600 mm From [РО] And Orlan Exiting per ФР9																

**ФР20****5.4.2. EMERGENCY A/L ACTIVITIES**

Emergency A/L activities are performed when one of EV crewmembers is disabled

1. Sublimator → Off (on Orlan of disabled EV crewmembers and yourself)  
 Temperature control handle → 6  
 ↙ EV hatch sealing interfaces  
 Close EV hatch  
 O<sub>2</sub> flow selector → АВАР (on Orlan of disabled EV crewmembers and yourself)  
 Temp secure the disabled EV crewmember
2. ↓ КВД РО-ПхО ENA (□ LED)  
 ↓ КВД РО-ПхО ОР □ КВД РО-ПхО ОТКРЫТ (PEV ОР)  
 When P.ПхО [МВ] = 400 mm  
 valve НАДДУВ → ОТКР

**WARNING**

Avoid compression of Orlan (close НАДДУВ valve when necessary)

3. To be performed on **able** EV crewmember Orlan only  
 O<sub>2</sub> flow selector → ОТКЛ  
 Ⓢ О.БЕИТ, Р.БЕИТ, О.НАС, Р.НАС  
 Depressurize Orlan using connector to ss depressurization, secured on БСС  
 Exit Orlan  
 Backpack tension line ring → onto hook
4. To be performed on the **disabled** EV crewmember Orlan only  
 O<sub>2</sub> flow selector → ОТКЛ  
 Ⓢ О.БЕИТ, Р.БЕИТ, О.НАС, Р.НАС  
 Depressurize Orlan using connector to ss depressurization, secured on БСС  
 Open Orlan  
 Doff gloves  
 Get the disabled EV crewmember out of Orlan by pulling at the strap on safety belt,  
 while pushing the able EV crewmember's feet against Orlan backpack  
 If necessary, provide first-aid to the disabled per 5.4.3 ФР20
5. Translate into ПхО  
 Close РО-ПхО hatch  
 ↙ Δ P.ПхО [МВ] (over 00:05:00) < 2 mm  
 КВД ПхО-РО → OPEN  
 Open РО-ПхО hatch  
 Translate into [РО]  
 Close РО-ПхО hatch  
**Report to MCC**

\*\*\*\*\* √MCC

**ФР21****5.4.3. PROVISION OF FIRST-AID**

Provide first aid depending on symptoms

**SUDDEN WEAKNESS:**

Inject intramuscular atropin and caffeine (1 ampule each) into upper buttocks

**FAINTING:**

1. Doff gloves
2. Remove the disabled EV crewmember out of Orlan
3. Extend the disabled EV crewmember 's neck and, if necessary, clear oral cavity of any obstructions to normal breathing

**RESPIRATORY ARREST**

1. Secure in place
2. Perform artificial ventilation of lungs using "mouth-to-mouth" ("mouth-to-nose") technique
3. After normal breathing is resumed/present/ remove the disabled EV crewmember completely of his Orlan, place head close to Orlan backpack ventilation duct and activate injector
4. Inject intramuscular atropin and caffeine (1 ampule each) into upper buttocks

**NAUSEA/VOMITING**

Inject intramuscular atropin (1 ampule) into upper buttock

**HEAT STROKE**

After translation into [PO], place wet cold towels on head and groin areas

**DECOMPRESSION DISORDERS**

Provide complete rest for the disabled crewmember during all stages of A/L sequence and after [PO] ingress for more than 12:00:00

**NOTE**

If necessary (**per MCC instructions**), use Orlan as a hyperbaric chamber per ORLAN OPS